ORIENTATED HAND CORING IN GEOLOGICAL FIELD WORK.

By K. ROHR.*

INTRODUCTION.

SUCCESS in exploration geology largely depends on the practicability of methods and means of obtaining adequate geological data in the field. Increased demands for more detailed mapping and elucidation of structural details require improvement in exploration technique. It is hoped that the method of orientated coring herein described will contribute towards this end.

HISTORICAL NOTES.

As far as surface exploration methods in Trinidad are concerned, a *résumé* of their history is of some interest.

Wall and Sawkins¹ carried out the first geological exploration of the island in the classical manner of making use of natural exposures only. About forty years later Cunningham Craig² investigated the oil districts of Trinidad on behalf of the Government. The results of his mapping have formed the basis of all subsequent exploration surveys for oil.

Cunningham Craig made use of natural outcrops only, though even in those days geologists engaged in oil exploration of the Dutch East Indian rain forests resorted to hand-dug pits wherever natural outcrops were lacking.

So far as is known, it was not until 1912 that *hand-dug pits* were resorted to in Trinidad. (F. Zyndel of Trinidad Leaseholds, Ltd., for detailed mapping of the Forest structure of South Trinidad.)

During the survey of the Naparima district, which is almost devoid of natural exposures, V. C. Illing³ was confronted with the interpretation of complex geology. In this connection he wrote :

"It soon became apparent that no half measures would be satisfactory, and that the area would have to be examined in detail with numerous pits and trenches. In the course of the work over 9000 pits and about 100 trenches were examined. The pits were usually 8 feet deep, this depth being quite satisfactory for structural evidence, provided that the pit was so located as to avoid positions of deep subsoil or of soil-creep. In areas of complicated structure it was found that trenches gave more valuable evidence than pits; such trenches were usually 18 to 27 feet long and 8 feet deep, but occasionally much longer.

Every pit and trench was thoroughly sampled and searched for fossils. For aminiferal washings obtained from the material were hand-

* Geologist, Trinidad Leaseholds, Limited, Trinidad, B.W.I.

H

picked, and form the basis of the associated paper contributed by Dr. W. L. F. Nuttall. In addition, all the sandy and silty material was treated for heavy mineral analysis, the records of such analyses being found to be valuable for local comparisons."

Others followed the lead set by Zyndel and Illing, with the result that geological mapping with the aid of pits constituted an essential part of field work.

Contrary to the procedure described by O. P. Jenkins⁴ in Sumatra, testpit lines should always be carefully located by the geologist himself and not by a native chainman. Pit-lines must be located on stable ground, preferably on the crest of ridges and on spurs, thus avoiding landslips, hill creeps and alluvial flats.

The hand-auger method, as a further means of obtaining well-preserved and uncontaminated samples for micro-palæontological, petrographical and geochemical analyses from otherwise inaccessible sediments, was introduced in Trinidad in 1920 by V. C. Illing and H. G. Kugler. Illing ³ stated:

"While the pitting was in progress, a soil-map was constructed, the boundaries of the various types of soils giving valuable evidence of the trend of the formation below. The soil-map, carefully interpreted, was a necessary adjunct to the pit-map in determining the geological boundaries; but in all the important areas these were proved by lines of auger-holes along and across them.

"In certain areas of difficult structure, the evidence of pits and even of trenches was found to be somewhat indefinite. In such cases, a series of deeper auger-holes from 27 to 65 feet were placed across the structure at distances apart varying according to the detail required. In areas of thick alluvium, the work was done completely with augers, and broad areas under 35 feet of alluvium were dealt with in detail. I found that such methods were infinitely to be preferred to core-drills for soft rocks, and even in the case of harder beds, such as gravels in the alluvium, the hole could be continued with a chisel-bit. In one area in the south it was found that the cheapest, quickest, and most effective method of examination was to discard pitting altogether, and to grid the area with auger-holes down to a recognizable horizon. The auger-holes were carefully surveyed and levelled, and a stratum contour-map produced of this particular horizon."

In 1939 E. C. Scott⁵ further analysed the merits of pitting and augering in conjunction with shallow core-drilling. He illustrated the various auger types ranging from 4-inch post-hole augers to the most commonly used 1½-inch carpenter's auger. The latter is generally screwed on to 10 or 20-feet joints of 1-inch standard line pipe or, preferably, steam pipe. They are rotated by the use of 18-inch or 24-inch Stilson wrenches. Another method is to weld the carpenter's auger on to a 5-foot joint of $\frac{3}{4}$ -inch pipe, a hollow "T" joint being screwed on to the other end : the pipe is then rotated by means of an iron bar placed through the "T" joint. On having drilled the length of the bit and the additional 5 feet of pipe, the "T" is removed and another 5 feet length of pipe added. The "T" is then screwed to the top of this additional joint and drilling resumed.

ROHR: ORIENTATED HAND CORING IN GEOLOGICAL FIELD WORK. 81

Below a depth of 40 feet simple hand operation becomes uneconomical, so that one has to resort to a drilling mast or tripod and snatch-block, by which means depths considerably over 100 feet have been reached in noncaving clays. To go deeper than 100 feet is not recommended because of the danger of twisting off.

The main disadvantage of sampling by means of carpenter's augers is that the samples obtained can be used only for chemical and microscopical studies. In formations without a marker bed, the three-point method of determining the dip is not applicable, and pitting or orientated core-drilling is the only alternative. The introduction of an easily transportable, economic type of coring equipment has, therefore, been one of the strong desires of exploration geologists. The author has designed such a tool for orientated hand-coring; and this was introduced in November 1941. It has proved to be very satisfactory for conditions in Trinidad.

DESCRIPTION OF ORIENTATED CORING DEVICE.

The device and accessories are illustrated in Figs. 1-7. The equipment as described is for use with augering tools, in which the auger bit is $1\frac{3}{4}$ inches in diameter, and is run on $\frac{3}{4}$ -inch pipe. The orientated coring device proper, as sketched in Fig. 1, consists of three main parts :

1. The outer string of $\frac{3}{4}$ -inch standard line pipe (A) of length equivalent to depth of auger hole plus about 1 foot. (This can be the same string of pipe as is used for ordinary augering.) When the string is made up for core-taking, the top of it protrudes approximately 3 feet above the ground, a height convenient for orientation and coring operations as described below.

2. The *inner string* consisting of an upper round iron road (B) of 4-6 feet length of $\frac{5}{8}$ -inch diameter to be used as driving hammer, and a lower rod (C) of approximately $\frac{1}{2}$ -inch diameter and a length equivalent to casing minus 2 feet. A buffer (D) of 1-inch length by $\frac{11}{18}$ -inch diameter is inserted between drive rod and core assembly to prevent deformation of core-barrel head.

3. Core-barrel assembly. The core barrel assembly embraces three pieces :

(i) A $\frac{3}{4}$ -inch slotted steel guide tube (E) of about 7 inches length, joined by an ordinary collar (F) to the bottom of the $\frac{3}{4}$ -inch outer string; (ii) the core-barrel head (G), consisting of a piece of turned steel having a sliding fit in the guide tube. A key (H) near the top of the core-barrel head engages in the slots (I) of the guide tube to prevent relative rotation; (iii) the core-barrel proper (J), which is screwed on the lower part of the core-barrel head. It is best made of steel, bored to 1-inch inside diameter and 7-inch length, thus yielding a core of a maximum length of 6 inches and 1 inch diameter. The cutting edge (M) is formed by bevelling the outside edge as shown in the sketch. Near the bottom end of the core barrel a steel scriber (K) inserted in line with the orientation marks on the outer string (L), produces an orienting groove as the core enters the core-barrel. The three parts of the core-barrel assembly are detailed in Figs. 2, 3, and 4.





Accessories.

A. Core Extractor.

As a rule, the core is held firmly in the core-barrel, and cannot be removed by hand, thus necessitating the use of a mechanical device, illustrated in Fig. 5; this device is a modification of the usual core extractor used in oilfields.



(Not drawn to scale.)

The illustration being self-explanatory, a description is omitted. Attention is directed, however, to the swivelling head (Fig. 6), the smooth and easy rotation of which, under any degree of stress, is an essential requirement for obtaining non-deformed cores.

Failing a proper swivel, or if the swivel does not rotate freely, torsion effect expresses itself firstly in a progressive deviation of the orientation groove in the upper portion of the core, due to rotation of the core in the barrel, and secondly in actual twisting of the substance of upper portion of the core. It will be appreciated that these effects are in opposed directions, but would usually be confined to the upper part of the core. Consequently, only the lower part of the core should be used for orientation purposes (see Fig. 8).







(Not drawn to scale.)

B. Table Suitable for Core Orientation of Prepared Core in the Field.

This consists of a simple 4-inch by 4-inch board of 1-inch thickness. A 1-inch hole bored in the centre keeps the core in vertical position, provided that the table is level. An orientation line, preferably the north direction, is drawn through the centre of the table (Fig. 7).

86 ROHR : ORIENTATED HAND CORING IN GEOLOGICAL FIELD WORK.

ORIENTATED CORING PROCEDURE.

1. Orientation of Coring Device.

After ascertaining that the pointer (K) in the core barrel and orientation marks (L) on the core barrel and the outer string are in line, the coring device is lowered to the bottom of the auger hole. For practical reasons, the orientation mark is then orientated to magnetic north by rotating to the right.



FIG. 8.

POSSIBLE DEFORMATIONS OF CORE CAUSED BY COBING AND EXTRACTION. (All deformations are exaggerated.)

- a. Deviation of orientating groove caused by inadequate swivel rotation indicated by arrow.
- 1. Upward edge drag caused by extraction of core from barrel.
- Downward edge drag caused by punching of core.
 Flattening at core base caused by vertical compression due to increased friction between core and core barrel at end stages of coring.

2. Coring.

About ten to fifteen strokes with the upper link of the drive rod, in general, suffice to secure a full-sized core. To prevent damage to the guide key and guide tube by over-driving, it is important to ensure that during the actual coring operation the outer string descends at the same time as the core barrel.

3. Recovery of Core.

It usually requires some effort to withdraw the core barrel from the core hole. Of course, rotation cannot be applied, as it might cause dis-orienta-

ROHR : ORIENTATED HAND CORING IN GEOLOGICAL FIELD WORK. 87

tion of the core or damage to the slotted guide tube. As a rule, two men can pull the coring device out of the formation, but occasionally the use of a lever is necessary. Care must be taken to avoid bending the outer string in such cases.

Before disconnecting the core barrel it is advisable to re-check the position of the orientation marks.

The extraction of the core from the core barrel is best undertaken with a core extractor of the type shown in Fig. 5. The swivel (Fig. 6) should be kept well greased to prevent distortion of the core and deviation of the orientating groove.

4. Preparation of Core for Orientation and Determination of Strike and Dip.

The geological compass is used in order to place the core so that the orientating groove faces magnetic north—*i.e.*, the direction which it faced when the core was cut.

Working on a carefully prepared bedding plane, the actual dip and strike of the subsurface rocks are then easily ascertained with the geological compass and dipmeter. Care must be taken, however, not to be misled by distortion of the core due to causes outlined above (see Fig. 8).

To assist in orientation of the core and in the reading of dip and strike, the use of a small table as shown in Fig. 7 is indispensable in the field. The level position of the table should be checked either by geological compass or by a non-magnetic "Universal" level attached to platform.

PRACTICABILITY OF ORIENTATED CORING BASED ON TESTS IN THE FIELD.

Based on extensive field work, it can be stated that almost 100 per cent. recovery of orientated cores can be expected from *soft formations* as are represented by Tertiary clays of Trinidad. In certain soft and loose sands, where ordinary hand-augering without circulation is very slow, if not impossible, the use of a hand-operated circulating pump and a spoon auger followed by auger-coring might yet prove more economical than pitting.

The fact that the use of orientated coring is restricted to relatively soft formations is not a serious drawback, since the dip and strike of hard formations can usually be adequately studied in surface exposures.

ACCURACY OF ORIENTATION.

The accuracy with which dips and strikes can be measured for core samples depends largely on the proper indentification of bedding planes, through which a very much smaller section is cut than is the case in a test pit or exposure.

It is to be expected, therefore, that on the average the use of orientated cores gives results slightly inferior to that attained in large exposures or in pitting. A comparison between strike values obtained from cores and from test pits dug at the same spot in soft formations shows differences of less than 5 degrees, indicating that the accuracy of core orientation is within the accuracy of average field measurements for such rock types. Though slight deformations like edge-drag and torsion may affect certain parts of the core (see Fig. 8), the experienced field geologist is always able to recognize and select an unaffected bedding plane for measurement. In occasional doubtful cases check coring is advisable.

88 ROHR : ORIENTATED HAND CORING IN GEOLOGICAL FIELD WORK.

In a general sense orientated coring may even yield more reliable data than those obtained from exposures, since observations are made on rocks which are beyond the effective range of hill creep and landslips; characteristic features of soft formations in areas of high rainfall. It can be stated, therefore, that from the point of view of accuracy, this method of orientated coring has been proved in the field to be satisfactory.

GENERAL REMARKS.

Efficiency.

A daily average of about twenty-five observations were made in the field. The investigation included the determination of strike and dips, a stratigraphical description of the core, sampling of the core for palæontological, petrographical, and geo-chemical analyses, and topographical sketching of the area under investigation. The above average compares very favourably with that attainable in test-pit investigations, which would be twenty pits per day under the same working conditions. Test pits, however, yield rather more information on account of the larger field of observation. On the other hand, coring offers better-preserved samples, containing foraminiferal assemblages, which are often absent at normal test-pit depths owing to the effect of weathering. A further advantage in favour of orientated coring over pitting is that cores may be taken at places where topography or land situation makes pitting impossible.

Time Distribution for Orientating, Coring and Notes.

	Coring and Orientating Procedure and	Time
	General Geological Notations.	(minutes).
1.	Setting and orientation of coring device for holes of a maximum depth	
	of 20 feet (in one string)	2
2.	Coring, retraction of coring device from hole and extraction of core	
	from core barrel	4
3.	Preparation of core for orientation and determination of strike and dip	3-5
4.	Geological description of core	1-5
5.	Sampling for various tests	2-3
6.	Topographical sketching	1-2
	LOW ALCOMENTATION OF DECISION OF THE PROPERTY AND A DECISION O	

Total time spent as per observation is 13-21 minutes.

The preceding time analysis, though based entirely on the author's experience during the initial stage of orientated coring, would probably represent a fair average on which to base the utility of the device. No doubt, the orientated coring device and working methods will still be improved. For the present, it can be stated that results are obtained more rapidly and more conveniently than by pitting, a fact which tends to improve the quality of observation, especially in tropical climate.

Costs.

A comparison between expenses incurred in orientated coring and pitting based on 17 feet of average coring and 10 feet pitting depth, is, under the present local contract prices approximately 1:3 in favour of the coring method. At the same time, price parity between a 10-foot test pit and orientated coring would be reached at a coring depth of about 29 feet.

Labour.

Auger-coring from depths not exceeding 25 feet is usually done under contract. Two auger-men can easily drill twelve to fifteen holes of 15 feet

ROHR: ORIENTATED HAND CORING IN GEOLOGICAL FIELD WORK, 89

depth as a daily average in clay and shale formations. This provides the geologist with an amount of information which could only be obtained from an equal number of test pits of 8-foot depths dug by twelve to fifteen test-pit diggers. With a labour shortage such as is being experienced in Trinidad at present, this aspect is important.

Furthermore, under competitive conditions, the value of orientated coring is such as to allow a slight increase in the contract price of augering without increasing exploration costs and thereby speeding up operations.

ADVANTAGES OF ORIENTATED CORING VERSUS TEST PITS.

1. A considerable increase in speed and ease of geological field investigation. The only disadvantage is slight inferiority of accuracy of orientation due to restricted field of observation.

2. Recovery of uncontaminated material.

3. Recovery of unweathered material with well-preserved foraminiferal assemblages.

4. Greater freedom in lay-out for field examination made possible by coring at depths below the effective range of hill creeps and landslips. This makes possible an even net of field observation which is of considerable importance.

5. Minimization of damage to cultivations, and no possibility of claims arising out of injury to personnel or stock, such as may occur with pits which are left uncovered or incompletely filled.

6. Reduced difficulty in obtaining consent from landowners to lay-out lines in their properties. Even when such consent is withheld, coring lines may always be established along public roads and the boundary lines of areas under investigation.

7. Lower cost of orientated coring as compared with investigation by pitting.

8. Considerable saving in labour.

ACKNOWLEDGMENTS.

The author is indebted to Mr. H. C. H. Thomas for many technical suggestions, to Mr. P. M. Greer for construction details, to Mr. C. F. Lamont for drafting the figures and to Dr. H. G. Kugler for assistance in the preparation of the paper. Special thanks are due to Trinidad Leaseholds, Ltd., for the permission to publish this paper.

BIBLIOGRAPHY.

¹ Wall, G. P., and Sawkins, J. G., "Report on the Geology of Trinidad."

¹ Wall, G. P., and Sawkins, J. G., "Report on the Geology of Trinidad." Memoirs of the Geol. Survey, London, 1860. ² Cunningham Craig, E. H., "Trinidad Oilfields. General Report by the Govern-ment Geologist on the Central and Northern Anticline (Western Districts)." Council Paper No. 60 of 1907. Port-of-Spain, Trinidad. April 1907. ³ Illing, V. C., "Geology of the Naparima Region of Trinidad," Quart. Journal Geol. Soc. London, 1928, Vol. 84. ⁴ Jenkins, O. P., "Test-pit Exploration in the Coastal Plain of Sumatra," Bull. Amer. Assn. of Petrol. Geol., 1930, 14, 1439–1444. ⁵ Scott, E. C., "Augering and Core-drilling for Geological Purposes in Trinidad," J. Inst. Petrol., 1939, 25 (190), 501–508.

THE INSTITUTE OF PETROLEUM.

AN INAUGURAL MEETING to mark the opening of the Institute's new premises at 26, Portland Place, W.1, took place on 17th February, 1944. The President, PROFESSOR F. H. GARNER, was in the Chair. Tributes were paid to the memory of the late President, Mr. C. Dalley, by LT.-CoL. S. J. M. AULD and DR. A. E. DUNSTAN, and subsequently two films, "Oil from the Earth" and "Protection of Fruit," were shown. Following tea, many members inspected the new offices.

THE PRESIDENT: Since the date of our last meeting, the Institute and its members have suffered a grievous loss in the death of the President, Mr. Christopher Dalley. As you know, Mr. Dalley was trained as an electrical engineer and took a very keen interest in all of the many applications of electricity to the oil industry, and in particular in connection with oilfield operations, some of which he described only as recently as a month ago. He was Chairman of the Finance Committee of the Institute of Petroleum for many years, and it is largely due to his action that we are present in this building today. But I think most of us will remember Mr. Dalley particularly for his personal qualities, and many of us will have pleasant memories of the inimitable way in which he conducted the meetings of the Oil Industries Club.

I will now call on Lt.-Col. Auld and Dr. Dunstan, both of whom have been closely associated with Mr. Dalley throughout many past years, to pay tributes to him.

.LT.-COL. S. J. M. AULD, O.B.E., M.C. : Christopher Dalley's death has robbed the Institute of a worthy and devoted President and parted its members from a dear friend. Yet I feel, and I am sure you will feel with me, that this occasion of the inauguration of our new home is a fitting opportunity for us to get together and speak of him openly and to praise him, because Dalley's spirit was one which never could cast a gloom over any proceedings, anywhere or at any time. Moreover, this successful culmination of our house-hunting, which has resulted in achieving an independent home of our own, was a matter which was close to Dalley's heart and one in which he naturally took a great pride, he being President at the time during which it was brought to fruition.

I, on my part, am proud to have the opportunity of talking about Dalley, because he was a personal friend as well as a professional colleague. I worked with Dalley off and on—and played with him—for the better part of a quarter of a century, and it was always a gift to me to feel he was there in the background of things. He had that wonderful attribute of giving strength to others, so that his very existence was a sort of benediction, and I think it might truly be said of him that ". . . his life, his spirit and his work were one."

Certainly I never attempted to disentangle any of these three things about him.

Dalley, as I think we all know, was a man of original and pioneering trend of mind, but he never let that originality of thought run riot with him. He was too much of the well-trained engineer, of the well-trained man of science, to let that happen. He always had his feet solidly implanted on the double truths of experience and of knowledge, and the result was that his engineering, even when it took in its application some of the most novel turns, was always substantially right and, in practice, a complete success.

Dalley came to the young Petroleum Industry in this country in 1915 with a fund of knowledge which he had acquired of industry in general and with a natural bias from his antecedents, of which the President has spoken, towards the application of electricity to industry and to the oil industry in particular. He almost immediately joined forces and established a quite remarkable technical partnership with that virile and vivid personality. Dr. Dunstan, which resulted, under the Chairmanship of Greenway-later Sir Charles Greenway and then Lord Greenway, and a Past-President of this Institute-in the magnificent technical development of the growing Anglo-Persian Oil Co. and which led to the outstanding successes it achieved. There was a whole procession of schemes for production. New fields, pumping-stations, pipe-lines and refineries followed each other rapidly, all dealing with an entirely new type of crude for which there was no past history or experience. These problems were all met in their stride, and at the back of it all was Dalley's ability to meet the new problems, which was always with that extra bit of knowledge and of thought beyond the then existing best. He himself, I think, was always proudest of his successful harnessing of the turbine direct coupled to the high-lift high-speed centrifugal pump for pipe-line work, but my personal recollection of him in that respect at that time was rather of the meticulous care which he took to ensure the very highest possible efficiency in the useof heat and heat exchange. At that time it was very largely a question of new types of boilers and of boiler efficiency, of scientific lagging of pipework and the use of exhaust steam-those things which Dalley had a humorous way of describing as tracking down the elusive B.Th.U's.

Dalley was a fine "picker" of men, and one of his greatest attributes, I think, was his successful team work. What is more, to the men whom he picked he was always an unchanging friend. They, in their turn, were invariably devoted to him. Past friends of ours, like Holmes and H. Y. V. Jackson, had an affection inspired in them which it is both difficult to describe or to exaggerate, and had to be known to be understood. The same thing applied when Dalley gave up his more purely engineering work and joined R. R. Tweed in the dual control of the administration side of the big companies with which they were concerned. The reason for this attribute of Dalley's was, of course, that he was essentially a big man, and he was essentially a good man. He was generous in his every thought and his every act was a gift. For all his recognized and outstanding success, amongst which he was greatly proud of his position as President of this Institute, I like to think of that side of him which will live in our hearts and of which Wordsworth wrote :

> That best portion of a good man's life— His little nameless unremembered acts Of kindness and of love.

DR. A. E. DUNSTAN: I think you will agree with me that there is no more difficult task set a man than to pay an appropriate tribute to a friend

INAUGURAL MEETING.

of very long standing. I suppose I knew Dalley longer than and better than most people in this room. I first met him just on thirty years ago, and in trying to pay this tribute to his memory perhaps I am apt to forget the man himself and see him through a mist of very affectionate reminiscences.

Like Col. Auld, I met him in the early part of 1915, just when the petroleum industry was beginning to feel its feet, and I joined the old Anglo-Persian Oil Co. at a time when Dalley and Andrew Campbell and myself formed such a small nucleus about which arose the great technical staff which subsequently made the Company's name so famous. It was my good fortune at that time to be at the chemical end, Andrew Campbell, with a solid background based on long experience with the Scottish shale industry and with the Burmah Oil Co., was the refining expert of the Company, but Dalley brought in, if I may say so, a sort of new life. Dalley came in with his expert knowledge of electrical engineering at a time when that had hardly begun to find a place in the industry. Dalley made electrical engineering a very real and very important factor in the winning and refining and transport of petroleum.

It is very curious to look back on those days nearly thirty years ago, when mineral oil was the raw material for just one or two products, and to realize how these pioneers builded better than they thought. They led the way for an ever-increasing and better technical staff, and they were even able to show the way to a more enlightened policy.

But there it was. All three of us—Dalley, Campbell and myself—found our intellectual home in this Institute. All three of us served on its Council for many years. Two of us attained to the honour of its Presidency.

Looking back on those early days, how can one fail to regard with the deepest sympathy and affection the youthful energy and enthusiasm which Dalley put into all those things that appealed to him ?

This, of course, is not the occasion to deal with Dalley's academic and professional attainments. They will be dealt with in a forthcoming issue of the Journal. But apart from all that, do not we realize that in Dalley we had one of those rare people who are by Providence endowed with the possibilities and potentialities of leadership? Dalley would have been more than honoured, more than delighted, to be here today. These new offices of ours were very much in his mind almost up to the day of his death. He was delighted to find that at long last the Institute had a proper and a delightful home. But once again one feels inclined to stress the personal qualities of the man, apart from his scientific and technical achievements. One feels inclined to stress particularly the man that we knew; the Dalley that we loved. He was primarily, as Priestley would have defined him, a Good Companion, and that is a pretty good testimonial to any man. Like that famous character, Abou den Adam, he loved his fellow men. His chief quality, I think, was that. He was the centre, the nucleus, of good fellowship. He was never lonely because he had the habit and the knack of surrounding himself with kindred spirits. He was as approachable to the latest-joined junior as he was to the oldest senior. He loved to shake off the shackles and trammels of his official position, and he loved to mix freely with his friends, to their advantage and to his. It is a very old tag, nisi bonum de mortuis.



MANSON HOUSE.



ENTRANCE TO OFFICES.

CORNER OF

SECRETARY'S OFFICE.

Ó

GENERAL OFFICE



COUNCIL ROOM.





LECTURE HALL OF THE ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE AVAILABLE FOR USE BY THE INSTITUTE. How particularly true is that of Dalley. How could anybody fail to say "Here is a good man, we can say nothing but good of him; here is a man of whom we speak with the greatest respect and the greatest affection?" We say to Dalley

Ave atque vale.

THE HON. SECRETARY said that after the very eloquent tributes that had been paid to the late President, it devolved upon him officially to announce the arrangements which had been made for the continuity of the work of the Institute: The Bye-laws of the Institute provided that the Council had in its power the election of a President to fill any casual vacancy which might occur. Therefore, they had unanimously selected Prof. Frederic Horace Garner for this very important position. Knowing as well as the members did the brilliant attainments of Prof. Garner, they would, he was sure, welcome the choice which had been made by the Council. Prof. Garner had for many years been a very keen and ardent worker for the affairs of the Institute in general, and if there was one effort to which special attention should be directed, it was Prof. Garner's work in connection with the compilation and production of "Standard Methods for Testing Petroleum," which were so widely used throughout the petroleum industry. The Council had every confidence that the members would give their full support to Prof. Garner in the arduous duties which he now undertook, and thereby enable the Institute to go from strength to strength.

OBITUARY.

JAMES MCCONNELL SANDERS.

JAMES MCCONNELL SANDERS died at Pinner on the 4th February, in his 70th year.

Educated at King Edward VI School, Berkhamsted, and at Eastbourne College, he gained a "Keeling" Scholarship to University College, Aberystwith, which, however, he had to relinquish at the end of a year owing to ill health. "He returned to his school as assistant science master for two years, and then went to the Dartford Works of Messrs. Burroughs and Welcome & Co., where he was engaged in research on photochemicals and alkaloidal and fine chemicals. In 1902 he went to Mexico, and in 1903 secured the appointment of Chief Chemist to the Mexican Government Central Customs Department, a position which he held for twelve years, together with that of Agregada in charge of the Department of Applied Chemistry and Technological Research. In 1908 he was appointed Professor of Applied Chemistry by the Department of Public Instruction, and in 1913 was accorded the title of Professor of Applied Chemistry in the University of Mexico.

He left the service of the Mexican Government in 1915 to become Chief Chemist of the Anglo-Mexican Petroleum Company, and later returned to England, where, from 1923 to 1938, he was Chief Chemist and Technical Adviser to the Mexican Eagle Oil Company, and later a research chemist with the Asiatic Petroleum Company.

Mr. McConnell Sanders had a deep and abiding interest in the microscope, and his great ambition was to probe into the origin and history of petroleum. He showed that the microscope could provide valuable information regarding the source deposits and reservoir formations from which any given oils were derived, and much of his work was described in a paper entitled "The Microscopical Examination of Crude Petroleum," which was read before the Institute in 1937.

Mr. McConnell Sanders joined the Institute of Petroleum in 1923, was elected a member of Council in 1928, and a Vice-President in 1933. Many past and present members of Council will wish to remember him as a very active colleague who rendered invaluable service to many Committees of which he was a member and whose wise counsel will be sadly missed. Far more will be missed a kindly and genial friend.

151 A

and a submitted over a light to a	PAGE	relation of the second s	PAGE
Geology and Development	152 A	Motor Fuels	 173 A
Drilling	156 A	Lubricants and Lubrication	 174 A
Production	158 A	Asphalt and Bitumon	 177 A
Gas	164 A	Special Products	 178 A
Cracking	164 A	Detonation and Engines	 179 A
Refining and Refinery Plant	165 A	Coal and Shalo	 180 A
Chemistry and Physics of Petrol-		Economics and Statistics	 181 A
eum	167 A	Books Received	 182 A
Analysis and Testing	172 A	- HILLERY MALE HALL AND A LOUGH AND A	

AUTHOR INDEX.

The numbers refer to the Abstract Number.

The original papers referred to in the abstracts marked with an asterisk may be borrowed by Members from the Institute Library.

Allan, H., 498 Allen, C. F. H., 527 Allinson, J. J., 552 Alson, G., 550 Anderson, A. P., 548 Arnold, W. P., 552 Auspos, L. A., 529

Bachmann, W. E., 514 Bartlett, J. F., 550 Baumann, C. A., 528 Bean, R. N., 498 Beaton, P. D., 498 Behnke, G. E., 498 Benson, R., 504 Bergmann, F., 517, 518 Bond, R. L., 547 Bradsher, C. K., 532, 533 Bragg, L. B., 505 Brown, M. G., 541 Byck, H. T., 498 Byrkit, G. D., 547

Caldwell, W. T., 498 Campbell, K. N., 511 Cantin, C. C., 498 Cantrill, O., 549 Carroll, D. L., 473 Carter, E. L., 498 Cass, U. R., 542 Claudet, A., 498 Claudet, A., 498 Clayton, J. C., 547 Cockrum, H. 1, 498 Cook, E. W., 547 Cook, E. W., 541 Cortes, G. D., 514 Curtis, J. H., 542 Curtis, R. R., 556 Curtis, W. H., 556

Davis, L. L., 547 Deely, C. L., 498 Dickinson, R. G., 519 Dillon, L., 498 Dralle, H. E., 540 Duval, R. H., 498

Earlougher, R. C., 495 Eckel, J. E., 498 Endersby, V. A., 551 Erkert, F. G., 498 Eschinzae, H. E., 517, 518

Farr, J., 521

M

Farrington, B. B., 547 Farrington, B. B., 547 Felsing, W. A., 510 Fiest, W., 538 Fischer, F., 538 Fischer, II. G. M., 542 Fischer, G. H., 498 Foster, A. L., 555 Franz, E. R., 498 Freeland, J. W., 498

Garfield, L. E., 498 Gates, J. W., 527 Gaynor, J. W., 547 Gold, H. M., 537 Goldinger, G., 520 Goodwin, H. S., 552 Urayson, R. P., 498 De Groote, M., 498

Hall, W. P., 524, 525 Hare, D. G. C., 498 Heine, A. L., 513 Henne, A. L., 513 Himer, C. M., 534 Hipple, J. A., 540 Hoback, J. N., 530 Hornday, C. F., 542 Howard, R. H., 498 Howes, D. A., 506 Huffman, H. M., 531 Humphrey, I. W., 847

Inskeep, G. E., 536 Irany, E. P., 516 Irwin, E. M., 498

Jakosky, J. J., 498 Jean, J. W., 542 Josefwitz, D., 520

Kalichevsky, V. A., 542 Kavanagh, F. W., 547 Kelly, M. E., 506 Kendrick, O. M., 498 Kendrick, J. F., 498 Klein, F. D., 557 Kornfeld, J. A., 471 Kubico, A., 537

Lassner, H. F., 502 Lewis, G. E., 498 Lewis, J. W., 505 Lincoln, B. H., 547 Little, E. L., 515 Livermont, F. W., 498

Lovell, R. G., 501 Lowrey, G. A., 498 Mamedli, M. G., 546 Mark, H., 520 Marvel, C. S., 536 Mckler, V., 542 Meunicr, A. C., 512 Middleton, A. W., 539 Miles, T. K., 551 Miller, J. A., 528 Miller, J. A., 528 Miller, L. C., 498 Morgan, F., 545 Mortan, A. V., 515 Mueller, M. B., 554 Musselman, J. M., 547 Muscleary, R. F., 547 McCoull, N., 543 McCoull, N., 543 McCoull, I., 509 McDonald, L. L., 498 547 Neely, G. N., 547

Loane, C. M., 547

Noyes, R. M., 519 Ogarrio, R., 498 Olsen, A. R., 535 Overholt, L. F., 560

Parker, F. D., 503 Parsons, D. O., 531 Paulsen, H. C., 508 Penick, A. J., 498 Penick, K. T., 498 Pew, J. E., 492 Pick, A. W., 498 Pick, A. W., 498 Pitety, R. G., 498 Pitety, R. G., 598 Porter, H. R., 559 Printton, C. F., 547 Puddington, I. E., 544

Racine, E. Ospina, 469 Ragatz, E. G., 503 Ralph, H. D., 481 Rapoport, L., 532 Reed, D. W., 545 Reid, E. E., 524, 525 Riegel, B. E., 537 Roberts, S. M., 547 Roberts, S. M., 547 Roberts, D. 552 Roelen, D., 538

Rouzer, W. H., 496 Ruehrwein, R. A., 531 Rule, B. H., 498 Russell, R. P., 542 Ryder, E. A., 543

S.A.E. Sub-Committee on Maintenance Methods, 558 Sampson, J. B., 545 Saunders, B. C., 509 Scholp, A. C., 543 Scholp, A. C., 543 Schomaker, V., 523 Scott, F. L., 498 Schultheis, H. L., 48 Schulter, 1 P. 498 487 Selberg, J. P., 498 Shabica, A. C., 520 Selberg, J. P., 498 Shabica, A. C., 526 Sheehan, J. V., 662 Simons, H. F., 490 Simons, J. H., 612 Smith, C. A., 498 Smith, C. A., 498 Smith, R. H., 500 Stancliffe, T. J., 498 Straut, T. J., 498 Straut, R. K., 500 Strong, W. O., Jr., 513 Stross, F. H., 549, 551 Swofford, P. J., 498

Tong, L. K. J., 535 Torrey, P. D., 497 Tucker, J. B., 498

Wallace, J. S., 547 Warner, B. R., 522 Watson, G. M., 510 Woil, B. H., 561 Wein, H., 561 Weinsberger, C. A., 526 Weisman, R., 554 Weisman, R., 554 White, F. R., 547 White, E. R., 547 Whitmore, F. C., 526 Wild, F., 509 Williams, N., 488 Wilson, J. H., 498

Young, B. B., 498 Young, E. E., 511

Zaba, J., 491 Zublin, J. A., 498

Geology and Development.

469.* Wildcat Operations Yield Encouraging Results in Colombia. E. Ospina Racines. World Petrol., September 1943, 14 (10), 36.—The El Dificil field was opened in May, 1943, after goological and geophysical work. The discovery well wont to 5950 ft. and entered the basement granite. Several hundred feet of pay formation was penetrated, and gas at 2500 lb./sq. in. was encountered. The pay is a cavernous Upper Oligocene limestone, and the initial yield with a $\frac{1}{8}$ in. bean was 700,000 cu. ft. of wet gas and 54 brl./day of 46° A.P.I. oil. El Dificil 2, about 2 km. to the northwost was spudded on 17th July, 1943.

The El Dificil field is 75 ml. from the Caribbean, in the Magdalena department. Shell also is drilling directly or under contract San Angel 1, and El Brillante 1, and has drilled the Casabe wells and El Doce 1. El Doce was abandoned in the basement granite. The Casabe wells brought in to date have been tested only partially, and have had initial yields ranging 200-1200 brl./day of 21° A.P.I. oil. It is reported that Casabe 9 has some 3000 ft. of pay formation, its depth being 6086 ft.

Just north of the Casabe field Socony is drilling under contract the Cimitarra wells. Cimitarra 2 is testing just above the 5000 ft. level, and the presence of 19° A.P.I. oil is shown. The pay is said to be 1000 ft. thick. Still farther north the Richmond Petroleum Co. explored the Villamizar and Camacho tracts, one well being abandoned on the former and three on the latter, the wells reaching the Cretaceous at depths of 815-4273 ft. Many structural holes were drilled for subsurface correlation by Schlumberger logs, micropalæontology and heavy residues. El Retiro 1, on the Granger concession, has shown some gas.

The Socuavo structure in the Barco concession has two pays, a Tertiary limestone at 4000-5000 ft., and Cretaceous limestone at 9000-10,000 ft. A high gas yield and 500-1700 brl./day of 56° A.P.I. oil have been obtained from the lower pay. The Tres Bocas wells, 14 ml. away, lie on the same structure.

The Texas Company has carried out considerable surface and geophysical work in the Llanos and along the Caribbean coast, and various concession applications have been filed in these areas.

The Gutierrez tract north of and adjacent to the Yondo block has been surrendered after the Tropical Oil Co. had drilled two unsuccessful tests which had reached 4171 and 9502 ft., respectively. Tropical is the fourth major oil company to apply for concessions in the Llanos.

Some of the legal difficulties regarding oil concessions in Colombia are described.

A bill recently submitted to Congress asks that the Government royalty participation be increased, and this and other economic burdens may postpone or even eliminate the development of half of Colombia's prospective oil land.

The oil production has continued to drop due to lack of tanker calls at the export terminals. In 1941 the average monthly production was 2,050,000 brl., in 1942, 875,000 brl., and for the first six months of 1943, 590,000 brl., $97\cdot5\%$ of which came from the De Mares concession. The country's domestic requirements are about 250,000 brl./month.

Although there has been a decline in production, unusual activity has been displayed recently in applying for oil concessions.

Tables list the concessions applied for and under contract in the Department of Magdalena, and give some of the more recent well completions. The economic situation in Colombia is discussed briefly. A map of the Magdalena Department, showing the concessions and some of the geology, is appended. G. D. H.

470.* Find Oil in Florida. Anon. World Petrol., November 1943, 14 (12), 58.—The first producing oil well on the Eastern Seaboard has been drilled in Collier County, Florida, north-west of Miami. A heavy crude with a fair amount of gas and salt water was found at 11,700 ft., and rose in the well to within a few hundred feet of the surface. G. D. H.

471.* Peace Creek Field—a Stratigraphic Trap. J. A. Kornfeld. World Petrol., December 1943, 14 (13), 38-47.—Peace Creek lies on the south-eastern flank of the Central Kansas Uplift, in a 70-ml. segment which has eight important oil fields and two gas fields in stratigraphic reservoirs. These fields produce from Palæozoic rocks, chiefly the Viola lime, the Mississippian chert, the basal Pennsylvanian conglomerate and to a less extent the "Misoner" sand and the Maquokota dolomite. Peace Creek, Zenith, Stafford, Barnholdt, Welch and Wherry have a proven area of nearly 16,000 acros, and 120,000,000 brl. of recoverable reserves. Peace Creek has 6880 acros of proved production in the Viola limestone.

The first exploratory drilling in the Peace Creek area was before 1929, when a well went 405 ft. into the Arbuckle dolomite without finding commercial production. No "Viola" lime was logged, and the Arbuckle was met at 3680 ft. In 1929 a reconnaissance core-drill survey was made, and afterwards reflection seismograph surveys were made. A wildcat met the Topeka lime at 2750 ft., the Lansing-Kansas City lime series at 3250 ft. with a showing of oil, the "Viola" lime at 3625 ft., the Simpson at 3660 ft., reworked Arbuckle dolomite with oil stains at 3747 ft., and true Arbuckle dolomite at 3750 ft. The Mississippian lime, Kinderhook shale, and part of the Viola lime were absent due to truncation. Later work showed this well to be $1\frac{1}{2}$ ml. west of the field. The next wildcat found good oil saturation in a zone 12 ft. below the top of the "Viola" limostone. This well penetrated the Mississippian lime and the Kinderhook shale. The third wildcat opened the field, the "Viola," topped at 3775 ft., being the producing horizon. It gave 125 brl./hr. A year later eighteen oil wells had been completed on a 40-acre spacing. Later in 1941 the Hendrickson pool was opened several miles north of the Peace Creek discovery well. This produces from the "Viola." Two miles north-east of the Hendrickson pool the Schweizer pool was opened, the location of the discovery well again being based on subsurface geological mapping. Production was from the Viola, but the wells had small potentials. This sector marks the northern limit of the Greater Peace Creek field. Several unsuccessful attempts have been made to extend the field northward. Peace Creek South-west was the fifth and last of the group of individual pool discoveries that were later consolidated into one pool. This exploration was also based on subsurface geology. Oil was found in the "Viola," the discovery well being on the upthrown side of a N.N.E.-S.S.W. strike fault, with a throw of 130 ft. A second producing horizon was found in the Arbuckle dolomite in this area.

The subsurface structure of the Peace Creek area is a monocline dipping southeast at about 25 ft./ml. The monocline is interrupted by a terrace and a N.N.E.-S.S.W. fault. The main trapping feature is a change in stratigraphy wherein parts of the two upper members of the "Viola" have been creded and overlapped successively by Silurian, Mississippian and basal Pennsylvanian strata. The same trapping conditions extend from Sterling in the north-east to Stafford in the southwest. The "Fernvale" member of the "Viola" is the principal oil reservoir. Oil occurs on both sides of the fault. Commercial gas production has been developed only on the upthrown western side of the fault.

Well completion practices are described, and tables give the discovery wells of the sectors of the Greater Peace Creek field, and the data on the other stratigraphic fields on the south-eastern flank of the Central Kansas Uplift.

³/₂ ml. south-west of the Peace Creek field pro-Cambrian granito was met at 4714 ft. 11 ml. north-west of the field 52 ft. of "Reagan" sand (Upper Cambrian) was found resting on pre-Cambrian. Arbuckle dolomite (Upper Cambrian and Lower Ordovician) has been found rosting unconformably on the "Reagan." The Simpson consists of red, grey and green shales with occasional linestone streaks and calcareous sandstones. It rests unconformably on the Arbuckle and is 60-80 ft. thick at Peace Creek. The "Viola" unconformably overlies the Simpson, and has a basal limestone member, a middle cherty dolomite member, and an upper coarsely crystalline limestone member ("Fernvale"). The Silurian Maquoketa shale rests unconformably on the Ordovician, but is generally absent at Peace Creek, possibly due to erosion. It is a light greenish-grey dolomitic shale. Thin sand lenses, known as the "Misoner" (Mississippian), overlie the "Viola" at Peace Creek. The Kinderhook has a lower silty dolomite and an upper green to red shale with chert. It thickens to the south-east. A thin "Mississippi" limestone (essentially chalky, residual chert, or limestone with chert) is found over most of the producing sectors of Peace Creek.

A number of maps are included.

G. D. H.

472.* Deep Test Drilling on Prince Edward Island. Anon. World Petrol., December 1943, 14 (13), 64.—After a preliminary survey several years ago, geophysical investigations were carried out on Prince Edward Island in the summers of 1940 and 1941. Seismograph work showed a crest 8 ml. south of Charlottetown in Hillsborough Bay, and drilling is now under way with a rig capable of going to a depth of 10,000 ft. if necessary.

For many years past there has been a small production of oil and gas in New Brunswick, which is adjacent to Prince Edward Island. G. D. H.

473.* November Wildcat Results Less than Previous Month. D. L. Carroll. Oil Wkly, 20.12.43, 112 (3), 49.—In November 1943, 274 exploratory wells were completed in U.S.A. compared with 326 in October. Forty-six wildcats were successful, nine fewer than in October. Texas had eighteen discoveries, five in North Texas, five in South-west Texas, and two each in West Texas, the Lower and Upper Gulf Coast. Illinois had eleven discoveries, and Oklahoma eight.

The best Texas wildcat in November was one in Young County which came in at 2224 brl./day from a 5-ft. section of the Bend line. This well opened a new pool, or else it extended a pool 1 ml. to the north-west. A new Frio sand pay was opened in the Placedo field, Victoria County, on the west flank of a salt dome field. This may add 300 acres of production, and increase the resorves by 2,500,000 brl. A new Frio pay was opened in the North Magnolia City field, Jim Wells County.

The deepening of a well on the apex of the McCamey structure in Upton County, West Texas, resulted in a second strike in the Silurian limestone. There are three pay zones between 7125 and 7200 ft.

The Johnsville North field of Illinois was opened in the Levias limestone below 3191 ft., and pumped 140 brl./day initially. The pool may be expected to give some good McClosky wells. The Levias has yielded a new pay on the Phillipstown pool of White County, Illinois. The Bethel sandstone in this pool has been proved over about 1000 acres. Low gravity oil has been found in a thick section of the Miocene Chanac sand on the Tejon Ranch, Kern County, California. The structure is anticlinal, and a second well found a thicker pay higher on the structure, suggesting that the field may cover 500 acres. This find has yet to be assessed, but the Chanac sand has given high yields in a number of fields.

The West Moore field of Cleveland County, Oklahoma, was opened in the Wilcox at 8780-8800 ft., for 250 brl./day. This well appears to be on a faulted anticline, and a number of structures of this type occur west of and parallel to the Nemaha Ridge zone of fracture.

Tables give by States and districts, the results of wildcatting in U.S.A. in November, and during the first eleven months of 1943, and comparative summaries for 1942 and 1943. The discovery wells for November are listed, with the location, field, completion date, depth, producing horizon, initial production, and other information. G. D. H.

474.* Exploratory Drilling is Under Way in New Zealand. Anon. Oil Wkly, 20.12.43, 112 (3), 64.—Preparations are being made to drill a deep test at Uruti, 35 ml. north of the New Plymouth area. To the south of New Plymouth additional structural drilling is being undertaken. G. D. H.

475.* Million-Barrel Turner Valley Well Canada's Best. Anon. Oil Wkly, 20.12.43, 112 (3), 64.—Home-Millarville 2 in North Turner Valley had produced 1,110,118 brl. of oil between its discovery in January 1939 and September 1943. In 1939 it yielded 221,082 brl., in 1942 231,013 brl., and in the first six months of 1943 133,655 brl. of oil. Originally its gas-oil ratio was 810 cu. ft./brl., now it is less than 2000 cu. ft./brl. Many Turner Valley wells have gas-oil ratios of more than 10,000 cu. ft./brl.

G. D. H.

476.* Nearly Fourth of Rumanian Drilling is Exploratory. Anon. Oil Wkly, 20.12.43, 112 (3), 64.—The Rumanian Press reports that drilling in 1942 was 11% greater than in previous years, and that 22.5% of the total drilling was exploratory.

G. D. H.

477.* One Completion in Colombia in October. Anon. Oil Wkly, 20.12.43, 112 (3), 64.—A well was completed on the Yondo concession in October, and seven wells were drilling at depths ranging 2375-9325 ft. G. D. H.

478.* Peruvian Oil Production up 11% this Year. Anon. Oil Wkly, 20.12.43, 112 (3), 64.—In the first half of 1943, Peru produced 7,281,140 brl. of oil, compared with 6,540,079 brl. in the first half of 1942. 540,153 brl. of natural gasoline was produced. G. D. H.

479.* Production Up in Canada Outside Turner Valley. Anon. Oil Wkly. 20.12.43, 112 (3), 64.—In the first eight months of 1943 Canada produced 6,510,458 brl. of oil, compared with 6,836,130 brl. in the same period of 1942. These figures are exclusive of the Norman production. Turney Valley gave 6,065,779 brl., compared with 6,537,896 brl. in the first eight months of 1942. Elsewhere in Alberta the production was 114,578 brl., compared with 84,556 brl. in the 1942 period. The Ontario and New Brunswick production was 109,718 brl. against 116,354 brl. in the first eight months of 1942. G. D. H.

480.* Turner Valley Completion Makes Good Well. Anon. *Oil Wkly*, 20.12.43, **112** (3), 64.—Major Oil Investments No. 6 well produced 7800 brl. of oil in the first sixteen days of November, from the upper porous zone of the lime pay. Early in December it was tested again after acidizing.

Alberta now has 261 producing wells, 231 of them in the Turner Valley field.

481.* Army Estimates Norman Wells Field Crude Oil Reserves at 100,000,000 brl. H. D. Ralph. Oil Gas J., 23.12.43, 42 (33), 12.—The Army hoped to get a reserve of 8,000,000 brl. at Norman Wells, but the field is now known to have 58,000,000 brl., and probably 100,000 brl. It is admitted that Canol was not designed as a commercially profitable venture, but Lieut.-General B. B. Somervell maintains that it was fully justified as a strategic aid in defence of Alaska. The continuation and probable expansion of Canol are justified by the crude-oil discoveries, and because it is a proved source of oil under U.S. control at a time when Ickes is proposing developing foreign oil sources much farther away.

The pour-point of the oil is -72° F., while the mean winter temperature is -25° F. The Skagway-Whitehorse section of the pipeline has been in operation since January 1943. Storage at Whitehorse is nearly complete, and the first stage of the rofinery will be completed at the ond of January 1944, and the second stage in May.

Canol is practically ready to deliver a small but substantial quantity of oil at a place where it is very much needed.

The refinery will have a throughput of 3000 brl./day, 800 brl. being used for operations, and 2200 brl. broken down into 479 brl. of 100-octane gasoline, 1048 brl. of truck gasoline, 400 brl. of diesel oil, and 293 brl. of Houdry charge stock and residual fuel oil.

There is stated to be a proven potential of 4800 brl./day from wells already acidized, and on the basis of acidizing the remaining wells already drilled the potential is 7500 brl./day. G. D. H.

482.* Active Drilling Campaign in Prospect for Georgia. Anon. Oil Gas J., 23.12.43, 42 (33), 24.--8,000,000 acres are under lease in 35 southern counties of Georgia, and an active exploration campaign is in prospect. Technical staffs are being moved into the area.

The deepest test in South Georgia near Donaldsonville is suspended at 7320 ft., and is still being studied. G. D. H.

G. D. H.

483.* Cycling Plant Proposed near Alta Mesa Field. Anon. Oil Gas J., 23.12.43, **42** (33), 24.—The construction of a cycling plant in the Alta Mesa area, south-western Brooks County, Texas, is under consideration.

The Alta Mesa field proper has been producing since 1936, with a proven area of 1300-1500 acres in the Catahoula and Frio around 2400 ft. and 3000 ft., respectively. Recently an oil well was deepened from 6652 ft. to 7361 ft., and it had a blow-out and fire at 7288 ft., when only 3 ft. into a coarse sand. When brought under control the well gave about 2,500,000 cu. ft. of gas and a spray of condensate before being cored to 7361 ft. G. D. H.

484.* Mexico's Crude-Oil Production Climbs. Anon. Oil Gas J., 23.12.43, 42 (33), 24.-3,249,074 brl. of oil was produced in November on Petroleos Mexicanos properties, and on independently owned lands in Tampico which are now managed by Pemex. The daily average was 108,302 brl. for November, 110,299 brl. for October, and 92,245 brl. for the first ten months of 1943.

Declines in production in November took place in North Tampico and Poza Rica, the latter district giving 56,191 brl./day, compared with 57,345 brl./day in October. The Isthmus region gave 12,849 brl./day in November, showing a slight rise due to the completion of a new well in the deeper pay-zone now being developed.

A table gives production figures for October and November by districts.

G. D. H.

.485.* Monthly Wildcat Completion Record, September-November 1943. Anon. Oil Gas J., 23.12.43, 42 (33), 78.—303 wildcats were completed in U.S.A. in November, 17 more than in October. 36 found oil, 2 found distillate, and 7 found gas in November, the corresponding figures for October being 37, 1, and 10, respectively.

365 exploratory wells were drilled in August, and only 269 in September.

A table gives by States and districts the results of wildcatting in September, October, and November 1943. G. D. H.

486.* Wildcat Completions and Discoveries. Anon. Oil Gas J., 23.12.43, 42 (33), 91.—Eight oil discoveries and four gas discoveries were made in the 79 wildcat completions in U.S.A. in the week ended 18th December, 1943.

The Gobo well on a dome on the eastern side of the Big Horn Basin has been completed for 90 brl./hr., and is regarded as a major discovery.

14 ml. south-west of Vornon, in Western Wilbarger County, North Central Toxas, a 400-brl. woll has been completed in a shallow sand. In Duval County, South Toxas, Pettus sand production has been extended 2 ml. east of the Bridwell field. A gas well has been re-completed as an oil-well in Liberty County, upper Gulf Coast, Texas.

A table gives by States and districts the results of wildcat completions in U.S.A. during the week ended 18th December, 1943, as well as cumulative totals to date.

G. D. H.

Drilling.

487.* Horizontal Drilling from Bottom of Shaft in Pennsylvania Field. H. L. Schultheis. Oil Gas J., 14.10.43, 42 (23), 49.—The method of horizontal drilling as applied to two wells in process of drilling is described. Two wells at a time are drilled in opposite directions from a common shaft. The first pair of opposite wells, each of which has now been drilled about 2000 ft. into the sand, are 5 in. in diameter for the first 100 ft. and are cased with 31-in. casing for that distance. From the ends of the cased holes, 3-in. diamond drill holes have been extended into the sand. These will not be cased. The most intricate feature of the horizontal drilling operation is to determine the elevation of the holes at any length, then to overcome the force of gravity and follow a predetormined course. At 1500 ft. the holes are said to be practically level with the well mouth. From that distance to the end they slant upward. On the bottom of the shaft, 20 ft. under the floor of the work-chamber, are three 20-brl. pressure tanks, into which flow the oil, water, and drill cuttings from the wells. Oil produced is accumulated in one of these tanks during the drilling operations, and water and drill cuttings in the other two. Lifting the drill water, oil, and cuttings, sometimes as much as 200 brls. a day, involves special methods.

156 A

Because of the diamond drill cuttings, an ordinary pump would be worn out in a few days, so air pressure is used to elevate the materials. When a tank is filled, and workmen learn of this fact through an automatic bell system, air under 90 lb. pressure is turned into the top of the tank and the fluid is forced to another tank in a waystation 215 ft. above. From this tank the fluid is blown to the flow-tank on the surface. This operation is accomplished by the turning of a valve by a workman in the power-house who is automatically warned of the coming fluid. In the surfaceflow tank, oil, water, and cuttings are separated by gravity. Every possible pro-vision for safety of the workmon in the 27-ft. chamber has been taken. A steel ladder leads to the surface. Each drilling well is provided with a strong suction from the ventilator fan, so that if gas is encountered it will be pulled directly to the surface without entering the work-chamber. All oil flows into an enclosed tank. Mechanical gas detectors are used at regular intervals for tests, and, in addition, a miner's safety lamp is kept burning in the work-chamber at all times. Ventilation is provided through a 15-in. updraft pipe in the shaft wall, and the air in the workchamber is completely changed every 4½ min. by use of an exhaust fan on the surface. To date the gas content of the subsurface air has never reached 0.1%.

A unique arrangement has been provided for shoeting the wells when they are completed. A pipe, embedded in the wall of the shaft, protrudes through the centre of the dome of the work-chamber. This will be connected to the casing head, thus permitting a free flow of exhaust from the well to the surface. In shooting, a fulllength hole charge of 80% gelatine, extending from a point 500 ft. beyond the workchamber to the end of the hole, and weighing $3\frac{1}{2}$ -lb./ft., will be used.

The operation now in progress is designed to tap approximately 400 acres of land. If all the 24 wells for which port holes are provided in the work-chamber are drilled, about 60,000 linear ft. of producing sand will be opened up, an exposure which would be equal to about 3000 vertical wells in the 20-ft. substratum to be worked.

A. H. N.

488.* Mud Control for Deeper Drilling in Rocky Mountain District. N. Williams. Oil Gas J., 23.12.43, 42 (33), 29.-Mud-conditioning problems in the Rocky Mountain area are concerned chiefly with the prevention of lost circulation and stocking of drill pipe, two of the chief hazards faced in deeper drilling. Sources of lost circulation are the various porous upper sands which are passed up in the deeper drilling, and crevices and fractured sections which may be found at any depth in the lower horizons. The porous upper sands include a number of those that have been or still are productive in many fields. When these sands were developed, loss of circulation in them was not a factor, since the holes were completed at their depths, but now that holes are being carried below them to much greater depths they constitute a hazard. Since the use of intermediate protective casing strings is being discontinued as a usual practice, and only short surface pipe is run, these sands remain open until the oil-string is run. The danger of losing returns in these upper sands, as well as in any crevice or fractured section below them, lies in the possibility of sticking of drill-pipe. The sticking of pipe in these instances is occasioned by the filtration of the water of the drilling mud into the porous or fractured sections, allowing the building up of filter cake and solids on the walls of the hole around the pipe at the point of lost circulation. The accumulated filter cake prevents the pulling of tooljoints or drill-collar and bit through it.

Control of water loss of the drilling mud is complicated in this area by the presence of anhydrite and lime. Sections giving the most trouble lie just below the Sundance sand, some 700-1000 ft. above the Embar lime and Tensleep sand, two of the main deeper horizons undergoing development. The calcium sulphate of those sections, although not always considered soluble, is taken into solution in the mud, and reacts to flocculate inorganic colloids. This is believed to have been one of the principal causes for many cases of stuck drill-pipe which have been experienced in deeper drilling, as the free water can readily filtrate into any of the upper porous sands, which result in the remaining solids building up a thick filter-cake on the walls of the hole around the pipe. More general use is now being made of organic colloids in the mud while drilling through and below the anhydrite and lime sections. The organic colloids, consisting of a hydrolyzed starch product, are not as readily flocculated, and generally have proved effective in reducing the water filtration. Base of the drilling fluids is fresh water, but the pH is usually raised to 12 or higher. In the presence of high pH the organic colloids will not forment. In many wells the water loss of muds using only inorganic colloids may exceed 100 c.c. at 100-lb. pressure in a filter press for 30 min. Use of the organic colloids has reduced the water loss to as low as 2 c.c. in many cases.

Circulating oil with drilling mud is also discussed, together with other practices. A. H. N.

489.* Portable Substructure Raises Clean-Out Rig Over Controls. Anon. Oil Wkly, 3.1.44, 112 (5), 12–13.—For cleaning out, deepening, and working over wells in Californian fields, it becomes necessary to get the rig above the surface controls. The substructure was designed for this purpose. It is constructed of condemned pipe, welded together in sections, is portable, and has all service piping permanently attached. A heavy portable rotary rig is mounted on the substructure, and operations are then carried on in the usual manner. The rotary rig is a complete unit, having a telescopic mast-type derrick, carried by and attached to the rear of the frame of a heavy-duty truck. The drive for the drilling equipment is made through the truck diesel engine by convenient take-off connections and power controls. A separate engine for auxiliary use in driving the mud pump is set beside the rig on timber mats when circulation is required for certain types of operations that may be necessary. Steel tanks are provided for water and fuel, as well as circulating fluid, all of which may be moved in sections when the rig is taken to a well.

The design of the substructure is briefly described.

A. H. N.

Production.

490.* Reasons and Methods for Perforating Tubing. H. F. Simons. Oil Gas J., 14.10.43, 42 (23), 53-54.—The principal reasons for perforating the tubing are: (1) to assist flow, particularly in gas-lift operations; (2) to provide a means of circulating through the tubing, and (3) as an aid in pulling a packer. At the present time perforation can be obtained either by a gun perforator or a mechanical tool. The mechanical tubing perforator is run inside the tubing on a single-strand 0.082-in .diameter wire line. With it, it is possible to put a selected-size (from 1/64 to 5/16 in.) hole in the tubing. For sizes up to and including $\frac{1}{6}$ in. and orifice insert, which is a tapered cone with a hole drilled along the axis, is driven into and through the tubing wall. The outer diameter of this cone is approximately 5/16 in. The tool for driving the insert or punching the hole through the tubing wall is simply but ruggedly constructed. Essentially it consists of two parts, a stationary one in which there is a driving head, or a hinged upright arm, which holds the orifice insert, and a movable wedge-shaped mandrel. Driving downward on the mandrel forces the insert, or the punch, outward and into the tubing wall. Below the tool there is a double knuckle joint and a stop, the latter being similar to an inverted bulldog spear or an inverted choke mandrel and slips. The stationary part of the tool is attached to the stop and is held in place by it. A shear-pin in the collar which holds the upper or movable member to the lower and stationary member allows the tool to be run into the tubing and the stop set. It is then sheared and the wedge driven downward to force the driving-head outward. Above the tool itself a set of 11-in. jars with a 20-in. stroke and a 5-ft. stem 11 in. in diameter and a wire line socket are used. These provide the necessary weight to drive the wedge downward.

Approximately 2 in. above the base of the stationary part of the tool there is a $\frac{1}{4}$ -in. shear pin which is used to indicate whether a hole has been punched through the tubing or not. By the time the housing which is part of the movable element has been driven to this point, the punch has been forced through the tubing. This assurance that a hole has been punched is needed when the annular space behind the tubing is plugged and it is impossible to establish circulation through the hole. The shearing of the pin shows that a hole has been punched. Numerous tests made with the tool show that it is necessary to hit 41 blows with the jars to drive the insert or punch through the tubing. When the tool is run in a well, this number of strokes is used, and then an additional 25 strokes employed to insure that the punch or the insert has been driven through the tubing. Jarring upward then frees the stop, and the tool can be pulled from the hole.

Other details of the operation are given. The perforator is illustrated diagrammatically. A. H. N.

491.* Surface Pumping Equipment. J. Zaba. Oil Gas J., 14.10.43, 42 (23), 60.-The arrangements of the equipment from the hanger to the crank are discussed. Ordinary beam set up with both clockwise and counter-clockwise rotation of the crank, setback, and contro-line arrangements are briefly analysed. Actual tests have been performed about 12 years ago to determine the validity of theoretical considerations in regard to these three rig arrangements. The results obtained can be summarized as follows : In comparing clockwise and counter-clockwise rotation for the usual rig set-up it has been found that counter-clockwise rotation resulted in lower power consumption and lower peaks, higher over-all rig efficiency, and lower rod and rig stresses than clockwise rotation. The setback position with clockwise rotation when compared with usual set-up with counter-clockwise rotation gave shorter polishedrod travel with slightly less fluid produced, and with corresponding decrease in power. Power peaks were considerably reduced, but the over-all rig efficiency was also decreased. Motor-speed variations and rod stresses were increased. Use of beam with upper pitman bearing and samson-post bearing in the line parallel to the beam resulted in effects on power and efficiency very similar to those secured through counter-clockwise rotation with usual rig set-up.

More recently, results of other tests were published on the effect of the three different rig set-ups on efficiency of the installation. These results indicate that beam with upper pitman bearing in line with sanson-post bearing gave most satisfactory results from the standpoint of power cost/barrel, power peaks, and over-all efficiency. During all these tests counter-clockwise direction of rotation was omployed.

Other factors—e.g., foundation—are also discussed in brief. A. H. N.

492. Cycling Operations and Potential Use of Products. J. E. Pow. Refiner, December 1943, 22 (12), 454. Paper Presented before California Natural Gasoline Association --The history of cycling operations is briefly sketched. In war-time, condensate has assumed, through its natural highly-refined state, a value superior in many instances to that of crude oil. In this connection, data compiled by the Sub-Committee on Aviation Gasoline Potentialities established by the PAW District 3 Natural Gas and Natural Gasoline Committee are of interest. It was disclosed that aviation-grade naphtha could be made available through cycling operations for only 28% of the critical material expenditure required for well-head production of this valuable fraction in crude oil. Following the extensive study undertaken, the sub-committee issued three recommendations which indicate fully the potentialities of cycling-plant operations: These were: (1) development of condensate fields for cycling-plant operations, including installation of equipment for segregation of components necessary to the aviation-fuel programme; (2) increased recovery and segregation of aviation-fuel materials through installation of additional facilities in plants now operating; (3) utilization of components such as ethane-propane mixtures, now being produced, but not entering into the war programme, for increased production of super aviation fuel.

The saving in material is discussed. The processing of natural gas is briefly studied.

493.* Analyses of Sub-Surface Conditions Aid Engineers. Anon. Petrol. World, December 1943. 40 (12), 46-50.—The procedures taken in obtaining and examining cores are described. In the laboratory the core samples are divided ordinarily into three parts, one to be tested for fluid content, one for permeability and porosity, and one for salinity, the last being also used to determine grain size, and petrographic (rock type) classification. The sample for fluid content is treated first, and as rapidly as possible. It is broken down into small pieces, and a weighed sample is placed in a retort, where it is heated for 40 min. at a temperature of $350-400^\circ$. This drives off all the water and all but the heaviest fractions of oil, following which the retort temperature is raised to 1100° F., and maintained there for at least 20 min. All the water and oil that distils over is condensed in a cooling tube, and centrifuged until all the drops clinging to the sides have been collected with the bulk of liquid at the

bottom, and a sharp boundary lines exists between the oil and water. The individual volumes of oil and water are then read off directly. The sand remaining in the retort is next cooled in a dry atmosphere and weighed. Thus, a weighed quantity of the original core is separated into three constituents—oil, water, and sand—and the volumetric or gravimetric percentages of each may be easily determined. Many precautionary measures and supplementary steps essential to the accuracy of the method are also taken, and a number of correction factors are involved necessary to render results comparable, but, to avoid confusion, the details have been omitted from this brief treatment.

For the permeability test a small $\frac{3}{4}$ -in. core, 1 in. long, is drilled from the original sample. If the sand is too friable to admit this, a rectangular parallelepiped is cut from it with a knife or hack-saw blade, and trimmed to the same volume as the small core. This test-block is then placed in a leaching and drying apparatus, where it is subjected to the alternate action of hot carbon totrachloride and hot air, until it is completely free of oil and water and is thoroughly dry. The permeability of the small block is now determined by measuring the quality of air that will flow through it in a direction parallel to its original depositional bedding, and under certain standard conditions of temperature and pressure. The device in which this is contrived is called a permeameter, and is simply an air-flow meter, in the main chamber of which the sample can be clamped tight enough to obviate the possibility of leakage between the sample and the clamp. Air is allowed to flow through the block at a pressure, and the reduction in pressure on the other side, measured by a manometer, indicates the resistance to air-flow, or the permeability of the sand.

On the same sample the porosity is measured by using a mercury pyknometer for bulk volume and crushing the sample for grain volume measurements. Salinity or chloride ion concentration is determined by titration with silver nitrate.

A. H. N.

494.* Determining Probability of Success of Secondary-Recovery Operations. Part 4. P. A. Dickey. Oil Wkly, 13.12.43, 112 (2), 36. Paper Presented before American Petroleum Institute.—Perhaps the most important single fact that determines the success of a secondary-recovery operation is the amount of oil recoverable. This amount is determined by the amount of oil in the sand. Possibly the next most important fact is the injected gas-oil or injected water-oil ratio necessary to recover this amount of oil. These ratios are determined by the gas and water saturations of the sand. It is clear that if these quantities were determinable by cores in advance of the heavy development expense incident to either gas or water drives, much of the hazard would be removed from secondary-recovery operations. The importance of further work on the fluid relationships in oil sands, as they affect productivity indices, and on methods of obtaining representative cores, cannot be over-omphasized.

Another conclusion to be derived from a study of fluid saturations is that the higher the oil saturation, the larger the percentage of oil in place that is recoverable. This fact needs a great deal more emphasis than it has received. The lifting cost of oil is usually a large fraction of the cost of production, and depends, more than on anything else, on the rate of oil production of the well. Wells with low rates produce oil at disproportionately high lifting costs. As a rule, gas or water drives are not initiated until the economic limit has been reached and the lifting cost has attained the selling price of oil. It would obviously be much better to start secondary recovery operations while the wells were still producing substantial amounts of oil. The ultimate recoverable oil would then be obtained much more quickly and, therefore, much more cheaply, and in many cases much more oil could be obtained. Perhaps the most obvious example is a field the up-structure wells of which produce gas from the high gas-oil-ratio wells, partly for the oil and partly for the oil gas. The oil in the more richly saturated parts of the pool is migrating up-structure, and may ultimately spread itself so thin by wetting dry sand that it cannot be recovered by any secondary recovery method. Gas should be either recycled and driven down-structure, resulting in the recovery of the same gas with large amounts of oil, or a water drive should be started down-structure before the gas pressure has been removed.

In fact, it might be possible to start both gas and water drives simultaneously after the discovery and definition of a new pool. Gas should be reinjected at the top of the structure to maintain the original pressure, and water should be injected down-

structure equal in volume to the oil removed, and the gas used for fuel. If this were done, it might be possible to reduce the oil saturation in the sand to the neighbourhood of 20%, and recover all the oil by flowing without ever having to install a pump. The oil would be recovered at a fraction of the cost/barrel of present methods, which involve a short period of flowing and a long period of expensive pumping. Lifting costs of the oil during the initial flowing period are only a very small fraction of the costs/barrel of the oil produced during the long pumping period. If some form of primary pressure control were initiated intelligently, with due regard for geological conditions, early in the life of a pool, the total lifting cost/barrel would be in the order of the flowing costs, and the ultimate recovery would be greatly increased.

A. H. N.

495.* Determining Probability of Success of Secondary-Recovery Operations. Part 5. R. C. Earlougher. Oil Wkly, 20.12.43, 112 (3), 28. Paper Presented before American Petroleum Institute.—Core analyses are essential in the evaluation of any property for secondary recovery. In certain areas where unflushed cores are obtained the success or failure of secondary recovery may be predicted to a high degree of accuracy from such data. In other areas, where serious flushing and contamination of cores are encountered, the data are of much more limited value at the present time. In this latter case the main value is the determination of net floodable sand; packer or casing point; necessity for shooting; water-input volumes, rate and pressure; pattern spacing, and determination of residual saturation by water-flooding.

In those areas where unflushed cores are obtained, the analyses may also be used to calculate the estimated oil recovery, as well as rate of recovery, to a high degree of accuracy. One of the most important factors is that of determining the desired shot to be used for sands of different permeability in order to even the flood front through the vertical sand section. Until better means are devised, this appears to be the best way to correct for wide variations in permeability and reduce to a minimum water by-passing through the more permeable sections. Calculations based on theoretical formulæ should be used with great care and caution unless substantial field data are available for correlative purposes. Sufficient cores must be taken for evaluation purposes if a ropresentative picture of secondary-recovery possibilities is to be had. Probably the biggest source of error is the non-uniformity of sand conditions over an area. In some places conditions of saturation may be fairly uniform, whereas sand thickness may vary widely. Such a variation, however, may be checked fairly closely if old well logs are available, and if enough cores have been secured to obtain a comparison between actual net feet of clean sand and that shown on the old logs. However, the most difficult variation, occurring more often than not in old fields having many abandoned wells, is that of oil and water saturation. In this latter case it is impossible to know how many of the old wells have served as a source of entry of upper hole water into the oil zone. In such a case the sand of several acros surrounding the old "leakers" may be water-logged or already flooded-out. It is a difficult problem to face; and it is one that is present in most of the shallow fields of the Mid-Continent first drilled in the early 1900's and later redrilled once or twice more.

Cores from shallow sands or sands depleted from practically all solution gas can be used successfully to predict the success or failure of a water-flooding development, and also a gas-injection programme. Cores from deeper sands, on the other hand. which still have appreciable gas in solution in the oil, cannot at this time be used with any such degree of success. It is possible, however, in the not too distant future, and as field results become available, that some solution will be found for utilizing such cores to an extent comparable with that now existing in areas where non-flushed cores are obtained. A. H. N.

496.* Co-operative Reservoir Control in the K-M-A Field. W. H. Rouzer, Jr., Oil Wkly, 3.1.44, 112 (5), 14-16.—The pool is described. There are 1611 wells producing from Strawn section horizons, which vary in saturated thickness from a few feet to over 100 ft. Because of the erratic conditions found in any one well-bore, it is difficult to give average figures on pay thickness, average permeability, or average porosity; however, as a generalization, the porosity is estimated at 16% and the average permeability at 80 millidarcies. Bottom-hole-sample analysis showed the pool to be

162 A

under-saturated and the 525 cu. ft. of gas/barrel of oil to have a saturation pressure of 1250 lb., 500 lb. below the original reservoir pressure of 1750 lb. Stock tank crude oil had an A.P.I. gravity of 42° .

A number of the owners of properties in the pool were familiar with the gas repressuring of their shallow properties, and when the general reservoir conditions became apparent and production caused reservoir-pressure drops in the order of 40–50 lb./ month, the idea of returning the produced gas to the formation gained momentum. It was generally realized that it would be advantageous to maintain the pressure within this depletion type unsaturated reservoir which was tight and would not produce at economical rates from gravity drainage alone. There was no market for the produced gas, and the logical thing to do was to return it to the formation. A small gasoline plant, constructed by Deep Oil Development Co., returned gas to its own properties with indications of success. The work of co-ordination between the various parties interested is briefly described, and the conclusion is reached that in other fields co-operative control may also result in success. A. H. N.

497.* Determining Probability of Success of Secondary-Recovery Operations. Part 8. P. D. Torrey. Oil Wkly, 3.1.44, 112 (5), 17. Paper Presented before American Institute of Petroleum.—See Abstract No. 495. A. H. N.

498. Patents on Drilling and Production. T. B. Wayne. U.S.P. 2,333,133, 2.11.43. Appl. 31.3.39. Treatment of mud-laden drilling fluids.

G. H. Fisher. U.S.P. 2,333,164, 2.11.43. Appl. 17.5.41. Fluid flowmeter mechanism for recording flow in wells.

P. D. Baeton. U.S.P. 2,333,229, 2.11.43. Appl. 1.5.40. Process of recovering condensable hydrocarbons from gas-oil well products.

F. G. Eckert. U.S.P. 2,333,305, 2.11.43. Appl. 18.1.41. Well bailer.

J. B. Tucker. U.S.P. 2,333,348, 2.11.43. Appl. 9.9.40. Screen cleaner for oil-well perforated pipes.

G. E. Behnke. U.S.P. 2,333,407, 2.11.43. Appl. 11.7.40. Rotary drill cutter.

L. L. McDonald, U.S.P. 2,333,664, 9.11.43. Appl. 29.5.40. Pull-rod carrier.

G. A. Smith. U.S.P. 2,333,691, 9.11.43. Appl. 1.11.40. Tool orienting method and apparatus.

F. L. Scott, L. E. Garfield, and H. L. Cockrum. U.S.P. 2,333,746, 9.11.43. Appl. 11.6.40. Cutter tooth for well-drills.

M. De Groote. U.S.P. 2,333,769, 9.11.43. Appl. 8.9.41. Process for breaking petroleum emulsions.

G. A. Lowrey. U.S.P. 2,333,802, 9.11.43. Appl. 2.4.42. Fishing tool.

C. L. Deely. U.S.P. 2,333,847, 9.11.43. Appl. 5.1.40. Rotary drilling apparatus

R. P. Grayson. U.S.P. 2,333,857, 9.11.43. Appl. 10.2.39. Power well-pumping unit.

R. G. Piety. U.S.P. 2,333,883, 9.11.43. Appl. 31.5.39. Well-surveying device by electrical logging.

T. B. Wayne. U.S.P. 2,334,051, 9.11.43. Appl. 31.8.39. Troatment of drilling fluids to control their gelling and viscosity characteristics.

D. G. C. Hare. U.S.P. 2,334,262, 16.11.43. Appl. 29.5.40. Subsurface prospecting, electronic method of well-logging.

H. Allen and R. N. Bean. U.S.P. 2,334,303, 16.11.43. Appl. 17.3.41. Means for closing and leakage testing of well equipment.

O. A. Brown. U.S.P. 2,334,309, 16.11.43. Appl. 28.2.41. Well-tool construction.
 W. T. Caldwell. U.S.P. 2,334,312, 16.11.43. Appl. 5.8.40. Drilling machine.

T. H. Stancliffe. U.S.P. 2,334,359, 16.11.43. Appl. 23.11.40. Side-cutter bearing.

L. Dillon. U.S.P. 2,334,393, 16.11.43. Appl. 26.2.40. Determination of magnetic and electrical anisotropy of formation core samples.

F. W. Livermont. U.S.P. 2,334,424, 16.11.43. Appl. 21.4.41. Protector for pipes and casings.

L. C. Millor. U.S.P. 2,334,428, 16.11.43. Appl. 15.7.40. An apparatus for sidewall coring.

L. C. Miller. U.S.P. 2,334,429, 16.11.43. Appl. 24.4.41. Orienting apparatus.

P. J. Swofford. U.S.P. 2,334,453, 16.11.43. Appl. 30.4.42. Speed rock-bit.

A. Claudet. U.S.P. 2,334,475, 16.11.43. Appl. 4.12.39. Method and apparatus for investigating earth formations traversed by boreholes.

J. J. Jakosky. U.S.P. 2,334,491, 16.11.43. Appl. 21.12.35. Method and apparatus for determining the electrical characteristics of geological formations traversed by drill holes.

R. H. Howard. U.S.P. 2,334,557, 16.11.43. Appl. 6.2.42. Transfer sleeve for drill-pipe protector.

M. De Groote. U.S.P. 2,335,262, 30.11.43. Appl. 14.11.41. Process for breaking petroleum emulsions.

C. M. Kendrick. U.S.P. 2,335,284, 30.11.43. Appl. 6.12.39. Rotary fluid prossure device.

A. J. Penick and K. T. Peniek. U.S.P. 2,335,355, 30.11.43. Appl. 11.9.39. Producing equipment for wolls.

C. C. Cantin. U.S.P. 2.335,387, 30.11.43. Appl. 26.6.40. Apparatus for comenting wells.

D. G. C. Hare. U.S.P. 2,335,409, 30.11.43. Appl. 29.8.41. Locating points of entry of water into boreholes.

T. B. Wayne. U.S.P. 2,335,554, 30.11.43. Appl. 29.7.38. Process and reagent presolving emulsions.

B. B. Young. U.S.P. 2,335,558, 30.11.43. Appl. 30.8.40. Well screen.

E. L. Carter. U.S.P. 2,335,578, 30.11.43. Appl. 3.3.41. Well casing.

L C. Morgan and T. J. Stewart. U.S.P. 2,335,689, 30.11.43. Appl. 3.8.40. Well-treating fluid.

J. C. Fortune. U.S.P. 2,335,929, 7.12.43. Appl. 13.7.42. Roller bit.

A. W. Pick. U.S.P. 2,335,961, 7.12.43. Appl. 15.11.40. Device for heating paraffin in oil wells.

R. Ogarrio. U.S.P. 2,336,029, 7.12.43. Appl. 27.2.42. Well-drilling apparatus.

E. R. Franz. U.S.P. 2,336,083, 7.12.43. Appl. 11.8.41. Oil-well pump-control system.

E. M. Irwin, G. E. Lewis, R. H. Duval, and B. H. Rule. U.S.P. 2,336,101, 7.12.43. Appl. 4.10.38. Well-survey system.

J. E. Eckel. U.S.P. 2,336,168, 7.12.43. Appl. 9.4.42. Mothod and apparatus for completing wells.

J. W. Freeland and H. T. Byck. U.S.P. 2,336,171, 7.12.43. Appl. 22.6.40. Oilwell drilling fluid.

J. F. Kendrick. U.S.P. 2,336,257, 7.12.43. Appl. 9.1.42. Method and apparatus for releasing jammed well-drilling tools.

J. P. Selberg and J. McEwen. U.S.P. 2,336,305, 7.12.43. Appl. 27.1.41. Portable derrick.

J. A. Zublin. U.S.P. 2,336,333, 7.16.43. Appl. 27.1.42. Apparatus for drilling lateral bores.

J, E. Zublin. U.S.P. 2,336,334, 7.12.43. Appl. 21.5.42. Means for drilling boreholes of different curvatures and diameters.

J. A. Zublin. U.S.P. 2,336,335, 7.12.43. Appl. 13.8.42. Rotary hammering bit.

J. A. Zublin. U.S.P. 2,336,336, 7.12.43. Appl. 13.8.42. Rotary turbine bit.

J. A. Zublin. U.S.P. 2,336,337, 7.12.43. Appl. 13.8.42. Heavy duty gyrating bit.

J. A. Zublin. U.S.P. 2,336,338, 7.12.43. Appl. 29.5.43. Apparatus for drilling bores deviating from existing well-bores.

J. H. Wilson. U.S.P. 2,336,432, 7.12.43. Appl. 24.5.41. Oil-woll servicing mast.

A. H. N.

Gas.

499.* Motor Vehicles Propelled by Producer Gas. G. Egloff, P. Van Arsdell. Petrol. Engr, December 1943, 15 (3), 65.—It is estimated that there are at present in existence \$20,000 gasogene vehicles (*i.e.*, vehicles running on producer gas from solid combustibles), substituting for more than 25 million brl. of gasoline per year. Their use is widespread—from Sweden, for example, where 73,000 such vehicles operate, representing 91% of all road vehicles, to Australia, Brazil, Chile, etc. Fuels include wood, wood charcoal, coal of various kinds, peat, corncobs, grain wheat, flax wasto, coffee husks, nutshells, cotton seed, sugar-cane branches, and lignin. Major fuel production problems are: (1) solid fuel shortage, (2) lack of transport for solid fuels, (3) steel and alloy shortage, (4) lack of equipment manufacturing, and (5) man-power shortage for ongine conversion and fuel production.

The problems loom larger in the smaller countries and in those which prior to 1939 were striving for national solf-sufficiency. Axis-controlled countries have been compelled to adapt agricultural tractors, stationary engines, river-boat engines and even fishing vessels to producer gas operation.

The use of solid fuels, of which a full list is given, presents problems of tar and acid deposition, leading to cleaning and corrosion difficulties. Coal and lignite present problems of clinkering, whilst it is difficult to burn sawdust and peat satisfactorily. Thus the type of equipment must be carefully considered for each fuel.

Gasogenes fall into four categories (which are illustrated diagrammatically): (A) Up-draught, (B) Down-draught, (C) Cross-draught, (D) Double-draught and doublezone. The plant as employed for the purpose of mobile power includes a generator with a fuel hopper, coolers, filters to dedust the gas stream, a gas throttle, and in some cases a starter fan and water regulator.

The up-draught seems best from the thermal point of view, but causes difficulty with tar-producing fuels. Normally low-temperature coke, anthracite, charcoal, and charcoal briquettes are used. Gas of better quality is given than with other types, and engine starting is easiest. Generally steam or water is added to the entering air stream. Down-draught producers use mainly wood-charcoal briquettes, raw wood, coal or mixtures, and whilst they can burn tarry distillates and fuel dust, they suffer from uneven thermal balance. Water is not normally added. The crossdraught types concentrate the combustion and reduction zone into a small space and develop very high temperatures (up to 2000° C. in the combustion zone). They are of simple construction and allow quick starting, and in 1939 were recommended by the British Committee on the Emergency Conversion of Motor Vehicles to Producer Gas. The producer and trailer recommended by the Committee are described and illustrated diagrammatically. Advantages are a minimum number of parts, cheapness, wide applicability, ease of production in quantity, and ease in fitting. Satisfactory performance is obtained with low-volatile anthracite and some low-J. C. temperature cokes.

Cracking.

500. Patent on Cracking. R. K. Stratford and R. H. Smith. U.S.P. 2,322,070, 15.6.43. Appl. 12.6.40.—In a cracking process a heavy naphtha is passed through a heating coil under pressure above 400 lb./sq. in. and at a temperature sufficient to reform the naphtha. The reformed naphtha is then mixed while still hot with a heavier distillate oil and the mixture is passed through a second heating coil under a pressure of at least 300 lb./sq. in. and at a temperature between 1000° and 1100° F., in the presence of a siliceous cracking catalyst. In this way a substantial portion of the heavier distillate is cracked to gasoline. H. B. M.

Refining and Refinery Plant.

501.* Modern Direct-Fired Tubular Oil Heater. Part I. R. G. Lovell. *Petrol.* Engr, December 1943, 15 (3), 59.—The general principles involved in obtaining the high degree of furnace efficiency required by present-day refinery processes are discussed. Problems of design and development are dealt with from two angles: (1) burning fuel with the best practicable combustion efficiency, and (2) transfer of heat of combustion to oil in tubes with the highest practicable thermal efficiency and utility. The discussion of (1) includes a simple account, from a quantitative viewpoint, of the chemistry of combustion. J. C.

502. Test Pressure and Safe Dimensions of Welded Pressure Vessels. H. F. Lassner. Refiner, December 1943, 22 (12), 421-424.-It is pointed out that however carefully the A.S.M.E. and the A.P.I.-A.S.M.E. codes for welded vessels have been prepared, nevertheless in certain cases ambiguities may arise. It is shown that the conception of both codes, that the test pressure had to be based on the full wall thickness of a vessel containing additions over a thickness necessary to stand the internal design pressure, leads many designers to "over-dimensioning" parts of shell openings. This is particularly true with regard to the A.P.I.-A.S.M.E. Code ruling that the longitudinal weld of a vessel be given the full test-pressure proportional to its thickness after completed construction. It is emphasized that thickening such parts as manhole covers and reinforcing pads, just to let them match a temporarily applied test pressure, appears to be an unnecessary expenditure, particularly when the stress in the engaged parts remains under the yield point of the material. Further, it is questioned if the use of alloy bolts justifies the design for a higher value than that for carbon-steel bolts for the bolt load applied to achieve a tight joint. In the interest of conserving material and labour, these questions are brought to the attention of the interested parties, especially so to the A.P.I.-A.S.M.E. committee on unfired pressure vessels, and to the insurance companies in charge of inspections.

A. H. N.

503. Refinery Processes for War Products. F. D. Parker and E. G. Ragatz. Refiner, December 1943, 22 (12), 437-447. Paper Presented before California Natural Gasoline Association .- The handling of 10,000 brls. of a selected 31° A.P.I. California crude is followed through three stages of processing, extending from conventional pre-war operations to latest catalytic-cracking operations for high yields of aviation gasoline. Each process is briefly described, and a flow-sheet illustrates its main characteristics. It is shown that for 10,000 brl. run: (1) Addition of alkylation and isomerization operations to conventional pre-war crude distillation and thermal cracking operations doubles the aviation gasoline production, while raising the gasoline octane rating (A.F.D.-I.C. 4 c.c. T.E.L.) from 91 to 100. (2) In order to achieve this production, additional normal butane must be obtained from outside sources for isomerizationplant feed. (3) Substituting two-pass catalytic cracking for re-cycle thermal gasoil cracking again doubles the aviation-gasoline production. (4) With catalytic cracking, a surplus of 436 brls. of isobutane results, as compared with a butane deficit of 134 brls. for thermal cracking. (5) Aviation-base-stock production from the catalytic-cracking operation is of considerably higher quality than the virgin base stock. (6) In going from the conventional pre-war operation to full-scale aviationgasoline production, components remaining for motor-gasoline production are cut in half. (7) The percentage of C_4 and C_5 fractions available for motor-gasoline blending drops from some 23% of the total motor gasoline components in the case of conventional pre-war operations, to some 7% for the case of large-scale catalytic aviationgasoline production. (8) A marked increase in aviation-gasoline production causes only a relatively small reduction in total distillate and residual fuel production.

Qualifying statements with regard to secondary products are made. A. H. N.

504. Safety in the Operation of Hydrogen Fluoride Alkylation Plants. R. Benson. Refiner, December 1943, 22 (12), 448-452. Paper Read before Thirty-Second Safety Congress, U.S.A.—The subject of safety in the alkylation plant is considered under the following headings: (1) Measures incorporated in the plant design. (2) Protective

166 A

ABSTRACTS.

devices auxiliary to the design. (3) Protective wearing apparel. (4) First-aid treatment of HF injuries. (5) Medical treatment of HF injuries. (6) Physical treatment of HF plant workers. (7) Some general precautions. The subject of fluorosisabnormal growth of the backbones and pelvis—is discussed. When hydrogen fluoride was proposed as a catalyst, the records of workers in plants where this material was made were investigated for evidence of fluorosis. One of the plants had been taking X-rays of its men every year, but had found no cases of fluorosis. Another plant, which had been making HF for over ten years, had all of its men X-rayed, but none had any evidence of fluorosis. One HF manufacturer had been giving his men physical checkups for more than five years, but had never been able to detect any sign of the disease. The men working in alkylation plants have even less chance of contacting fluorine than those in the acid-manufacturing plants, as the alkylation equipment is all outside, while the hydrofluoric acid retorts are all inside.

A. H. N.

505.* 100 Plate Pilot Fractionating Plant. L. B. Bragg and J. W. Lewis, Jr. World Petrol., December 1943, 14 (13), 61-63.-A pilot plant which gives fine fractionating is described and illustrated. The plant has a 16 ft. by 4 in. column of Stodman packing, which affords surface area effects equivalent to a 100 theoretical fractionating plates. The packing consists of gauze screens, each of the same geometrical pattern, which, when wetted by the reflux, provides a great number of liquid-vapour contacts per unit height (1.92 in, of Stedman packing is the height equivalent to a theoretical plate). Other features of the plant are: (a) improved automatic top temperature control; (b) heat input to still automatically controlled to maintain a constant differential pressure drop across the column, permitting maximum rate of throughput; (c) electrically heated fractionator allowing adiabatic column operation; (d) still heating by electricity, steam, or Dow-therm vapour; (e) somi- or full continuous operation. A graph shows the relationship between (a) degree of purity required in the fractionation of the more volatile component of an equi-molal mixture of two components; (b) minimum number of theoretical plates required, and (d) differences in boiling points of two components of the charge. A quick approximation of the minimum number of theoretical plates required to effect different degrees of separation from different types of charge may be obtained from the graph. For example :---

		Minimum number of theo-
	2 juli in marchine 20	retical plates required to ob-
Equi-molal mixture.	Boiling point difference.	tain a 99.9% purity product.
(a) Butane-iso-butane.	9.44 C.	27
(b) Octane-iso-octane.	22° C.	10

(c) With 100 theoretical plates, equi-molal, two component mixtures with boiling point difference of 2.4, 1.6, and 0.8° C. would give products having 99.9%, 99%, and 90% purity respectively.

The graph also shows that for any given difference in boiling points the number of theoretical plates required is roughly doubled for an increase of purity from 90% to 99%. A graph is given showing the pressure drop across the column packing in relation to reflux rate. W. H. C.

506.* Petroleum Refining Terminology. M. E. Kelley and D. A. Howes. J. Inst. Petrol., January 1944, 30 (241), 1-12.—The authors explain technical terms which have become commonplace in papers on refining process. A. H. N.

507. A New Canadian Oil Refinery. Anon. Chem. Tr. J., 25.2.44, 114, 205.—An article in Canadian Chemistry and Process Industries of December 1943 gives details of a complete new refinery at Clarkson, Ontario, recently put into operation by the British American Oil Co., Ltd. It consists of atmospheric and vacuum distillation units, lubricating solvent extraction and dewaxing units, and a polyforming plant. The atmospheric distillation unit can handle 350,000 gals. of crude oil per day, producing stabilized aviation base, naphtha, mineral spirits, light gas oil, and topped crude. The vacuum unit has a production capacity of 35,000 gals. a day of lubricants, distillation being carried out at 4 mm. pressure. The polyforming unit
handles naphtha, excess kerosine distillate, gas oil waxy distillates, and excess wax from the dewaxing unit, and produces polyformed aviation base gasoline, domestic fuel oil and industrial fuel oil. Lubricating oil cuts are solvent extracted with furfural and dewaxed with M.E.K., followed by a catalytic contact filtration in which a slurry of sulphuric acid activated bontonite is mixed with the oil, heated to 400- 600° F., and vacuum filtered. The plants are fitted with completely co-ordinated controllers and recording equipment. A 1900-ft. dock on the shore of Lake Ontario can handle five 24-ft. draught tankers unloading at the same time. C. L. G.

508. Patents on Refining and Refinery Plant. W. O. Heilman. U.S.P. 2,324,927, 20.7.43. Appl. 24.2.41.—In a process for the removal of mercaptan compounds from a feed oil boiling in the motor-fuel range, the original oil is separated into a relatively low-boiling fraction and a relatively high-boiling fraction. The low-boiling fraction is contacted in a primary treating zone with an alkali metal hydroxide solution to remove mercaptan compounds. The alkali metal hydroxide solution is withdrawn from the primary treating zone and treated in a tertiary zone with an event of the corresponding disulphides. The relatively high boiling fraction of the feed oil is treated in a secondary zone with an additional quantity of alkali metal hydroxide solution to remove mercaptan compounds. The treated high-boiling fraction is combined with the treated low-boiling fraction to produce a finished product.

H. C. Paulsen. U.S.P. 2,324,948, 20.7.43. Appl. 24.12.41. Improved process for sweetening hydrocarbon distillate oils containing mercaptans with copper salts. Normally the sweetened products contain small amounts of copper deleterious to the stability of the oil. This is obviated by treating the sweetened oil with an alkali metal salt of arsenious acid, and separating from the oil decomposition reaction products formed from the reaction of copper compounds with the salt. H. B. M.

Chemistry and Physics of Petroleum.

509. Preparation of Nitroethane. H. McCombie, B. C. Saunders, and F. Wild. J. chem. Soc., 1943, 24.—A convenient method for the preparation of nitroethane on *i* the laboratory scale is described. E. H. W.

510. Pressure-Volume-Temperature Relations of 2:2:4-Trimethylpentane. W. A. Felsing and G. M. Watson. J. Amer. chem. Soc., 1943, 65, 780-781.—The compressibility of liquid *iso*octane, 2:2:4-trimethylpentane, has been determined at 25° C. intervals over the range $100-250^{\circ}$ C. and at pressures ranging from 5 to 300 atmospheres. The results are presented both in graphical and tabular form.

T. C. G. T.

511. Addition of Hydrogen to Multiple Carbon-Carbon Bonds. IV. The Electrolytic Reduction of Alkyl and Aryl Acetylenes. K. N. Campbell and E. E. Young. J. Amer. chem. Soc., 1943, 65, 965-967.—Alkyl and aryl acetylenes are roduced at a spongy nickel cathode in acid solution. 5-Decyne, 4-octyne, and diphenyl-acetylene yield the cis-olofins, phenyl-acetylene gives a mixture of ethylbenzene and styrone, whilst 1-heptyne yields 1-heptene. No reduction occurs with 5-decyne at cathodes of cadmium, lead, amalgamated lead, or platinum, and very little with copper.

T. C. G. T.

512. Hydrogen Fluoride as a Condensing Agent. XVII. The Addition of an Alkyl Chloride to the Double Bond. J. H. Simons and A. C. Meunier. J. Amer. chem. Soc., 1943, 65, 1260–1271.—In the presence of hydrogen fluoride t-butyl chloride reacted with cyclohexene giving cyclohexyl chloride (65%), cyclohexyl fluoride (11-5%), and 1-chloro-3-t-butyl-cyclohexene (11%). Reactions of t-butylchloride with trimethyl-ethylene and of isopropyl chloride with cyclohexene gave no isolatable addition product of the chloride to the olefin. E. H. W.

513. Addition of Hydrogen Fluoride to Halo-olefins. A. L. Henne and E. P. Plueddeman. J. Amer. chem. Soc., 1943, 65, 1271-1272.—Addition of hydrogen fluoride to N the following types of halo-olefins is described: RHC = CHX, RR'C = CHX, RCX = CR'R'', $RR'C = CX_2$, RCX = CXR', $RCX = CX_2$, and $CX_2 = CX_2$. E. H. W.

514. Phenanthrene Derivatives. XI. Acetylation and Succinoylation of 3-Methylphenanthrene. W. E. Bachmann and G. D. Cortes. J. Amer. chem. Soc., 1943, 65, 1329-1334.—3-Methylphenanthrene reacted with acetic anhydride giving 3-methyl-6-acetylphenanthrene, but with acetyl chloride the acetyl group was substituted in the 9-position. With succinic anhydride, β -6-(3-methylphenanthroyl)-propionic acid was formed. New syntheses of 3-methylphenanthrene, 2-methyltriphenylene, and 2'methyl-1: 2-benzanthracone are described. Two new preparations are also given, 3-methyl-6-ethylphenanthrone and 3-methyl-9-ethylphenanthrene. E. H. W.

515. Condensations by Sodium. XXVII. Metalation of Benzene, Toluene, and Xylene. The Orienting Influence of Sodium and the Influence of Alkyl Groups on Metalation. A. V. Morton, E. L. Little, Jr., and W. O. Strong, Jr. J. Amer. chem. Soc., 1943, 65, 1339-1346.—Benzene or toluene was mono- or dimetalated with amyl sodium depending on the proportions of the reactants, the temperature, and offectiveness of stirring. Carbonation of the dimetalated products gave *iso*phthalic and homoisophthalic acids, respectively. With m- and p-xylene a sodium atom was introduced into each of the methyl groups, carbonation of the products gave the corresponding phenylene diacetic acids. o-Xylene was substituted to some extent in the nucleus. Alkylation of the mono-products of the xylenes gave the corresponding methylhoxylbenzene. Benzene and toluene when dimetalated were meta-substituted exclusively. The xylenes were more difficult to metalate or alkylate, and this was correlated with the general rotarding effects of alkyl groups on metalation. These results are discussed, and the suggestion made that the mono-metalation product acts as an ion pair and the sodium ion exerts a meta directing influence because it is so close to the anion.

E. H. W.

516. The Viscosity Function. IV. Non-ideal Systems. E. P. Irany. J. Amer. chem. Soc., 1943, 65, 1392-1398.—In the first paper of this series (*ibid.*, 1938, 60, 2106-2115; J. Inst. Petrol. Tech., 1938, 24, Abstr. No. 1425) there was deduced the "ø scale," which provides linear representation of the relationship between viscosity and composition for ideal (*i.e.*, non-associating, non-dissociating, non-compoundforming, etc.) mixtures. This scale is now applied to non-ideal mixtures. The system sulphuric acid-ether, the aqueous and formamide mixtures of dioxane, the lower alcohols and fatty acids are discussed as examples, and it is claimed that the method yields results which are more plausible and concordant than otherwise are obtainable. C. F. M.

517. Friedel-Crafts Reactions of 9-Phenyl-dodecahydrophenanthrene-10-carboxylic Acid. H. E. Eschinazi and F. Bergmann. J. Amer. chem. Soc., 1943, 65, 1411-1412.--Several unsuccessful attempts have been made to cyclize the chloride of 9-phenyldodecahydrophenanthrene-10-carboxylic acid, in the course of which an unusual reaction of this compound with stannic chloride was noted, which lead to 9-phenyloctahydrophenanthrene. E. H. W.

518. 1:2:3:4-Dibenzphenanthrene and its Derivatives. I. Synthesis with Chrysene as Starting Material. F. Borgmann and H. E. Eschinazi. J. Amer. chem. Soc., 1943, 65, 1413-1417.—The correlation between the spatial form of a moleculo and its carcinogenic properties is noted with reference to 1:2:3:4-dibenzphenanthrene and its derivatives. Various attempts (starting with chrysene) to synthesize 1"-methyl-1:2:3:4-dibenzphenanthrene are described, but the tetrahydro-derivative could not be aromatized. To test an hypothesis advanced for the influence of aliphatic side-chains on the activity of carcinogenic hydrocarbons, a series of 6-alkenyl- and 6-alkylchrysenes (related to 1"-methyl-1:2:3:4-dibenzphenanthrene) wore synthesized for carcinogenic tests. E. H. W.

519. Equilibrium of Gaseous Dibromoethylenes. R. M. Noyos and R. G. Dickinson, J. Amer. chem. Soc., 1943, 65, 1427-1429.—The gaseous equilibrium of cis- and trans-

dibromoethylenes catalyzed by iodine has been found to correspond to equal amounts of the two isomers in the range 144-178° C. The standard free energy, entropy, and heat content changes for the isomerization are therefore all zero. E. H. W.

520. The Heat of Polymerization of Some Vinyl Compounds. Note by G. Goldfinger, D. Josefowitz, and H. Mark. J. Amer. chem. Soc., 1943, 65, 1432-1433.—Adiabatic calorimetry has been employed to measure the molar heats of polymerization of styrene, methyl methacrylate, and vinyl acetate. Results are given as 15,000, 7900, and 8000 cals./mol., respectively. C. F. M.

521. Acid Strengths of Aliphatic Nitro Compounds. Note by G. W. Wheland and J. Farr. J. Amer. chem. Soc., 1943, 65, 1433.—An explanation is advanced for the fact that the acid strengths of the nitro-forms of nitromethane, nitroethane, and 2-nitropropane increase in that order, whilst the acid strengths of the aci forms decrease in the same order. E. H. W.

522. Mechanism of the Steam-Carbon Reaction. B. R. Warner. J. Amer. chem. Soc., 1943, 65, 1447-1451.—The general mechanism for the steam-carbon reaction is well established, and data from the literature are shown to confirm that the primary products of the reaction are carbon monoxide and hydrogen, carbon dioxide being formed from the water-gas reaction which reaches or tends to reach equilibrium. Available data are used to discuss various kinetic problems, in particular concerning rate of gasification. It is suggested that there is at any temperature a saturation pressure of steam above which the rate of gasification becomes constant. Further work on the dependence of rate of gasification on steam pressure is called for.

The nature of the intermediate adsorption complexes is discussed, a reaction scheme being postulated, together with a mochanism for the catalysis of the steam-carbon reaction. E. H. W.

523. An Electron Diffraction Investigation of Biphenylene. J. Wasor and V. Schomaker. J. Amer. chem. Soc., 1943, 65, 1451-1455.—Tho structure assigned by Lothrop to the biphenylone which he synthesized (J. Amer. chem. Soc., 1941 63, 1187) has been confirmed by an electron diffration investigation. The distances and angles for the molecule are given. Quantum-mechanical calculations of the resonance energy and relative bond strengths in biphenylene have been calculated. E. H. W.

524. A Series of a, ω -Dimercaptans. W. P. Hall and E. E. Roid. J. Amer. chem. Soc., 1943, 65, 1466-1468.—The a, ω -dimercaptans up to dodecamethylene have been propared. Their properties were determined and compared with those of the corresponding glycols and dibromides. E. H. W.

525. Preparation of Nonane and Decane a, ω -Dicarboxylic Acids. W. P. Hall and E. E. Reid. J. Amer. chem. Soc., 1943, 65, 1468.— μ -Hydroxystearic acid from hydrogenated castor oil when exidized by nitric acid gave a mixture of heptoic acid and a C₁₁ dibasic acid, hexeic acid and a C₁₂ dibasic acid. The monobasic acids were removed by steam distillation, the remaining acids converted into their ethyl esters which were separated by fractionation. E. H. W.

526. Formation of cycloPropanes from Monohalides. IV. Some Reactions of 1-Chloro-2-methyl-2-phenyl-propane. (Neophyl Chloride.) F. C. Whitmore, C. A. Weisgerber, and A. C. Shabica, Jr. J. Amer. chem. Soc., 1943, 65, 1469-1471.—Some reactions of neophyl chloride are described and compared with the corresponding reactions of neopentyl chloride. Neophyl chloride was less reactive with sodium, but more reactive with ethyl sodium than neopentyl chloride. Both chlorides were inert to most basic reagonts, but neophyl chloride showed slightly greater activity. The relation of the Wurtz reaction to the action of a halide with an alkyl sodium was further demonstrated. E. H. W.

527. A New Synthesis of the Pentacene Ring System. C. F. H. Allen and J. W. Gates, Jr. J. Amer. chem. Soc., 1943, 65, 1502-1503.—The synthesis of symmetrical or unsymmetrical polyarylated pentacenes by addition of two molecules of an iso-

benzofuran to one molecule of benzoquinone is described. 5:7:12:14-Tetraphenyl-6:13-pentacenequinone was prepared in this way. E. H. W.

528. The Effect of Oxygen on the Fluorescence of Certain Hydrocarbons. J. A. Miller and C. A. Baumann. J. Amer. chem. Soc., 1943, 65, 1540-1546 .- Intensities of fluorescence of the carcinogenic hydrocarbons 3: 4-benzpyrene, 20-methylcholanthrone, 9: 10-dimethyl-1: 2-benzanthracene, 1:2:5:6-dibenzanthracene, 1:2-benzanthracene, and anthracene have been measured in various solvents in vacuo and after shaking with known amounts of oxygen. With six solvents the fluorescence in vacuo of benzpyrene was nearly the same, the other hydrocarbons showed differences; in air the fluorescence of all the hydrocarbons was quenched to various degrees, the fluorescence varied hyperbolically with the oxygen partial pressure. In certain solvents the fluorescence varied directly with their oxygen solubility, but the relationship was not general. The fluorescence bands altered in position with different solvents, but oxygen only caused a diminution of intensity of the bands. Sulphur, nitrobenzeno, tetranitromethano, sulphur dioxide, hydrogen chloride, and trimethylamine also inhibited the fluorescence of benzpyrene. Sulphur dioxide was found to be many times more potent than oxygen in quenching the fluorescence. The fluorescence of the non-saponifiable matter from mouse tissue was much less sensitive to dissolved oxygen and to changes in solvent than the hydrocarbons. Two theories are suggested for the mechanism of the quenching by oxygen: (a) formations of a non-fluorescent dissociable complex between oxygen and the hydrocarbon, or (b) a collision phenomenon. No definite conclusion was reached from the results as to the mechanism, except that benzpyrene reacts in some way with oxygen, the reaction being regular, reproducible, and even predictable. E. H. W.

529. The Isomeric *p*-Dibutylbenzenes. G. F. Hennion and L. A. Auspos. J. Amer. chem. Soc., 1943, **65**, 1603-1606.—Direct alkylation of the butylbenzenes, or acylation of the butylbenzenes followed by Clemmensen reduction, has been employed to prepare the isomeric *p*-dibutylbenzenes. The isomerization of *n*- and *iso*butyl groups to *s*- and *t*-butyl groups respectively, by boron fluoride in alkylation procedures has been reconfirmed. No isomerization of a butyl group already in the benzene ring is effected by further alkylation at temperatures up to 75° C., in the presence of boron fluoride alone or with phosphorus pentoxide. Eight new *p*-dibutylbenzenes were prepared and described. E. H. W.

530. Some Esters of Normal Aliphatic Alcohols and Acids. J. N. Hoback, D. O. Parsons, and J. F. Bartlett. J. Amer. chem. Soc., 1943, 65, 1606-1607.—The proparations and common physical properties are reported for nine esters not previously known—viz., nonyl, undecyl, dodecyl, tridecyl, tetradecyl, and pentadecyl caproates; propyl, butyl, and amyl polarganotes, together with nine esters already known—viz., the propyl, butyl and amyl esters of caproic, heptylic, and caprylic acids. E. H. W.

531. Thermal Data. XVII. Heat Capacity, Entropy and Free Energy and Formation of cycloHexane. A New Method of Heat Transfer in Low Temperature Calorimetry. R. A. Ruehrwein and H. M. Huffman. J. Amer. chem. Soc., 1943, 65, 1620–1625.— The measurement of the heat capacity of cyclohexane from $13-300^{\circ}$ K. is described. The results differ from those of Aston, Szasz, and Fink (J. Amer. chem. Soc., 1943, 65, 1135) by amounts greater than the claimed experimental errors of either laboratory. The authors hope that this paper may be of use in tracing the source of this discrepancy. The heats of transition and fusion were also determined and the molal entropy and free energy of liquid cyclohexane calculated. E. H. W.

532. Aromatic cycloDehydration. XIII. 1:2:3:4-Dibenzophenanthrene. C. K. Bradsher and L. Rapoport. J. Amer. chem. Soc., 1943, 65, 1646-1647.—The olefin oxido type of cyclization was found to give a simple and convenient method for the preparation of 1:2:3:4-dibenzophenanthrene. E. H. W.

533. Aromatic cycloDehydration. XII. The Mechanism of the Cyclization of o-Benzylphenones. II. C. K. Bradsher and E. S. Smith. J. Amer. chem. Soc., 1943, 65, 1643-1645.—The action of hydrobromic acid on a suitable imine may bring about cyclization to form a six-membered ring, even when the ketone expected as an intermediate cannot undergo enolization. ^{*} E. H. W.

534. Dissociation of Hexa-arylethanes. Equilibria Involving "Mixed Ethanes." Note by C. M. Himer and M. B. Mueller. J. Amer. chem. Soc., 1943, 65, 1654-1655.— The calculation of the equilibrium constant for the dissociation of a "mixed ethanes" is outlined. Equilibrium constants calculated in this way are tabulated for the mixed ethanes whose apparent dissociation has been previously reported (J. Amer. chem. Soc., 1942, 64, 2227). E. H. W.

535. A Study of the Dilatometric Method of Measuring Rates of Reactions. The Application to the Determination of the Rate of Hydrolysis of Acetal. L. K. J. Tong and A. R. Olson. J. Amer. chem. Soc., 1943, 65, 1704–1707.—The effects of the heat of solution and the heat of reaction on the determination of rate constants by the dilatometric method are analysed. A magnetically stirred dilatometer which minimizes the errors due to these effects has been used to determine the heat of solution and the heat of hydrolysis of acetal in water, in 4M sodium chloride and in 1M potassium nitrate, and also the volume change due to hydrolysis in these systems. The hydrogen ion catalyzed rate constant for the reaction in these solvents at 25° C. has also been determined. C. F. M.

536. End Group Structure of Polyvinyl Alcohol. C. S. Marvel and G. E. Inskeep, J. Amer. chem. Soc., 1943, 65, 1710-1714.—It has been noted experimentally, and also on the industrial scale, that hydrolysis of polyvinyl acetates and also acid treatment of various polyvinyl alcohols cause unusual molecular weight changes, based on viscosity determinations. It is suggested that this may be due to the polyvinyl alcohol having one terminal aldehyde group. E. H. W.

537. Synthesis of 3'-Alkyl-1:2-cyclopentenophenanthrenes. B. R. Riegel, H. M. Gold, and A. Kubico. J. Amer. chem. Soc., 1943, 65, 1772-1776.—The synthesis of sufficient quantities to test for possible carcinogonity of the following compounds is described: 1:2-cyclopentenophenanthrene and its 3'-methyl-, 3'-ethyl-, and 3'-iso-propyl derivatives. (3'-Methyl-1:2-cyclopentenophenanthrene is otherwise known as Diels' hydrocarbon.) Since the side chains of the various steroids are attached to the 17-position, these compounds now reported with substituents attached to the corresponding 3'-position of 1:2-cyclopentenophenanthrene are of particular interest. E. H. W.

538. The Synthesis of Gasoline by The Fischer-Tropsch Process. Part I. F. Fischer. O. Roelen, and W. Feist. Refiner, December 1943, 22 (12), 429-436. Translated from Brennstoff-Chemie, 1943, Vol. 13, No. 4.-The paper describes the development of the Fischer-Tropsch process over the last few years. The contact chamber, in particular, has been developed to give a sound, cheap, and simple unit. The catalyst and its activity are discussed. To prepare the catalyst, to a solution of 250 parts of nickel nitrate (6 mols. water), 50 parts of manganese nitrate (6 mols. water), and 34 parts of aluminium nitrate (9 mols. water) in 600 parts distilled water there are added in the cold 60 parts of kieselguhr. There is next added a solution of 210 parts of anhydrous potassium carbonate in 600 parts of distilled water, and the precipitate which forms (plus the whole solution) is brought to the boil and filtered from the liquor. The precipitate is washed with 600 parts of hot water, and is dried in an air stream at 110° C. For laboratory purposes, the dried mass is best ground to a powder in a mortar in order to obtain reproducible results. In that case it is used as a fine powder. Commercially, the coarse, dried material is preferred, due to ease of handling when used in non-moving contact. Coarse pieces of granules also allow a rapid penetration of the gases. After reactivation the life of the catalyst is indefinitely long.

The difficulties connected with contact chambers in this process have always been great and frequently stressed by the workers. On the one hand, the prevailing temperature range is quite small (15° C.); on the other hand, the reaction being exothermic, the liberated heat is quite appreciable (about 450 small calories/cu.

meter of 28/56 gas, or about 33,500 small calories/cu. meter of contact volume an hour). These thermal relationships are, however, not the only factors which make the design of contact chambers difficult. More important are two factors with which an apparatus must comply in order to be practical: (1) the synthesis must proceed to completion based on the chemical reaction; the synthesis must also in the main produce benzine—and not proceed in directions making mostly by-products. To accomplish this it is necessary to maintain: (a) a constant temperature; (b) a complete and uniform distribution of the gas. (2) The synthesis must be able to proceed technically in a practical manner, and the apparatus must be fool-proof. To do this the following are necessary: (a) simple charging methods and emptying procedure in handling the catalyst; (b) the possibility for enlarging the apparatus; (c) low initial and operating costs.

Several types, using catalysts suspended in oil and dry catalysts, are discussed. It is believed that the solution has now been found. Large flat chambers are hung in batches in oil baths, so as to form units or batteries. Such a close formation in batteries has many advantages. The chambers are large enough to eliminate the element of surprise, and it has since been found unnecessary to change the dimensions of such units. Damage to a single chamber is easily remedied by disconnecting the chamber from the remainder of the battery. For the reduction stage, the chambers or cells can be collectively raised by a crane, withdrawn from the oil bath, and brought to the desired reducing temperature in a special chamber or vat. The circulating oil removes absorbed heat or reaction and is cooled, while yielding its real contents to water or steam superheaters for available energy-supply heaters. This absorbed heat furnishes energy for the steam plant to the whole plant and for many other uses, and is far in excess of what is needed. A. H. N.

Analysis and Testing.

539. pH of Bitumen and Tar Emulsions, etc. A. W. Middleton, Analyst, 1943, 68, 368.—Two drops of the emulsion are placed on a white porcelain tile and covered with a slip of Whatman No. 1 filter paper. The aqueous part filters from the suspended matter to form a ring of clear liquid round the spot, and B.D.H.4/11 indicator is applied to this to obtain the pH colorimetrically. T. C. G. T.

540. The Mass Spectrometer for Gas Analysis. J. A. Hipple and H. E. Dralle. Refiner, December 1943, 22 (12), 425-428 .- The mass spectrometer is an instrument in which ion streams of different masses can be separated and measured in a manner that permits both qualitative and quantitative measurement of the components of a gas mixture. It is essentially a high-vacuum tube into which this gas to be analysed is admitted and ionized. By closely controlled electrical and magnetic fields, the ions are caused to move through the tube, so that each stream of ions of different mass can be successively focused on an exit slit at the end of the tube where they impinge upon a plate and give up their charge. This charge or current is amplified and measured by electrical instruments. From these electrical readings the exact composition of the gas mixture is readily obtainable. The apparatus is described in some detail. A typical analysis of a nitrogen-oxygen mixture is discussed. Hydrocarbon analysis is then discussed in some length. The analysis is complicated by the fission of a molecule upon bombardment instead of merely ionizing. A table compares the analytical results with true composition of five synthetic samples. The mass spectrometer is an extremely useful tool for analysing hydrocarbons for impurities of higher molecular weight than the main components, because there is no conflict in masses, and the impurities stand out uniquely. It is also generally true that hydrocarbon analysis by the mass spectrometer becomes most difficult when the components have the same or nearly the same molecular weight.

The value of the spectrometer as an analytical tool in the analysis of hydrocarbons alone well justifies its development. However, there are already in evidence other promising fields of application, such as leakage testing, outgassing of vacuum equipment, metallurgical analyses, purity of controlled furnace gases, automatic controls of processes where it may be important to measure the relative quantity of a desired constituent or to detect presence of an undesirable element, and so on. Any of these applications might conceivably require simpler, and consequently less expensive, instruments than the ones now used for analyses in laboratories. A. H. N.

541.* The Abbe Refractometer and Use of Dispersion Measurements. M. G. Brown. Oil Gas J., 6.1.44, 42 (35), 42-44.-The principles of refraction and the Abbe refractometer are described. Illustrations of the instrument and the optical elements are givon, the latter showing also the compensating Amici prisms which collapse the spectrum that results from dispersion of white light passed through the sample and prisms to a sharp edge such as is obtained with monochromatic light. The Amici prisms are designed so that the edge is at the position for sodium D light. Tables are required for conversion of the Amici prism reading to dispersion value. More accurate measurement of dispersion can be obtained by using the instrument with monochromatic light, without the Amici prisms, or by setting them so as to cancel each other's offects. Most literature references are to dispersion indexes of the hydrogen lines $C(H^{\alpha}) - F(H^{\beta})$. These lines are single and widely spaced in wavelength in the visible spectrum, and therefore give good measurement. A continuous-flow hydrogen discharge tube has been designed, and is described. Sodium and morcury vapour lamps are also available as sources of monochromatic light. Sets of filters for these three light sources are given in a table and the improvement in accuracy by their use is discussed. An important use of dispersion data is in process control where the percentage of aromatics in gasoline has to be determined. In gasoline and naphtha fractions the aromatics C-F specific dispersion values are of the order of 180×10^{-4} , whereas paraffins and naphthenes have values around 99×10^{-4} . From the specific dispersion values σ , the weight per cent. of aromatics may be obtained from the equation :---

100 $\frac{\sigma \max \times 10^4 - 0.16 \text{ Br No.} - 99}{\sigma \text{ aromatics } \times 10^4 - 99^*}$

where the bromine number (grams Br as K Br $O_s/100$ grams sample) enters into the relationship as a necessary correction for the increase dispersion due to unsaturation of some of the components. Typical graphs are given (1) for correction of n_D scale of a particular Abbe refractometer to indices with other monochromatic light; and (2) specific dispersion values for benzene-gasoline mixtures from Abbe refractometer and monochromatic lights. A table shows the specific dispersion of some aromatic and alkyl-benzenes in various temperature cuts of petroleum.

* In the original article the term $\times 10^4$ was omitted from this line.

W. H. C.

Motor Fuels.

542. Patents on Motor Fuels. V. A. Kalichevsky and G. F. Hornaday. U.S.P. 2,321,604, 15.6.43. Appl. 22.12.39.—In a conversion process, hydrocarbons of high boiling point are vaporized without substantial cracking, and the vapours are then superheated to a temperature suitable for catalytic cracking to gasoline, again without substantial cracking of the vapours. A small amount of ammonia is added to the vapours, which are then contacted with a clay-like catalyst. In this way substantial cracking to gasoline is effected. Products of cracking are fractionated to produce gasoline and a heavier oil of light gas oil character. Thus, without substantial change in the physical properties or yields of gasoline and gas oil produced, an increased in cetane number of the gas oil is obtained as compared with that produced in the absence of ammonia.

V. Mekler and J. H. Curtis. U.S.P. 2,321,841, 15.6.43. Appl. 26.8.39. Heavy hydrocarbons are converted into a mixture containing a maximum amount of hydrocarbons boiling within the range of gasoline in the following manner. The heavy hydrocarbons are subjected to low-pressure and low-temperature cracking conditions to accomplish viscosity breaking. Immediately afterwards all these partly cracked hydrocarbons are non-destructively hydrogenated in the presence of hydrogen and a hydrogenating catalyst. Thus the heavy unsaturated products of cracking are converted into saturated compounds, and polymerization to heavy tar-liko materials is substantially prevented. Converted hydrocarbons are then fractionated to obtain

an additional cracking stock for conversion into gasoline and a fraction boiling within range of gasoline.

H. G. M. Fischer. U.S.P. 2,322,007, 15.6.43. Appl. 27.9.39. Pre-formed gasoline containing gum is conditioned by adding to it a quantity of lecithin sufficient to render the gum fluid on evaporation of the gasoline.

H. G. M. Fischer and R. P. Russell. U.S.P. 2,322,622, 22.6.43. Appl. 28.12.39. To prepare an internal-combustion engine fuel of high octane number, a hydrocarbon oil consisting essentially of hydrocarbons boiling within the gasoline range is subjected to catalytic reforming in the presence of hydrogen at a temperature between 850° and 1050° F. The products of reforming are catalytically isomerized in the presence of a hydrogen at a temperature between 700° and 900° F., and the products of this latter reaction are catalytically polymerized in the presence of hydrogen at a temperature between 400° F. From the products of catalytic polymerization are recovered a fraction boiling in the range of an internal-combustion fuel and a fraction which is uncondensed. The uncondensed fraction is continuously recycled to the catalytic reforming process to provide gas rich in free hydrogen.

R. P. Russell. U.S.P. 2,322,664, 22.6.43. Appl. 27.6.41. In the production of motor fuel by the alkylation of *iso*paraffin with mono-olefin, an aromatic hydrocarbon is mixed with the mineral acid catalyst prior to conducting the alkylation reaction.

J. W. Jean. U.S.P. 2,322,850, 29.6.43. Appl. 26.5.41. Gasoline is produced from hydrocarbons of greater molecular weight by contacting their vapours at a temperature between 650° and 950° F. with a granular catalytic mass composed of tetraphosphates of the metals of the eighth group of the Periodic Table containing traces of ortho and pyro phosphates of the same metal.

C. B. Kass. U.S.P. 2,324,779, 20.7.43. Appl. 25.7.40. A motor fuel for sparkignition engines consists of a gasoline base fuel blended with 0.5-5 c.c. per gallon of load alkyl anti-knock agent, and 0.005-0.2% by weight of the fuel composition, of an alkyl nitrate containing form 3 to 6 carbon atoms per molecule. H. B. M.

Lubricants and Lubrication.

543.* Oil Corrosion Tester. N. MacCoull, E. A. Ryder, and A. C. Scholp. J. Soc. aut. Engr. 1942, 50 (8), 338-345.—Tests to establish the characteristics and stability of engine oils at high tomperatures by a simplified apparatus for testing corrodibility of bearings and corrosiveness of lubricants are described. The apparatus does not eliminate necessity for engine tests, but enables results to be obtained which correlate satisfactorily with full-scale engine tests. The examination of specific properties of engine oils may be undertaken, and oils can be sorted so that engine testing may be reduced to a minimum. A large number of samples may be tested quickly for corrosion behaviour under a variety of conditions, and the effect of changing engine operation variables, such as rate and magnitude of oil additions, temperature, and variations of bearings, may be simulated, and the stability of oils indicated under operating conditions. The test procedure is as follows : 125 c.c. of oil are placed in each beaker and the space around the beaker filled with heavy oil. The bearings are weighed, lowered into the beakers, the beakers covered, and the assembly rotated for 2 hrs. at 3000 r.p.m. The bearings are removed, weighed, and the corrosion loss calculated. The effects of catalytic surfaces, copper-lead structure, temperature, oil additions, and bearing changes are discussed. It is believed that the apparatus would be suitable for uses other than the tests reported in this paper, and further development of the apparatus is desirable. J. F.

544. Preparation of High Temperature Stopcock Greases. I. E. Puddington, J. Amer. chem. Soc., 1943, 65, 990–991.—Mineral-oil greases containing aluminium or lithium stearates make excellent stopcock greases because they are stable, have good hightemperature characteristics, and are water resistent. A method of preparing the greases is described, and it is claimed that a grease compounded from an S.A.E. 50 mineral oil and 20% lithium stearate retained its form after 2 hrs. at 175° C. The aluminium greases are not quite so good. T. C. G. T. 545. Friction Behaviour during the Slip Portion of the Stick-Slip Process. J. B. Sampson, F. Morgan, D. W. Reed, and M. Muskat. J. Appl. Phys., December 1943, 14 (12), 689-700.—The jerky form of motion described as "stick-slip," which is sometimes observed in the sliding of surfaces, has been studied by means of the stick-slip apparatus. A comparative study of motion during the slip has been made for a number of combinations of unlubricated metals. The variation of friction with velocity has been determined for several typical cases. Most slip traces are symmetrical about their point of inflection, indicating that the kinetic friction remains approximately constant. The static friction is greater, and a rapid drop to kinetic friction usually occurs. The kinetic friction is least at the end of slip, so that the friction-velocity relation is not reversible. There is evidence that the friction does not return immediately to its higher static value when the sliding surfaces come to rest. These results are considered in terms of several theories of friction.

Bowden, Moore, and Tabor have suggested that there are two important mechanisms responsible for sliding friction: (1) Shearing of adhesive metal-to-metal junctions formed at the local points of contact. (2) Resistance encountered due to high points of one surface plastically "ploughing" through the other. This is a clarifying classification of the processes involved, even though there may be no absolute distinction between the two types. However, they are fundamentally different if "shearing" is understood to mean a discontinuous process of breaking junction, whereas "ploughing" is understood to involve continuous applied pressure and continuous plastic flow whether or not a furrow be formed. "Flowing" seems to be a truer description of the latter process, but in accord with the existing termin-ology, it is here referred to as "ploughing." This shearing-ploughing theory fits in well with the results reported, and in addition the results support an extension of the theory. Bowden, Moore, and Tabor did not distinguish between static and kinetic friction. It seems probable that shearing occurs at the beginning of sliding. and is reponsible for the excess of static friction over kinetic, whereas ploughing contributes to both. The following qualitative explanation may then be made. Time is required for local adhesive junctions to form, probably because plastic deformation and rearrangement of surface atoms must first take place. After the junctions are sheared adhesion forces will be lower while the surfaces are in motion, so that mainly ploughing takes place and the friction drops to its kinetic value. It does not return to its static value unless the surfaces remain at rest long enough for new adhesive junctions to be formed. The surfaces are torn during shearing, so that the kinetic friction is greater at the beginning of slip and decreases somewhat as the irregularities are ploughed away.

It is pointed out that molecular forces or other possible causes of friction are not excluded, and may be operative in addition, but that they alone are insufficient to explain the results of this investigation. A. H. N.

546.* Synthetic Lubricating Oils from Cracked Distillates. M. G. Mamedli. Petrol. Engr, December 1943, 15 (3), 138 (translated from the Russian oil journal Zhurnal Prikladnoi Khimii (Journal Applied Chem. U.S.S.R.), 1943, 16 (3-4), 143-150, by A. A. Boehtlingk, Berkeley, California.-This article described a laboratory investigation into the preparation of synthetic lubricating oils by the action of heat and a catalyst on (1) pressure distillate from a Winkler-Koch eracking unit operating on the usual raw materials—*i.e.*, Surakhany topped crude and (2) cracked distillates obtained by cracking Surakhany "plug" (*i.e.*, coresine, so called because it plugged walls and pipes) and Grozny white paraffin wax in a laboratory still. The process of polymerization was carried out in a 3-litre iron vessel fitted with a mechanical stirrer and a bulb condenser. 3% aluminium chloride (calculated on the distillate) was added as a fine powder, and temperatures of 65° C. and 125° C. used for periods of 30 and 3 hrs. respectively. Two types of product were obtained, an upper layer consisting of a solution of oil in saturated hydrocarbons and a lower semi-liquid resinous layer, resembling acid sludge, which was a complex combination of oil with aluminium chloride. The upper layer was soda washed and fractionated by steam distillation.

Synthetic oils obtained from (1) were of low quality, whilst those from (2) were exceptionally good as judged from specific gravity, viscosity index, flash point, pour point, and slight oxidation characteristics.

The general conclusions were that the best lubricating oils are obtainable from cracked distillates of paraffin and that the process of polymerization proceeds ten times as fast at 125° C. as at 65° C. The product depends on the composition of the cracking stock and the conditions of cracking, which should be carried out at low prossures giving maximum yields of unsaturateds and minimum yields of aromatics. J. C.

547. Patents on Lubricants and Lubrication. J. O. Clayton and B. B. Farrington. U.S.P. 2,321,575, 15.6.43. Appl. 10.6.40. A compounded hydrocarbon oil contains a metal salt of an organic acid in sufficient quantity substantially to increase the corrosivity of the oil, and a corrosion inhibitor consisting of an ester having a divalent sulphur substituent attached to an alkyl carbon atom no more than two carbon atoms removed from a carbonyl group of the ester.

J. O. Clayton and B. B. Farrington. U.S.P. 2,321,576, 15.6.43. Appl. 10.6.40. A lubricant consists of a hydrocarbon oil and a quantity of a metal salt of an organic acid sufficient substantially to increase the corrosivity of the oil. To reduce this corrosivity an inhibitor is added consisting of an ester having as substituent an element of the phosphorus group in a trivalent state no more than two carbon atoms removed from a carbonyl group of the ester.

J. O. Clayton and B. B. Farrington. U.S.P. 2,321,577, 15.6.43. Appl. 10.6.40. A compounded lubricant contains a metal salt of an organic acid, and a corrosion inhibitor consisting of an ester having a keto group no more than two carbon atoms removed from a carbonyl group of the ester.

J. O. Clayton and B. B. Farrington. U.S.P. 2,321,578, 15.6.43. Appl. 10.6.40. A compounded hydrocarbon oil contains a motal salt of an organic acid and a corrosion inhibitor consisting of an ester having a substituent comprising nitrogen with at least two bonds connected to a single atom. The substituent is directly attached to an alkyl carbon atom, and no more than two carbon atoms removed from a carbonyl group of the ester.

L. L. Davis, B. H. Lincoln and G. D. Byrkit. U.S.P. 2,322,116, 15.6.43. Appl. 5.9.40. A lubricating oil having a viscosity index above 90 consists essentially of an ether of the type $YnRXR^{1}Zm$. R is a high-molecular-weight aliphatic radical having at least 13 carbon atoms, R^{1} is an organic radical containing at least one cyclic nucleus, X is an atom of an element selected from the group consisting of oxygen, sulphur, selenium, and tellurium, and Y and Z are groups containing an atom of an element selected from the group consisting on atom of an element selected from the group consisting of oxygen, sulphur, nitrogen, and phosphorus. m and n are zero or integers, the sum of which is at least one.

E. R. White. U.S.P. 2,322,184, 15.6.43. Appl. 21.1.41. A lubricant consists of a mineral lubricating oil and a small amount of an addition compound selected from the group consisting of semicarbazones and thiosemicarbazones.

C. F. Prutton. U.S.P. 2,322,209, 22.6.43. Appl. 21.4.38. An extremo pressure lubricant consists substantially of a lubricating oil the film strength of which has been increased by the inclusion of a small amount of dibenzyl disulphide and a separate organic halogen compound.

G. L. Neely and F. W. Kavanagh. U.S.P. 2,322,307, 22.6.43. Appl. 20.6.39. A lubricant normally subject to deterioration and deposition of adhesive materials at high temperatures is improved by the addition of 0.1-5% by weight of oil-soluble mixed salts of aluminium having a naphthenic and a saturated higher fatty acid radical.

R. F. McCleary and S. M. Roberts. U.S.P. 2,322,376, 22.6.43. Appl. 13.5.41. A lubricant is prepared from mineral lubricating oil and a small proportion of an aromatic methylene thioether containing at least one substituent linked to an aromatic nucleus selected from the group consisting of hydroxyl and sulfhydryl radicals and metal salts thereof.

C. M. Loane and J. W. Gaynor. U.S.P. 2,322,859, 29.6.43. Appl. 30.9.40. A lubricant is prepared from a mineral lubricating oil, 0.05-5% of a glyceride phosphoric acid ester, and 0.05-10% of a sulphurized fatty oil.

J. S. Wallace. U.S.P. 2,323,360, 6.7.43. Appl. 1.7.41. A lubricant suitable for use as a transmission oil contains 55-85% of a mineral oil having a relatively low viscosity index, 1-15% of a sulphur-containing pressure agent, and 10-30% of a resin-like oil obtained by treating an asphalt-free, wax-free lubricating oil stock with a liquefied normally gaseous hydrocarbon.

I. W. Humphrey. U.S.P. 2,323,471, 6.7.43. Appl. 28.2.41. A lubricating oil is substantially thickened by the addition of a motal salt of polymerized rosin.

J. M. Musselman. U.S.P. 2,323,670, 6.7.43. Appl. 28.9.40. A mineral lubricant is improved by the addition of a small amount of tetramethyldiaminodiphenyl methane and sodium lauryl sulphate.

R. L. Bond. U.S.P. 2,323,789, 6.7.43. Appl. 27.9.40. A viscous mineral oil composition has incorporated in it a small amount of an oil-soluble, water-insoluble, sufficiently non-volatile alkyl amine ester of sulphurous acid to improve its lubricating value.

E. W. Cook. U.S.P. 2,323,797, 6.7.43. Appl. 16.11.40. An extreme pressure lubricant consists of a mineral lubricating oil and a small proportion of a dixanthyl dialkyl thioether. H. B. M.

Asphalt and Bitumen.

548. Stripping VS. Coating of Mineral Aggregate. F. H. Stross and A. P. Anderson. Proc. Ass. Asph. Pav. Technol., 1942, 13, 1-8.—The authors demonstrate the importance of the differences in particle-size distribution which may occur below 200 mesh. It is shown by means of illustrations that small amounts of colloidal matter, such as clay, can increase the surface area considerably and make complete coating almost an impossibility. In the examples quoted, granite with $8\cdot8\%$ below 200 mesh requires 5 parts of liquid asphalt compared with 25 parts for a clay-containing aggregate with 20.7% below 200 mesh. The authors conclude that only aggregates which have a critical oil content falling within the range of compositions yielding mechanically satisfactory mixes should be used. H. G. W.

549. Use of a Circular Track for Testing Bituminous Paving Mixtures. C. Cantrill. Proc. Ass. Asph. Pav. Technol., 1942, 13, 69-83.—This paper discusses results obtained in developing circular track tests. A description of the track and the method of laying and compacting the test mixes is given. The heavy truck tyres used are run at 8 m.p.h. with a 10° skow to the horizontal for bituminous concrete mixes, and with a 2° skow for cutback pavements. This was found to reduce the time of testing, particularly when water was allowed to permeate the subgrade and applied at regular intervals by overhead sprinkler. It is considered that the method does not introduce stresses differing appreciably from those imposed by traffic, but that they are applied much more frequently. It is thought that temperature and humidity control, as by running in an air-conditioned room, may be necessary. It was found that bituminous concrete containing sandstone aggregate outlasted one with hard limestone, and it appeared that road tests would confirm this. Results to date correlate extremely well with the known service records of the mixes. H. G. W.

550. Softening of Oxidized Asphalts at High Temperatures, and its Relationship to Oxidizing Temperatures. G. Alson. Proc. Ass. Asph. Paving Technol., 1942, 13, 182-193.—The author shows that, contrary to general belief, softening of asphaltic material occurs if it has previously been oxidized in manufacture or during incorporation in a paving mixture; and the softening effect increases as the temperature increases providing such temperatures are below the "cracking" temperature—*i.e.*, 600° F. Results of tests made over the temperature range 300-572° F. show the softening effect for bitumens from different sources. L. A.

551. Durability of Road Asphalts. V. A. Endersby, F. H. Stross, and T. K. Miles. *Proc. Ass. Asph. Paving Technol.*, 1942, 13, 282-328.—The authors compare the condition of road surfaces with the penetration of the recovered bitumen. It was found that cracked and straight-run bitumens vary greatly in their durability, but the data confirms that disintegration of surfaces tends to occur when the penetration

178 A

has fallen to 20-30. It is considered that hardening results from oxidation and loss of volatile constituents, with exidation being the most important factor in paving grades. Hardening in itself is not the cause of disintegration, but is associated with loss of binding ability, the reason for which is not yet fully understood.

The behaviour of surfaces in an accelerated road test under uniform conditions is shown to correlate with practice and, as a result, simple durability tests which can be made on the bitumen prior to construction have been devised. L. A.

552. Patents on Asphalt and Bitumen. J. C. Roediger. U.S.P. 2,322,059, 15.6.43. Appl. 16.11.39. A building material is prepared by impregnating at temperatures above the boiling point of water, a fibrous material containing moisture with a mixture of straight reduced asphalt of relatively low consistency, and an oxidized asphalt from a straight reduced crude of relatively high consistency. In this way excessive foaming of the mixture is prevented.

W. P. Arnold. U.S.P. 2,322,105, 15.6.43. Appl. 15.7.40. The following process is involved in the provision of a substantially moisture repollent coating of a bituminous liquid to wood and similar substances. The material is first impregnated with the coating to a considerable depth by means of pressure on the liquid in contact with the material. In this way sufficient coating is confined within the cellular structure of the wood to coat its exterior surface. Pressure is then reduced to allow the impregnated liquid to extrude from the wood on to its surface. During extrusion the surface of the wood is gradually cooled under conditions designed to effect coalescence of the liquid which is retained as a substantially continuous non-tacky coating.

H. S. Goodwin. U.S.P. 2,322,629, 22.6.43. Appl. 24.2.41. A non-foaming asphalt saturant for fibrous material consists of a mixture of 99.8-99.95% of asphalt and 0.20-0.5% of sulphonated tallow.

J. J. Allinson. U.S.P. 2,324,473, 20.7.43. Appl. 29.1.40. Pollet formation in bituminous paving emulsions of the asphalt-in-water type is prevented in the following way. An asphalt of relatively high penetration, which in aqueous emulsions tends to form pellets through coagulation of previously dispersed particles, is reduced to a penetration not substantially below 77 mm./10 (100 gms, 5 secs.) at 77° F. Then prior to its emulsification, $\frac{1}{2}$ -10% by weight of a petroleum fraction boiling between the lower limit of kerosenes and the upper limit of lubricating oils, is added to it. H. B. M.

Special Products.

553. Alkathene. Anon. British Plastics, December 1943, 15 (175), 417.-Alkathene is a solid thermo-plastic polymer of ethylene consisting of completely saturated straight-chain hydrocarbons, the molecules of which contain about 1000 carbon atoms. It has a yield point of about 90° C. and melts sharply at 115° C. to a very viscous liquid. It is marketed in grades according to its viscosity-viz. Grades 2, 20, 7, and 70, Grade 2 being 10 times more viscous than Grade 20, etc., in the form of chips, or in strips when mixed with polyisobutylene which facilitates extrusion control in rods, film, or moulding powder. Its applications are based on its outstanding electrical properties, flexibility, and resistance to water and chemicals, it being in general only attacked by strong reagents at high temperature. The main uses are thus in the manufacture of cables and accessories, especially for high-frequency and high-voltage work, and in chemical plant. Polythene can be processed by any of the methods used with thermoplastics, and may be extruded or moulded in compression or injection machines. In moulding the pressure must be maintained during cooling owing to the 16% volume reduction which occurs. Also the thermal conductivity is low (0.0007 c.g.s. units), so that large sections cool slowly. C. L. G.

554. Fly Control in Stables. R. Weisman. Soap, December 1943, 19 (12), 117. (Translation from article in Anzeiger für Schädlingskunde, 1943, 19 (1), 5).—It is stated that effective control of stable flies can be obtained with a 1% solution of "Gesarol" (marketed by T. R. Geigy in the U.S. under the name D.D.T., see J. Inst. Petrol., 1943, Abs. No. 1023). The deposit from the solution applied to walls and ceilings acts as a contact poison, and although the kill is relatively slow, a contact

of only 30 secs. is fatal within a few days. The deposit is stable and insoluble in water and retains its toxicity for 5 or 6 weeks. Spraying in early June and at the beginning of August should therefore eliminate the fly plague in stables, etc., for the whole summer. Gesarol is also stated to be an effective substitute for arsonicals, and to have been proved satisfactory for the control of fruit and vegetable pests. It is non-toxic to man and warm-blooded animals. C. L. G.

555.* "Grain" Alcohol from Cracked Hydrocarbon Gases. A. L. Fostor. Oil Gas J., 6.1.44, 42 (35), 39-41.-Baton Rouge Refinery, California, is the first petroleum refinery to instal a plant for the synthesis of ethyl alcohol from cracked gases. The operation of the plant is briefly described and illustrated by a flow diagram. Esterification is accomplished by the absorption of the ethylene, in the gases, in 90% H_2SO_4 . Mono- and di-ethyl esters are formed in an absorber, and are pumped to a hydrolizer, to which measured amounts of water are admitted. The esters are converted to H₂SO₄, ethyl alcohol, and ethyl ether, small amounts of other by-products being also formed. This mixture passes to a stripper where the alcohol and ether is vaporized, and passes to a caustic scrubber to eliminate any entrained acid. The H₂SO₄ formed in the stripper is transferred to an acid concentrator. After the caustic scrubbing the product vapours are condensed and pass to another stripper where the ether is vaporized and condensed. The alcohol-water residual from the ether stripper then flows to a concentrator in which the alcohol is vaporized, and then condensed, yielding a 190-proof (95% purity) spirit product. Production of alcohol from cracked still gases is the cheapest method of manufacture known. Fermentation processes require 2.5 gal. of molasses to produce 1 gal. of 95% alcohol, or one bushel of grain to give 2.5 gal. of alcohol. The cost of the raw material alone, without the fermentation and rectification costs, is greater than the final cost of the same quantity of alcohol from petroleum gases. W: H. C.

Detonation and Engines.

556.* Fuel Feed at High Altitude. W. H. Curtis and R. R. Curtis. J. Soc. ant. Engrs, 1942, 50 (8), 321-337.-Investigations have been carried out by ground tests simulating actual practice, with the view to elimination of vapour lock in fuel feed at high altitude. The effect of the following factors are discussed : dissolved air vapour pressure, fuel temperature, turbulence, velocity of fuel flow, rate of climb, altitude, vent line effects and heat transfer. Partial pressure equation graphs are shown for fuels of typical vapour pressure, as a means of prodicting critical altitude for simple fuel systems, also a curve of initial boiling points indicating temperatures and absolute pressures at which air-free fuel with a 7 lbs. p.s.i. Reid vapour pressure will probably boil. Reference is made to the variable fuel tank temperature and vapour evolution relative to external conditions. Flight temperature data obtained show, however, disparity in fuel temperature drop, e.g., 23° F., as compared with 13° F. at higher altitude. Diagrammatic plans of simulation equipment are shown and itemized. Use is made of a known bi-pump system of fuel feed incorporating a specially designed centrifugal pump. Although the simulation equipment is not an exact replica of an aeroplane fuel system, for primary research work, it has certain advantages. Three methods of test and results are described. J. F.

557. Use of Petroleum Products in Aircraft. F. D. Klein. J. Soc. aut. Engrs, 1943, 51 (9), 305-309.—A discussion, with graphical illustrations, of the variations in meteorological conditions under which aircraft operate, and hence the conditions that rule the specifications of fuels and lubricants.

Pressure is reduced to one-eighth of an atmosphere at 48,000 ft. altitude. This mainly affects vapour locking tendencies of the fuel system, but solubility of air in the hydraulic fluid and engine oil is also influenced.

It is stated that the greatest need in engine lubricant development is improved stability in order to reduce engine deposits. Detergent-type oils are effective in improving engine cleanliness and reducing ring-sticking.

Special addition agents are being used in aircraft fuels to increase full-power performance, and this has necessitated the use of corrosion resistant materials in the fuel system.

180 A

It is stated that grease lubrication can be accomplished with two grades: (1) a high-temperature grease for continuously operated units, subject to low temperatures for only short periods, and (2) a low-temperature grease, chiefly for intermittently operated units that are never subject to high temperatures.

Corrosion preventives for aircraft fall into two general classes, one for the protection of exterior surfaces of parts, and the other for interior protection of engines. They consist generally of a rust-inhibiting base incorporated in a liquid or solid vehicle, depending on the desired method of application and type of protective film. W. H. W.

558.* Preventive Maintenance and Inspection Procedure. Report by Sub-committee of S.A.E. Maintenance Mothods Co-ordinating Committee. J. Soc. aut. Engrs, 1943, 51 (9), 25-29.—War conditions, resulting in more severe operating conditions, shortage of trained mechanics and spare parts, has caused the vehicle owner and maintenance men to consider what must be done to keep vehicles in operating condition for the duration of the war, or until new equipment is available.

The practical application of a preventive maintenance and inspection procedure requires a simple, concise, and flexible system that will extend the life of the vehicle and save replacement parts and labour. To simplify the procedure, all important parts of the motor vehicle have been tabulated, divided into groups and systems, and arranged alphabetically to provide a quick, practical source of reference. Using a standard type of service, the mileage or time interval can be varied to fit the individual operating conditions, and still maintain a standard maintenance service. The number of mechanical failures on the road is the best indication as to how often the vehicle should be serviced. W. H. W.

559.* Cold-Starting Tests on Diesel Engines. H. R. Porter. J. Soc. aut. Engrs, 1943, 51 (10), 356.—The investigations described were initiated to determine the relative importance of diesel-engine variables and the effect of fuel properties, and to compare laboratory and service results on cold-starting performance. Tests indicated that cranking time is decreased with increased cranking speed, increase in temperature, and decrease in altitude. The delay cetane number gives an indication of the starting performance of undoped fuels, but is not a reliable guide in the case of doped fuels. Increase of cetane number results in greater ease of starting.

Various substances are effective as starting dopes, but it is suggested that an auxiliary applicator should be used, and that the effect of such dopes on maintenance should be determined. Among the additives used were chlorine, hydrogen sulphide, amyl nitrate, ethyl disulphide, and chloropicrin.

The fuels, equipment, and test procedure, together with the results, are described in detail. A. P.

560. Dust Problems in Military Vehicle Operation. L. F. Ovorholt. J. Soc. aut. Engrs, 1943, 51 (10), 381-384.—The operation of vehicles in heavy dust concentrations resulted in serious wear in engines, transmissions, and electrical equipment in proportion to the amount of quartz dust present. Tractor designers had long been concerned with these problems, but the conditions of operation, space, and accossibility, etc., present greater difficulties in the case of military vehicles.

Investigation showed the following to be desirable: (1) For the engine, an auxiliary air cleaner, in addition to the oil-bath type, with screened air inlet located in the zone of lowest dust concentration; (2) Total enclosure of transmission and electrical equipment; (3) the development of dirt-proof brakes, and (4) particular attention to be paid to radiator and fin design for liquid and air-cooled engines. A. T. L.

Coal and Shale.

561. Oil Shale and Shale Oil. Parts 1 and 2. B. H. Weil and Whitney Weinrich. Oil Gas J., 22.4.43, 41 (50), 48; 29.4.43, 41 (51), 73.—It is estimated that there is sufficient oil shale in the U.S.A. to produce over 100,000 million brl. of shale oil, from which it is possible to produce more than 60,000 million brl. of gasoline. Heavy war demands for petroleum, coupled with recent estimates of petroleum reserves in the U.S.A., have focussed attention once more on the possibility that shale oil production may before long become necessary and commercially practicable in America. The authors attempt to re-assess the position in terms of modern demands and modern production technique.

Oil shales occupy a position intermediate between coal and petroleum, with the H:C ratio of the shale kerogen approximating more closely to that of petroleum. The yield of oil may vary from about 5% up to 45% (the latter on Australian shale).

For the production of shale oil, low-temperature carbonization in some form of retort has invariably been used. The quality of the oil obtained is very largely characteristic of the particular shale, but improves as the rate of distillation is reduced. The yield increases as distillation rate is increased up to a certain point, and then falls away again. The shale oil is a mixture of primary decomposition products and of oils resulting from breakdown of these primary products. Hence redistillation is beneficial. Shale oils exist as paraffinic types, which resemble mixed-base petroleum oils, and as asphaltic types which are more closely related to certain coal tars.

Until recently, it was believed that solvent extraction of shales was impracticable, since the kerogen is virtually insoluble in organic solvents at atmospheric pressure. It has now been shown, however, that solvent extraction at high temperatures and under pressure may recover more oil than does carbonization. Suitable solvents include fuel oils, anthracene oil, and primary tars. Partial breakdown of the kerogen occurs. Complete or nearly complete recovery of the solvent may be attained, the extract being suitable for hydrogenation.

Direct hydrogenation of shale after crushing and mixing with heavy oil also gives higher yields than carbonization. The data on these new processes are not sufficient to say whether the increased yields will counterbalance possible difficulties.

The refining of shalo oil is still based on distillation followed by acid and soda treatment. The recovery of finished products is only about 80%. Experimental data show that modern cracking processes are applicable to shale oil and result in increased gasoline yields. Blends of straight and cracked shale gasolines vary from 55 to 70 O.N., with high lead susceptibility. Some authorities claim that shale gasolines may be produced with O.N. competing with gasolines from petroleum sources.

Hydrogenation of shale oil gives higher yields of products than any other process, and is said to succeed with high-sulphur oils which do not respond to other methods.

Recent estimates of all costs involved lead to an approximate figure of 0.75 to 1.50 per barrel for shale oil, and some authorities claim that gasoline might be produced for 2 cents per gallon.

"Thus, shale oil would seem to be approaching the era where large scale use may be possible . . .; it seems likely that the shale oil era has been hastened by the heavy demands for petroleum products occasioned by the war."

C. G. G.

Economics and Statistics.

562. Economics of Post-War Carriage of Air Cargo. J. V. Sheehan. J. Soc. aut. Engrs, 1943, 51 (10), 362-368.—A study of the factors to be considered in the dovelopment of post-war air cargo transport when cost will again be of paramount importance. The author states that a survey showed that 83% of the airline carriers favour cargo facilities in passenger planes, particularly for transcontinental and transoceanic operation, and even for feeder line service. For the lowest ton-mile costs, exclusive cargo planes are the ultimate goal, but the larger combination planes will doubtless prove most practical during initial stages of domestic cargo development.

Curves and charts showing the cost of operation of different size planes with varying power units indicate that the largest airplane operates at the lowest ton-mile cost. Speed is shown to be a factor in cargo haulage, and where speed is of major importance, twin-engined planes are most efficient. With four-engined planes takeoff weight must be limited so that landing weight is not exceeded on short ranges.

The twin-ongined plane has its best advantage under 250 miles, whereas the efficiency of the four-engined plane improves above this range, and at 500 miles a 20-mile difference in speed affected operating costs by about 5 cents a ton-mile, as compared with about 2 cents per ton-mile for a twin-engined plane. W. H. W.

BOOKS RECEIVED.

Journal of the Iron and Steel Institute. Vol. 47, No. 1, 1943. Proceedings, 1 P to 457 P. Survey of Literature, 1 A to 233 A, Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1.

International (Chemical and Export) Industry. Vol. 25, No. 3, March 1944. Leonard Hill, Ltd., 17, Stratford Place, London, W.1.

A monthly journal devoted to the initiation and development of productive industries in all countries, especially to the wider use, through chemical and engineering processes, of world mineral and agricultural resources—embracing the elimination of waste and the more enterprising utilization of by-products—simulating exploration and prospecting and the better exchange and use of raw and manufactured materials—above all promoting the fullost possible application of scientific discovery and technical advance for human progress.

British Standard No. 1152 : 1944.—Rolled Asphalt. Pp. 10. British Standards Institution, 28, Victoria Street, London, S.W.1. Price 2s. not.

A war emergency specification adapted from B.S. 594 and providing in one document for the use of aggregates of a wider range and variety than those in general use in pre-war days. The specification is designed to cover forms of asphalt construction varying from $\frac{3}{4}$ in. to $4\frac{1}{2}$ in. in thickness.

British Standard No. 308 : 1943.—Engineering Drawing Office Practice. Pp. 51 and 4 plates. British Standards Institution, 28, Victoria Street, London, S.W.1. Price 3s. 6d. net.

This specification supersedes B.S. 308: 1927. Former standard sizes of drawings and tracings have been rotained, and maximum frame or borderline sizes have been added. Three additional sizes and one minor alteration of size have been included.

It has been considered preferable to include references to other British Standards which are helpful to the designer and draughtsman rather than print extracts from them.

INSTITUTE NOTES.

APRIL 1944.

NEW MEMBERS.

The following elections have been made by the Council in accordance with the By-Laws, Sect IV, Para. 7.

Elections are subject to confirmation in accordance with the By-Laws, Sect. IV, Paras. 9 and 10.

As Fellows.

GLYDE, Harold Stanley.

HARRIES, Gwynne H.

As Members.

HULL, Charles. Lowe, Robert. Polson, Hector F. PARTRIDGE, Edwin Francis. SMITH, Ernest Daniel. YOUNG, John Paterson. HARDY, Alfred Cecil.

Transferred to Members.

HALL, John Desmond. HARDIMAN, Eric W. HITT, Donald George. NISSAN, Alfred H. THORN, Ernest George.

As Associate Members.

ASTON, Leslie. CAMPION, James Douglas. CROOK, Lionel J. FORD, George W. W. HARLAND, William Stanley. HUTCHINSON, Fred. KENZIE, Raphael G. KING, George. STEPHENSON, Maurice. TIGG, Thomas Hugh. TRIPCONY, Donald F. WYKES, Frederick/Edgar.

Transferred to Associate Member. CUDE, Arthur L.

As Students.

GARDINER, Michael A. R. HEBBERD, Richard S. H. LOXLEY, Michael J. STOUT, Kenneth R. LEIGHTON, William A. LYON, James Robert. MOCKFORD, Denis James. WATSON, Kenneth James. BARANY, George Martin. SMITH, Jack Kitson. PETTY, Donald Stuart. SHEARN, Ronald Bertram.

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

The following have applied for transfer or admission to the Institute. In accordance with the By-Laws, the proposals will not be considered until the lapse of at least one month after the publica-

INSTITUTE NOTES.

tion of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

The object of this information is to assist the Council in grading the candidate according to the class of membership.

The names of candidates' proposers and seconders are given in parentheses.

Membership.

- Collins, Charles Harnaman, Departmental Manager, Petroleum Board. (E. Evans-Jones; F. Tipler.)
- COOPER, David Wallace, Analytical Chemist, Williamson & Hogg, Ltd. (H. S. Williamson; A. R. Williamson.)
- KEMPTON, William J. H., Analytical Chemist, Silvertown Lubricants, Ltd. (L. O. Maskell; E. A. Evans.)
- JOHNSON, Christopher Hollis, Manager, Shell Refining & Marketing Co., Ltd. (R. I. Lewis; C. H. Barton.)
- MCNAMARA, Francis T., Laboratory Assistant, Trimpell, Ltd. (P. M. Griffiths; J. D. Hall.)
- MURRAY, George, Technical Representative, Shell-Mex & B.P., Ltd. (A. E. Hope; H. E. Priston.)
- SHELBROOKE, George Edward, Chemist, Sternol, Ltd. (A. L. Read; A. M. Nicholas.)
- THOMAS, David William, Works Chemist, National Oil Refineries, Ltd. (R. B. Southall; S. W. Cooke.)

Transfers.

JACKSON, George Gordon (Associate Member), Engineer. (J. M. Leitch.)

NEWTON, Ernest John (Associate Member), Ernest Newton & Co., Ltd. (R. D. Streeton; Percy K. Snow.)

WAELE, John Pierre Armand de (Student), Design Officer, R.E. (A. E. Dunstan; Ashley Carter.)

PERSONAL.

We congratulate Professor V. C. Illing on having been awarded the Murchison Medal by the Geological Society for "his talented contribution to oil geology and palaeozoic stratigraphy."

INSTITUTE NOTES.

FORTHCOMING MEETINGS. AT 26, PORTLAND PLACE, W.I.

Friday, 28th April.

il. 31st Annual General Meeting.

"Geo-physical Methods Applied to Oil Prospecting," by Dr. J. McGarva Bruckshaw.

Tuesday, 9th May. Tuesday, 13th June. "Mountains and Oil," by Dr. J. V. Harrison.

"The Oil Prospects of Portugal," by A. Beeby Thompson, O.B.E.

ARTHUR W. EASTLAKE, ASHLEY CARTER. Joint Honorary Secretaries.

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.



MANUFACTURING COMPANY BROOK HOUSE, PARK LANE, LONDON, W.I Telephone : Mayfair 3067-B Cables : "Nordberg London"



MEASUREMENT OF OIL IN BULK

(STANDARD WEIGHTS AND MEASURES)

A report on the Imperial, U.S.A. and Metric Fundamental Units of Weight and Measure, together with a Table of Recommended Contracted Ratios for the interrelation of units in general use in the petroleum industry.

> Price 2s. 6d. post free Obtainable from : THE INSTITUTE OF PETROLEUM 26, Portland Place, London, W. I.

LIST OF ADVERTISERS

PAGE

AUDIEV ENGINEERING CO LTD							
RADDOR & WHON LTD						••••	
DABLOCK & WILLON, MID							Harris
W B BUTTERETED LTD							
A E CRAIG & Co LTD							will
Empericov & Empeon Imp	••••						V 111
FERGUSON & TIMPSON, MID					•••		
FOSTER INSTRUMENT CO., DID.	• • •						
FOSTER WHEELER, LTD	•••						XV
NOXBORO-IUXALL, LID							
W. J. FRASER & CO., LTD	•••			•••		•••	
GRIFFIN & TATLOCK, LTD	•••					•••	XIII
HADFIELDS, LTD	•••			•••	• • • •	•••	v
G. A. HARVEY & CO., (LONDON), L	TD.	***	•••				
HEAD, WRIGHTSON & CO., LTD.	•••	•••				***	vi
H.M. CONTINUOUS PLANT, LTD.	***						vii
W. C. HOLMES & CO., LTD							X
HYDRONYL SYNDICATE, LTD			***	•••			
ROBERT JENKINS & CO., LTD.							xi
GEORGE KENT, LTD							xix
LEGRAND SUTCLIFF AND GELL, LTD							
LUMMUS Co						Insl	de back cover
NATIONAL SUPPLY CORPORATION							ix
NORDBERG MANUFACTURING CO.							lii
OIL WELL SUPPLY CO							Back cover
OXLEY ENGINEERING CO., LTD.							XX
SENIOR ECONOMISERS, LTD							
JOHN G. STEIN & CO., LTD							xvi
STEWARTS AND LLOYDS, LTD.							
TINTOMETER, LTD							ív
TYLORS, LTD							
WHESSOR FOUNDRY AND ENGINEER	RING	Co., LT	D.				TI
WORTHINGTON-SIMPSON, LTD.							TI
in our date of ball borry bibi							1 1 1



Kindly mention this Journal when communicating with Advertisers.



WORTHINGTON-SIMPSON PUMPS FOR PIPE LINE AND REFINERY SERVICE



Worthington-Simpson have had long Experience in designing and building special pumps to suit this service.

Power driven or Direct Acting Steam Driven Pumps for Crude Oil, Gas Oil, Heavy Wax Distillate and Reflux, Residue and Blending duties, for both Atmospheric and Vacuum operation. High Efficiency Centrifugal Pumps for highest pressures and temperatures.

Rotary Gear Pumps with Double Helical Rotors.

Steam Jet Air Ejectors.

De-Waxing and Heat Exchange Auxiliaries.

WORTHINGTON-SIMPSON LTD., NEWARK-ON-TRENT

CONTINUOUS WASHING

Holley Mott Plants are efficiently and continuously washing millions of gallons of Petroleum products daily. Designed for any capacity. May we submit schemes to suit your needs?

MOTT

Telegrams : " Typhagitor, Fen, London." Telephone: Royal 7371/2.

World-Wide Licensees, H.M. CONTINUOUS PLANT LTD FOUR LLOYDS AVENUE, LONDON, E.C. 3.

Continuous Counter-Current Plant

HOLLEY(HM)

CRAIG OIL REFINERIES

A^S all our Departments are fully employed on work of national Importance, we regret that for the present we are only in a position to deal, to a very limited extent, with our normal production of Oil Refining Plant.

We, however, have pleasure in informing our many old and valued customers that our technical staff is still with us, and we are keeping in close touch with our American Associates, THE WINKLER-KOCH ENGINEERING COMPANY, WICHITA, U.S.A., on all matters of recent development touching the most modern Processes of Oil Refining.

On the termination of hostilities, we will be in the position to deal with all problems of development and reconstruction, on which clients desire to consult us.

A. F. CRAIG & CO., LTD. CALEDONIA ENGINEERING WORKS PAISLEY SCOTLAND

Kindly mention this Journal when communicating with Advertisers.

Telephone: Kelvin 4756



FE-27½ B ROTARY MACHINE

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

N.S. CO. Id<u>ea</u>l

SPECIFICATION INCLUDES :

Table and hold-down ball bearings. Pinion shaft roller bearings.

One-piece steel base providing oil reservoirs.

Table ring gear of alloy steel with machine-cut teeth, shrunk on table.

Table ring safety guard, &c., &c.

Other sizes and types of rotary tables are available for all purposes.





The 'HARRISON' PURGING MACHINE

gives a supply of Inert Gas consistent in quality and at low cost for the purging of Oil Stills, Tanks, Pipe Lines and Hydrogen Producers.

Inert Gas from these machines is also extensively used for blanketing Oil Storage Tanks and Vacuum Filters in solvent de-waxing processes.

SAFER & CHEAPER THAN STEAM

CONNERSVILLE BLOWERS

deliver a positive reliable and oil free supply of Air or Gas economically and efficiently. Absence of internal contact ensures long life, low maintenance and continuous operation over long periods.

≈ 185=

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



Also at 21 BENNETT'S HILL, BIRMINGHAM 2. Telephone : Midland 6830. Telegrams "Biprodeng," Birmingham.





GUM (EXISTENT) IN MOTOR FUEL, ETC.

IP38/44(T)



This method is designed to determine the amount of gum existent at the time of test in motor fuel.

The apparatus comprises a water-bath fitted with flame-proof electric heaters. Provision is made for the accommodation of four sample dishes. A jet manifold, with manometer, is fitted and by connection of an external source of compressed air at low pressure delivered from jets 4 cm. above the surface the sample is evaporated. The increase in weight of the tared dish is determined to the nearest 0.1 mgm.

Petroleum testing equipment of all kinds supplied. Please specify your requirements.



STANDARD METHODS

FOR TESTING

PETROLEUM AND ITS PRODUCTS

(FIFTH EDITION-1944)

This new edition of "Standard Methods" contains twenty-four new methods of test. New matter includes a low temperature filtration test for gas oils and diesel fuels, the Fraass breaking point test for Bitumen, and a method for determining the water tolerance of a motor fuel.

An innovation is the inclusion of a series of methods for testing bituminous emulsions and chemicals derived from petroleum.

The Sampling methods have been completely revised, and major alterations have been made in seventeen methods, including Acidity, Colour (Lovibond), Free Acid and Alkali in Grease, Oxidation of Lubricating Oils, and Reid Vapour Pressure.

Specifications for wartime hydrometers and thermometers are included, and the "Appendix" has been enlarged by the addition of a standard scheme for evaluating crude oils and a vapour pressure/temperature nomograph for hydrocarbons.

500 pages-127 diagrams

Price 15s., post free (U.S.A. \$3.00)

Published by

THE INSTITUTE OF PETROLEUM 26 PORTLAND PLACE, LONDON, W.I

Obtainable also from

AMERICAN SOCIETY FOR TESTING MATERIALS 260 SO. BROAD STREET, PHILADELPHIA, PA., U.S.A.

Kindly mention this Journal when communicating with Advertisers.

xiv



We offer RESEARCH DEVELOPMENT PROCESS DESIGN ENGINEERING FABRICATION CONSTRUCTION OPERATION

for

PETROLEUM REFINERY EQUIPMENT ranging from

INDIVIDUAL HEAT EXCHANGERS

COMPLETE REFINERIES



For Oil -Fired Furnaces

NETTLE (42/44%Al₂O₃) Firebrick is Highly Refractory (Seger Cone 34/35) and combines Resistance to Spalling and Corrosion with Volume-Stability and Accuracy of Shape. Jointed with "NETTLE" Refractory Cement, it is recommended with confidence for Oil-Fired Furnace Linings.

In cases where exceptionally high temperatures are experienced, we recommend "STEIN SILLIMANITE" $(62/63\%A1_2O_3)$ and where conditions are easier. "THISTLE" $(35/37\%A1_2O_3)$ Firebrick.

STEIN

of from SELECTED RAW MATERIALS

UNDER CAREFUL CONTROL

ies

JOHN G.STEIN & CO. LTD. BONNYBRIDGE, SCOTLAND

FORD CUP VISCOMETER

B.T.L. IMPROVED MODEL

For the VISCOSITY MEASUREMENT OF OILS, PAINTS, VARNISHES, LACQUERS, AND ENAMELS

A robust and serviceable instrument designed for use in workshop or laboratory.

• Gun metal cup, silver plated inside and out.

- Four different sizes of orifice to meet varying requirements.
- Protective sleeve around orifice to safeguard from damage.
- Convenient stand with adjustable ring support, levelling screws and spirit level.

Full particulars on request

BAIRD & TATLOCK (LONDON) LTD. Makers of Scientific Apparatus, 14-17 ST. CROSS STREET, LONDON, E.C.1



مر الدر الدر الار الار

BUTTERFIELD Road Tanks



IN MILD STEEL Stainless steel And Aluminium

For safe, speedy, economical transport of bulk supplies of petroleum and fuel oil.

W. P. BUTTERFIELD LTD. Head Office: SHIPLEY, YORKS. Telephone - Shipley 851 (5 lines) London : Africa House, Kingsway, W.C.2 Telephone HOLborn 1449

BRANCHES: Belfast, Birmingham, Cardiff, Dublin, Glasgow, Liverpool, Manchester, Newcastle upon Tyne, Nottingham.

KENT CONTROLLERS

0 0



Kent Controllers, air-operated, hydraulic or electrical, as may be required.

These controllers are extensively employed for the control of flow, pressure, temperature, pH, liquid level, flow ratio, specific gravity and for the automatic control of boilers.

They embody the Kent standard of workmanship and design.



GEORGE KENT LTD. LUTON, BEDFORDSHIRE. LONDON OFFICE: 200 High Holborn, W.C.I. Agents: MELBOURNE: George Kent (Victoria), Pty. Ltd., 129, William Street. PORT-OF-SPAIN, TRINIDAD: Davidson-Arnott & Co., Union Club Buildings. BUENOS AIRES, ARGENTINE: Evans, Thornton & Co., 465 Calle de Fensa.

