afferent nerves thus have the double function of (1) contributing to the excitation of the cells in the respiratory center, and (2) of controlling the movements of the muscles arising from this excitation. While it is undoubtedly true that the respiratory center may act automatically under conditions which preclude the effect of afferent impulses[6] it is our opinion that its normal activity is not wholly automatic but partly reflex.

F. H. PIKE
HELEN C. COOMBS
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THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY. II

The application of certain commercial dyes to the reductase test on milk: MINNIE F. DRESSLAR and H. A. WEBB. The decolorization of methylene blue by the reductases in milk furnishes a rapid approximate determination of its bacterial age. In order to make the test more convenient for bakers, grocers, restaurant keepers, cooking classes or housewives, who might wish to test milk claimed to be fresh on delivery, eighty-four dyestuffs sold under trade names for household use were tested. By a series of eliminations, the most satisfactory ones were determined, eight in number. They are: "Diamond Dyes" (wool and silk), cardinal, garnet, orange, turkey red; "Rit" dyes, blue, flesh, lavender, red. The decolorization times, which vary for each, but are reasonable, and the effect on various types of milk-whole, skimmer, cream, pasteurized, boiled, malted, condensed, evaporated, were determined. Suggestions for the use of the test by non-technical people are given.

Data on the thickening of condensed milk: ALAN LEIGHTON and COURTLAND S. MUDGE.

Use of frozen eggs in mayonnaise: S. K. ROBINSON. Comparisons between the fresh and frozen eggs were made on batches of mayonnaise. No difference in the product was noticeable, immediately after preparation. Both products were well emulsified and had good body. The following physical tests were then applied: microscopical examination, freezing test, incubation, shaking test and effect of air and light. Not any of these tests put the frozen egg product at a disadvantage. Mayonnaise made from frozen eggs held well in a warm room for thirty days.

Changes in hens' eggs stored in water glass and in lime solutions: F. C. COOK and J. B. WILSON. Strictly fresh and commercial eggs, which were preserved in water glass (1-10, 1-13 and 1-20) and saturated lime solutions. Separate jars of each were stored in the laboratory and in a cellar. At the beginning of the experiment and after various periods samples of the eggs were examined physically, bacteriologically and chemically. Best results were obtained by holding strictly fresh eggs in a 1-10 water glass solution at cellar temperature. Changes of considerable magnitude were found in water, ash and nitrogen contents of both whites and yolks. Bacteria were not found to be a factor in deterioration. Ammonia nitrogen and acidity of fat proved to be the best indices of decomposition.

Manganese, aluminium and iron ratio as related to soil toxicity: R. H. CARR and P. H. BREWER. Much emphasis has been given in the past to the isolation of organic toxins which were thought to be the cause of soil toxicity, while in more recent times the trend of investigation has been turned more specifically to soil acidity as the reason for poor crop yield. Investigations which have been conducted on a large variety of soils using the potassium thiocyanate method for soil acidity and toxicity, described by one of the writers, indicates that the cause of infertility of many soils, supplied with sufficient plant food, is due to the presence of soluble manganese compounds in some cases, to aluminum compounds in other instances and sometimes to a combination of the two. The toxicity of soluble iron is not so apparent, as it is usually associated with a considerable quantity of soluble aluminum in an acid soil. The potassium thiocyanate method has been found helpful in this study, because of the color changes taking place when these elements are present in the soil in easily soluble form. If the soil is more acid than p_H 5.5 a red color of ferric thiocyanate is produced in the presence of soluble ferric iron and if this soil solution containing manganese is made slightly more basic, a green color will develop in the liquor. The depth of the color will be proportional to the amount of manganese in the soil solution. This color begins to form when the soil contains about 0.008 per cent. of soluble manganese. The green color will be found associated with nonproductive acid soils, and since it is shown that manganese does not precipitate as a hydroxide until a p_H of about 7.9 is reached,

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[6] Stewart, G. N., and Pike, F. H., *Am. Journ. Physiol.*, 1907, xix, 328.

a large amount of limestone (8 to 10 tons in addition to that required to remove the red color) will be required. In some instances the cost of this large amount may be prohibitive.

The effect of selenium compounds upon the growth and germination of plants: VICTOR E. LEVINE. The findings of Gassmann (*zs. Physiol-Chem.*, 1917, 100, 209) that selenium is a constituent of plants has led to the inquiry as to the effect of selenium compounds upon germination and growth. White lupine and timothy seedlings were used in the experiments. Concentrations of 0.001 per cent. to 0.0001 per cent. show no injurious effect; in some experiments these concentrations favor growth. Concentrations of 0.01 per cent. and over are exceedingly inimical to germination and to growth. The compounds may be arranged as follows in the order of diminishing toxicity: selenious acid, selenic acid, sodium selenite, sodium selenate and potassium selenocyanate. This order agrees well with that obtained with animal experiments testing the relative toxicity of these compounds. It is evident from the results obtained that selenium can not replace sulfur in the nutrition of plants.

The determination of nitric nitrogen in the soil solution: WALTER THOMAS. The determination of nitric nitrogen is the *bête noir* of the soils chemist. Inasmuch as the phenoldisulfonic acid method is the one that is the simplest and most rapid, and therefore more generally used by soil chemists than any other, the author has carried out some experiments on the effect of various flocculating and clarifying agents under carefully controlled conditions by this method and compared the results with the Devarda reduction method, which is the only one that has escaped serious criticism. The results obtained by different investigators have been very conflicting, but the results of the present investigation indicate that: (1) The use of either potash alum or alumina cream (even if neutral) results in large losses of NO_3; (2) CaO if freshly ignited is the most satisfactory flocculating and clarifying agent; (3) The Devarda alloy method gives excellent results on the soil solution, but is not applicable to rapid routine work.

DIVISION OF FERTILIZER CHEMISTRY

F. B. Carpenter, *chairman*
H. C. Moore, *secretary*

Water-soluble nitrogen in mixed fertilizers: R. N. BRACKETT.

Studies on the availability of organic nitrogenous compounds: C. S. ROBINSON.

Review of methods of determining nitrogen in fertilizer: E. W. MAGRUDER.

Possibilities in the use and preparation of concentrated fertilizers: WILLIAM H. ROSS. The Haber and other processes for fixing nitrogen and the volatilization method of preparing phosphoric acid all yield materials, directly or by combination, of different composition and higher concentration than those ordinarily used in the manufacture of fertilizers. Some of these materials, as ammonium phosphate, have chemical and physical properties which make them admirably suited for mixing with ordinary fertilizer materials, or for making mixed fertilizers of higher concentration than any now in use. Others, as ammonium nitrate, can not be satisfactorily used in present fertilizer mixtures unless means can be devised for eliminating or neutralizing properties which interfere with their use in this way. The work of the Bureau of Soils on concentrated fertilizers and fertilizer materials was therefore undertaken not with a view to replacing the ordinary fertilizer materials, nor of providing high quality fertilizers which would command higher prices per unit, but rather with the double purpose of devising means of utilizing new sources of fertilizer materials and of decreasing the cost of handling and transporting fertilizers by increasing the concentration of mixtures which require shipment to a distance. The advantages and disadvantages of low-grade fertilizer mixtures are discussed and a review given of progress made in the preparation of concentrated fertilizer materials.

Recent investigations on the oxidation of sulfur by micro-organisms: J. G. LIPMAN. There has been isolated at the New Jersey Agricultural Experiment Station a new sulfur-oxidizing organism which has been named *Thiobacillus thioxidans*. This organism grows readily in purely inorganic media containing, aside from the usual mineral salts, elementary sulfur. It derives its energy from the oxidation of sulfur and obtains its carbon from carbon dioxide. It will grow readily in a medium having a hydrogen-ion concentration of 4.0 to 5.0 and will continue to multiply when the hydrogen-ion concentration exponent is below 1.0. The sulfur is oxidized by this organism to sulfuric acid. The acid so produced may be utilized for a variety of purposes. Mixtures of mineral phosphates and sulfur, properly inoculated with *Thiobacillus thioxidans*, will be converted into acid phosphate. Inoculated sulfur added to the soil will increase its acidity to a point where certain objectionable fungi, like those producing scab of potatoes and scurf of sweet potatoes, may be largely if not entirely suppressed. The transformation of sodium carbonate, present in excessive amounts in so-called black alkali soils, into sodium sulfate may be similarly accomplished. The direct use of inoculated sulfur for the purpose of supplying sulfates where these may be present in inadequate amounts, or the use of the same material for the production of potassium sulfate from greensand marl is indicated. The elimination of soil-infesting insects, or nematodes and of undesirable vegetation may also be accomplished by means of sulfur inoculated with cultures of *Thiobacillus thioxidans.*

Trend of modern fertilizer plant construction: Peter S. Gilchrist. This paper will deal with the construction features of up-to-date fertilizer plants, including types of buildings, materials for building construction, equipment for plants and the relation of equipment to the building. Especial attention will be given to the design of plants with the necessary equipment for the economical handling of materials, silos or storage bins for storing phosphate rock, air separation for ground rock, the development of mechanical dens for making acid phosphate and economical methods of manipulating and bagging finished goods.

Modern trend in fertilizer plant operation: E. H. Armstrong. The manufacture of sulfuric acid as the basis of the fertilizer industry. A brief résumé of this subject, giving developments from its inception to the present time. A brief discussion of the present methods pursued in operating a modern sulfuric acid plant. A short discussion of the developments in acid phosphate manufacture, together with a review of the more modern methods and the trend toward finer grinding, emphasizing the necessity for close chemical control. A comparison of the old and new ways of mixing fertilizer, showing the tendency towards larger mixing units and a better conception of the necessity for more methodical sampling and for coordination between operating and analytical departments to insure closer analyses.

Modern trend of chemical control in the fertilizer industry: H. C. Moore. Chemical control involves the practical application of chemical phenomena and laws to the manufacturing operation, thereby directing or restraining influences as conditions require. Chemical control is not chemical analyses alone, but is the sum total of chemical analyses, chemical knowledge and practical experience and the correlation and application of these with the problems at hand. Chemical control has pointed the way to remarkable economy in the manufacture of sulfuric acid; to economic progress and a greatly improved product in the manufacture of acid phosphate; and to the cost, mechanical condition and quality in the manufacture of mixed fertilizers. The modern trend of chemical control in the fertilizer industry is to substitute knowing for guessing; to learn the best working conditions for each type of plant, and the materials and mixtures it is required to use or make; to determine the best and most economical combinations of materials to be used in the manufacture of fertilizer; to determine the best methods of formulating and using the materials so selected; to determine the general crop needs and materials most suitable for supplying it; to determine the combination of materials which must be avoided or if possible to see how this may best be done; to determine the best means of avoiding large unit losses of materials, of preventing analytical discrepancies and of sampling all products to insure reliable analytical results. Thus chemical control properly becomes both the governor and safety valve on the whole machinery of the fertilizer industry.

Modern trend in state fertilizer control: Andrew J. Patten.

Modern trend in fertilizer legislation: J. E. Breckenridge.

Modern trend in fertilizer experimentation: Dr. H. J. Wheeler. Fertilizer experiments at Rothamsted on permanent meadows, at Rhode Island on limed and unlimed soils and with different phosphates and potash salts, coupled with similar experience elsewhere, and the studies of lime-magnesia ratios, of the different effects of iron, magnesia and of manganese, boron, strontium, barium, lithium and other elements not usually considered plant foods have shown the necessity for intensive study of the physical, chemical and biological conditions best adapted to each kind of plant. At the same time, the relation of soil colloids to problems of fertilization and plant nutrition has been especially emphasized. Future investigators will study thoroughly physical and biological soil properties as related to fertilization, correlating them more closely than before with individual plant requirements and adaptations.

The determination of potash in mixed fertilizers: F. B. Carpenter. A brief review of the methods for the determination of potash in mixed fertilizers prior to the adoption of the Lindo-

Gladding method as official by the Association of Official Agricultural Chemists, with modifications which have been made since. The official method, although popular with analysts, gives low results and suggestions are made as to modifications, which may be used to recover all the available potash. It is recommended that the fertilizer division take up the matter and work out an accurate method, which will be acceptable to the Association of Official Agricultural Chemists.

Some sources of error in the determination of insoluble phosphoric acid in acid phosphate and fertilizers: W. R. Austin.

Some sources of error in the determination of total phosphoric acid in acid phosphate and fertilizers: W. R. Austin.

A qualitative scheme for the detection of cyanamide and related compounds: G. H. Buchanan. Quantitative methods for the determination of cyanamide and its transformation products are only of value when preceded by a reliable qualitative examination. A qualitative scheme is presented, modeled after the ordinary schemes of inorganic analysis, whereby ten forms of nitrogen which are commercially related to cyanamide may be detected. Provision is made for the interference of the more common inorganic radicles. The ten forms included in the scheme are as follows: (1) Ammonia and its salts; (2) Cyanamide; (3) Hydrocyanic acid and its salts; (4) Dicyandiamide; (5) Guanidine and its salts; (6) Quanylurea and its salts; (7) Nitric acid and its salts; (8) Thiocyanic acid and its salts; (9) Thiourea; (10) Urea. Comments relating to the behavior of several other less common nitrogenous forms are also made.

The importance of correct methods of applying fertilizer: E. J. Pranke. Faulty methods of applying fertilizer in the seed row in direct contact with the seed frequently causes visible damage to the crops, for which the grower often seeks to recover compensation from the fertilizer manufacturers. There is probably also a great deal of invisible damage caused by improper method of applying fertilizer. The effect of the relative position of seed and fertilizer on the efficiency of the latter, as developed in extensive researches conducted during the past three or four years, is discussed.

Fertilization in relation to plant composition: H. A. Noyes. Mention was made of different methods of testing the fertilizer requirements of soils. A study of these methods showed that the users of fertilizers measure results, almost entirely, on the increases in the marketable portions of the crop grown. There are many reports of increased crops resulting from fertilization but very little information of the character and composition of the plants. Industries which manufacture food-stuffs from grains and fruits find the control of their finished products difficult, due *to immense variations in the composition of the grains and fruits which serve as their raw materials.* Data was presented showing that large variations exist in the composition of two economic plants. A plea was made for a study of the optimum analyses for each economic agricultural crop. Such a study would cause fertilizer results to be judged in terms of variations toward or away from the optimum analyses. As a result of a long series of investigations of one crop under field conditions the following hypothesis was evolved. *When the optimum composition for any two parts of a plant is worked out it will be possible to determine how to fertilize the soil by studying the ratio that exists between the analysis of the different portions of the plant.*

Replacement of plant food adsorbed by the hydrogels of ferric oxide and alumina: A. L. Flenner, A. L. Lichtenwalner and N. E. Gordon. The hydrogels of ferric oxide and alumina were allowed to suffer their maximum adsorption of salts. When this equilibrium had been reached the gels were subjected to successive washings with distilled water, and when 50 cc. of the filtrate failed to give more than a very slight test for the adsorbed salt, the gel was subjected to washings with various acid, base and salt solutions, and the resulting filtrates analyzed for the respective salts. Analysis of the gel was made at each change of the leaching solution.

Can plants use salts adsorbed by soil colloids: R. C. Wiley and N. E. Gordon. Experimental work was started in order to find if plants were able to use salts which had been adsorbed by soil colloids. The soil colloids were artificially prepared, and after they had suffered a maximum adsorption of the various salts used in plant nutrition work, the plants were allowed to root and grow in the colloids. After a certain period of growth the plants were analyzed for the quantity of different elements which the plants had been able to take up from the colloids.

Utilization of waste products for organic nitrogen: E. H. Armstrong. The comparative abundance of materials carrying organic nitrogen in available form which were to be had in the early stages of the fertilizer industry; the gradual withdrawal of these from the fertilizer materials market to the feed market; the use of part mineral ammoniates and part organic ammoniates to offset this shortage; the necessity of conserving all waste materials carrying organic nitrogen and of developing methods to render available the nitrogen in such inert materials as leather, hair, etc.; a description of the manufacture of leather meal, its undesirability and a comparison of the European and American products; a refutation of the general understanding that the nitrogen in the inert materials can not be made soluble without loss of ammonia, and the reference to a high class product which can be used in any quantity; a discussion of garbage tankage and other waste.

DIVISION OF PETROLEUM CHEMISTRY

T. G. Delbridge, *chairman*
W. A. Gruse, *secretary*

The vapor pressure of solutions of benzol, hexane and cyclohexane in lubricating, gas absorbent and vegetable oils, with molecular weight data: ROBERT B. WILSON and EDWARD P. WYLDE. A knowledge of the vapor pressure of volatile solvents, such as benzol and hexane, dissolved in various types of relatively non-volatile oils, is of commercial importance in a considerable number of applications. Of these the three most important are (*a*) the dilution of crank-case oils with fuels in internal combustion engines; (*b*) the complete removal of volatile solvents from oils and fats obtained by the solvent extraction processes; and (*c*) the recovery of solvents by scrubbing with cold absorbent oils, as in benzol recovery from coal gas. It was the object of the work described in this paper to make possible such generalizations and approximate calculations for the three general types of volatile hydrocarbons—paraffin, napthene, and aromatic—dissolved in most ordinary types of oils. Molecular weights were determined on all of the oils used, and the amount of vapor pressure lowering for different combinations was compared with the theoretical as predicted by Raoult's law. It appears that the amount of lowering produced by different types of combinations is fairly definitely predictable and that the results for any combination met with in practice can be calculated with quite satisfactory accuracy for any ordinary temperature if the vapor pressure of the pure volatile constituent is accurately known, together with the molecular weight and type of hydrocarbons present in the oil. Molecular weight data included in the article is also of interest in being the first published data on a fairly wide range of the higher mineral oil fractions, the results having been obtained by measuring the freezing point lowering in benzol.

Further data on the measurement of the effective volatility of motor fuels: ROBERT E. WILSON and DANIEL P. BARNARD, 4th. This paper is an extension of the work presented at the Rochester Section where some new methods of determining the effective volatility were described and the results on three typical fuels presented in some detail. This work has been extended to more than a dozen fuels in this laboratory and this, combined with data obtained in other laboratories, makes it possible to draw certain generalizations as to the effect of the shape of the distillation curve on the effective volatility of the fuel in so far as it affects the completeness of vaporization and proper distribution in the manifold. In the light of these investigations, the writers believe that a single specification for the 85 per cent. point should replace all the present limitations at 50, 90 and 96 per cent., and, similarly, that the effective starting volatility can best be measured as a routine proposition by a specification at the 25 per cent. point rather than at the 5 per cent. or initial point.

Some applications of vapor pressure measurements: HAROLD S. DAVIS. An improved differential-pressure apparatus for measuring vapor pressure is described. The apparatus can be successfully applied to the control of light oil recovery plants. Actual data from plant tests are given. It has been suggested that oils could be standardized for efficiency in gas absorption by preparing solutions containing the same concentration of benzene and measuring their vapor tensions. Experiments on seven representative absorbent oils have shown no appreciable differences between them in this respect, and practical variations in their efficiencies must be attributed to other factors rather than to their ability to lower the vapor tensions of dissolved benzene. Some applications of vapor pressure measurements in gasoline recovery are discussed.

A rapid test for the decolorizing efficiency of fuller's earth: LEON W. PARSONS and LEONARD R. CHURCHILL. The paper covers the development of a rapid test for determining the relative efficiencies of various samples of fuller's earth for decolorizing purposes. This test was desired to avoid the necessity for resorting to tedious filtration processes in the laboratory to determine the quality of the clay, and it serves two purposes: first, to compare the decolorizing power of various clays used in experimental investigations; and second, to serve as a rapid control test for plant operation. A survey of the properties of fuller's earth which would parallel its power to decolorize oils is given and the development of several different tests is indicated. The most satisfactory test, however, is based on the reaction between fuller's earth and pinene. Fuller's earth reacts vigorously with pinene to form polymerized products with the development of a very large amount of heat. The amount of temperature rise is used as a measure of the efficiency of the clays and data is given to show the relation between this pinene efficiency and the decolorizing power of such clays. A discussion of the mechanism of the reaction, the materials used and the application of the test for laboratory and plant use is indicated.

Effect of certain physical and chemical properties of emulsifying agents on the stability of oil-water emulsions: Leon W. Parsons and Brian Mead. This paper embodies further studies on Nujol-water emulsions and a comparison of these systems and commercial mineral oil emulsions. The technique of investigating these emulsions, making use of microphotographic apparatus and the ultra-microscope, is given. A study has been made of the following factors of extreme importance in connection with the stability of emulsions: Physical characteristics of emulsifying agents; effect of opposing emulsifying agents in the same system; action of oil soluble colloids on the emulsifying agents; and similarity between behavior of soaps and of finely divided solids. The importance of relative wetting of the different phases by the emulsifying agent is emphasized and it has been found that several common emulsifying agents give abnormal results with regard to type of emulsions produced. This latter observation has important bearing on the mechanism of the behavior of soaps and finely divided solids as emulsifying agents. Certain parallelisms have been observed between the behavior of the emulsifying agents used for Nujol-water systems and those present in commercial oil emulsions.

Engine experiment with high sulfur fuels: Carl O. Johns. These experiments were conducted by Professor George Winchester, formerly in charge of the Engine Research Laboratory of the Standard Oil Company of New Jersey. A Hvid type of Diesel engine ("Thermoil") was used. Several fuels were tested to ascertain the effect of both free and organic sulfur. The runs were continued for 384 hours. The fuels included high sulfur Mexican crude and gas oil, and mixtures of these with a polymer oil containing about 19 per cent. of combined sulfur, or 10 per cent. of sulfur in the mixed fuel. The running time for these fuels was 180 hours. The compression in the engine reached 500 pounds. A run of 204 hours duration was made with kerosene containing 0.85 per cent. of free sulfur in solution. Frequent examinations of the dismantled engine disclosed no evidences of corrosion, nor was the copper tubing affected appreciably. Trouble was encountered by the excessive formation of carbon which deposited on the exhaust valve and clogged the spray holes to the cylinders.

Gasoline saved on government trucks due to adjusting the carburetors by gas analysis: G. W. Jones and A. O. Fieldner. Carburetor adjustments by exhaust gas analysis on 15 trucks, varying from 2½ to 7½ tons capacity, showed that all but one were too richly adjusted for maximum power and economy. The adjustments made gave an increase of over 20 per cent. in mileage for the first month after testing and 16 per cent. increase for the second month. The CO_2 indicator used for making the adjustments while the trucks were operated was found to be practical and easily operated by the laymen inexperienced in the handling of chemical apparatus. An analysis of the exhaust gas under the conditions which the truck is operated gives an absolute indication of the carburetor adjustment and removes all guess-work. By adjustment for maximum power and economy is meant the leanest adjustment without reduction of power.

Some factors affecting the accuracy of Saybolt viscosity measurement and their control: P. E. Klopsteg and W. H. Stannard. Without a suitable form of automatic temperature control, it is impossible to secure experimental conditions which conform to A. S. T. M. specifications, namely, that "the bath shall be held constant within 0.25° F. (0.14° C) at such a temperature as will maintain the desired temperature in the standard oil tube." At any rate, the requirements can not be met with the form of bath described in the specifications. In this paper, the development is described of an electric heating and regulating device which at a temperature of 212° F. (100° C.) will hold the bath temperature constant within 0.1° F. (.05° C.) throughout an entire day's run without attention. Conditions within the oil tube are also considered, and it is shown that when the A. S. T. M. method of stirring is followed, even with the bath temperature very constant at 212° F., variations of 0.5° F. are observable on a sufficiently sensitive stirring thermometer. A method of stirring is then described by means of which it was found possible to hold the temperature of the sample under test constant to 0.01° F. over a period of many minutes. Tabulated data show the Saybolt readings at different temperatures, for samples tested under "standard" conditions, and with the new apparatus.

Cracking of unsaturated hydrocarbons by heat to give saturated hydrocarbons: RALPH H. MCKEE and RALPH T. GOODWIN. The real liquid fuel reserve of America is in its oil shale deposits. In a study of oil shale we have found that distillation in vacuum gives an intermediate product which on heating gives over into petroleum. A study of this intermediate from various oil shales shows it always to be highly unsaturated (dissolved by 66° Be sulfuric), sometimes 100 per cent. unsaturated. If this waxy intermediate is distilled at atmospheric pressure, there is obtained a petroleum containing 48 per cent. saturated hydrocarbons. Redistillation brings about additional cracking with a further increase of the percentage of saturated hydrocarbons. Ordinarily we expect the cracking of hydrocarbons to proceed with increase of unsaturated constituents but here we have the reverse, the unsaturated constituents decreased 48 per cent. on the first distillation and still more on redistillation.

The refining of gasoline and kerosene by hypochlorite solutions: A. E. DUNSTAN and B. T. BROOKS. The present paper is a description of the process developed and perfected by A. E. Dunstan and his associates in the Anglo-Persian Oil Company. It is the first successful industrial utilization of hypochlorite solution for refining of petroleum oils. Gasoline and kerosene may be refined in this way with treating losses of less than one half of one per cent. Malodorous compounds, including sulfur derivatives, are removed. The treated oil is free from chlorine, is free from substances which develop acidity, gummy substances or discolorations on standing, and it eliminates obnoxious waste products, such as acid tar, eliminates acid recovery and the process can be carried out in the usual form of treating apparatus. The new method, therefore, is cleaner and easier to operate, gives a much better refined product, and the refining costs are markedly lower, particularly when the losses incidental to sulfuric acid refining are included in the comparison. The process is particularly adapted to light distillates from high sulfur crudes and the savings are greatest in the case of cracked gasolines.

Refining of cracked hydrocarbon oils: JACQUE C. MORRELL and GUSTAV EGLOFF. The various methods of refining light petroleum distillates are discussed. The general methods involved are (*a*) physical and (*b*) chemical. The physical method of refining involving the use of various adsorbent earths, though giving good results, can not compete commercially with the chemical methods of refining. The chief chemical method in use to-day is the sulfuric acid method of refining, and it is the use of various modifications of this method upon which the authors lay the greatest stress. Applying various modifications of this method with regard to subsequent treatment as well as concentration and amounts of reagents, the authors have successfully refined cracked distillates from the following raw materials and have produced water white gasoline of sweet odor, as well as a product which will pass the corrosion and doctor test: (*a*) California gas oil, (*b*) Midcontinent fuel oil, (*c*) Midcontinent gas oil, (*d*) Mexican gas oil, (*e*) Texas fuel oil. The raw oils were cracked on a commercial scale in the gas-liquid phase. The authors describe in detail the methods used with full discussion of the theories involved, especial stress being laid upon the treatment of hydrocarbons containing sulfur compounds. The effect of the sulfuric acid treatment upon the unsaturate per cent. is also discussed. It is concluded that following the methods and principles laid down by the authors, all types of cracked hydrocarbons, regardless of the type of raw oil used to produce them, can be successfully treated to produce water-white products of sweet odor.

Fractional distillation of various petroleums under reduced pressure with new type receiver: JACQUE C. MORRELL and GUSTAV EGLOFF. A new type of receiver for fractional distillation under reduced pressure is described. The general principles and elements of the receiver are as follows: The receiver is made up of two graduated chambers, the whole being arranged so that it can be properly mounted. These chambers are connected by a stop-cock. The arrangement is such that one fraction may be drawn off from the lower chamber, while the next fraction is being distilled in the upper chamber. The rate of distillation is always under perfect control. With regard to the fractional distillation of petroleums under reduced pressure, following a general discussion of the theory and experimental method, comparative distillation of the following crude oils, under atmospheric distillation and vacuum distillation, are shown: Kentucky crude, Arkansas crude, Colorado crude, Ohio crude, California crude, Texas crude and Mexican crude. A discussion of the results from the viewpoint of unsaturate content, percentage of paraffin and viscosity of lubricating stock for both types of distillation follows the experimental results.

Sulfo-acid bodies in lubricating oils: G. L. OLIENSIS. When lubricating oils are overtreated or prematurely neutralized in the agitator, some sulfo-acid compounds from the sludge are re-incorporated in the oil. The breaking of the resultant emulsion or blowing of the oil to brightness causes some of these compounds to go into perfect solution in the oil. The Conradson Demulsibility and Vacuum Company steam tests then cause these bodies to precipitate as a soapy layer below the oil, thus constituting qualitative tests for such material. Evidence indicates that a foamy layer differs from a homogeneous layer only in concentration. It is indicated that this layer is caused by salts of inorganic acids, etc. The significance of the presence of such material and the usefulness of the Conradson test for its recognition are discussed.

Calculations of flash points: EDWARD MACK, CECIL E. BOORD and HAROLD N. BARHAM.

SYMPOSIUM ON "LUBRICATION FROM THE CHEMISTS' VIEWPOINT"

Lubricant and asphaltic hydrocarbons in petroleum: C. F. MABERY. The work of this paper is a continuation and expansion of the preliminary notice presented at the Rochester meeting, in which it was stated that an investigation had been begun to ascertain the composition of the part of petroleum that can not be distilled without decomposition. This work is now well advanced and a large number of hydrocarbons have been identified in typical West Virginia, Pennsylvania, Mecca, Texas and Baku oils. The more soluble lubricant hydrocarbons, at least those of lower molecular weight, collect for the greater part in the D series (more soluble) and the heavier asphalts in the H series (less soluble). The two series differ widely in viscosity and in lubricant quality. Tested on a fractional machine, the D's are superior in wearing quality to the H's. The highest viscosity is shown by the Mecca D No. 8, the last one of the series, $C_{78}H_{138}$, 5461 seconds, in an Ostwald tube, water standard 0.25 S. at 38 C., 100° F., 2780 Saybolt. This paper also gives tables of viscosity, iodine numbers, showing unsaturated hydrocarbons and values by the formolite reaction showing internal cyclic unsaturation.

Viscosity temperature curves of fractions of typical American crude oils (Second paper): F. W. LANE and E. W. DEAN.

Low speed-high pressure friction tests with a Kingsbury machine: W. F. FARAGHER and RONALD REAMER. A discussion is given of data on frictional coefficients obtained with a Kingsbury oil-testing machine in which speed was maintained at 7.4 feet per minute and pressure was varied over the range of 2,000-4,000 pounds per square inch. A number of mineral oils and several compounded lubricants were studied.

A graphical study of journal lubrication: H. A. S. HOWARTH. This study is based on W. J. Harrison's paper, "The hydrodynamic theory of lubrication." The oil pressures and friction are represented quantitatively by simple diagrams showing the effects of varying the speed, oil viscosity, eccentricity and clearance. A few examples are given showing the practical application of this study to the case of a journal surrounded by the bearing.

The mechanism of partial lubrication: R. E. WILSON. This subject is presented from the standpoint of the author's recently published papers on the subject, and some additional material is brought forward.

Notes on the chemical composition of mineral lubricating oils: A. DUSTON and THOLE.

The origin of petroleum—origin, migration and accumulation of oil and gas: R. E. SOMERS. The inorganic theories of origin, such as that of Mendeleef, are geologically impossible for large amounts of oil and gas. The organic theories better account for the commercial pools. Effects of geologic alteration continue beyond the first formation of oil and gas and, according to White's laws, lighter fractions are added with increasing pressure and longer time. The geologically older oils are lighter in weight and the younger are heavier. Oil passes from the source bed shales into the reservoirs because of compacting of the shales, and perhaps because of a differential capillarity. Accumulation into pools starts when the reservoirs are loose and uncemented, and is then due principally to differences in specific gravity between oil, gas and water. It continues as the reservoirs become cemented, but gravitation is either assisted by other influences, such as gas pressure, or else replaced by capillarity.

The probable mother substance of petroleum: REINHARDT THIESSEN.

CHARLES L. PARSONS,
Secretary