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CHEMISTRY AND TECHNOLOGY OF TUNG PRODUCTS

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY

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ABSTRACT BIBLIOGRAPHY OF THE CHEMISTRY AND TECHNOLOGY OF TUNG PRODUCTS, 1875 - 1950

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VOLUME I

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FOREWORD

This compilation [1] of more than 2800 references and abstracts of articles and patents relating to the culture of the tung tree, Aleurites fordii, and to the chemistry and technology of the tung fruit and of the oil and meal derived from the fruit, covers the period 1875 to 1951. The references are arranged alphabetically by author under each subject division listed in the table of contents. Subject, author, and numerical patent indexes are provided.

The main sources of these references are as follows:

Journal of the Chemical Society, Abstracts, 1875-1925
Journal of the Society of Chemical Industry, Abstracts, 1875-1925
Chemisches Zentralblatt, 1875-1926
Chemical Abstracts, 1907-1951
Journal of the Oil and Fat Industries, 1924-1931
British Chemical Abstracts, 1926-1947
Biological Abstracts, 1927-1950
Oil & Soap, 1932-1946
Bibliography of Agriculture, U. S. Dept. of Agr. Library, 1942-1950
Oléagineux, 1946-1951
Journal of the American Oil Chemists' Society, 1947-1951
American Tung News, 1950-1951

In addition, the following bibliographies on tung and tung products were consulted.

Ho, K. and Liu, H. Bibliography on tung tree and tung oil. Government Testing Bureau of Hankow, China. 175 pp., 1937.

Stevens, G. H. and Armitage, J. W. Patents, technology and bibliography of China wood oil (tung oil). 2 vols. in 4 parts, 1914 (processed); Index. Stevens, Irvington, N. J., 135 pp., 1914.

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[1] Report of a study made under the Research and Marketing Act of 1946.

This bibliography is primarily concerned with the products of the tree now known as Aleurites fordii Hemsley. In the older literature this species was variously designated or referred to as Elaeococca vernicia, Dryandra cordata, Aleurites cordata, oil varnish tree, Chinese oil tree, tung-yu tree, etc. In 1906, W. B. Hemsley distinguished it as a species different from the Aleurites cordata of Japan whose fruit yields Japanese wood oil (Japanese tung oil).

A. fordii was introduced into the United States in 1902 and subsequently into Argentina, Brazil, Paraguay, Uruguay, and other South American countries. It is the source of all of the tung oil produced in the United States and most of that produced in South America as well as the bulk of the oil produced in the northern part of the tung-producing region of China. Another species, A. montana, thrives better under the climatic conditions of southern China, the East Indies, and Africa. The oil produced from the fruit of A. montana is very similar to that of A. fordii. Tung or Chinawood oil shipped from China is sometimes derived from the fruit of A. fordii and sometimes from A. montana, but frequently it is a mixture derived from the two species.

In the protective coatings industry both the domestic and imported oils are often designated as wood oil or Chinawood oil. Domestic growers and millers use the term tung oil following the recommendation of the U. S. Department of Agriculture. A few writers make a distinction between domestic tung oil and imported Chinawood oil.

The many contributors to the literature on tung have shown little consistency in referring to the fruit and its components. The term "nut" has been applied to the whole fruit, but it is now generally used in trade reports to refer to a kernel fully covered with shell. In domestic mills "nut" or "hulled material" designates kernels partially covered with shell. Particularly confusing is the use of "fruit" and "nuts" in statistical reports.

Often there is nothing in the report to indicate whether whole fruit or hulled fruit (nuts) is actually meant, although the latter represents only about one-half as much weight as the former. In some cases the term "tung nuts" has been used with a footnote indicating that they yield about 16% oil. This figure actually corresponds to the yield of oil from whole fruit, whereas the yield of oil from nuts is about 40%.

The nomenclature currently applied to the various components of the tung fruit is shown in the following table.

ANATOMICAL TERMINOLOGY FOR COMPONENTS OF TUNG FRUIT

Component	Description	Anatomical name	Other names
Fruit	Pod consisting of several seeds surrounded by husk	Ripened ovary and contents	Nut
Outer hull	Brown sub-woody husk	Matured ovary wall, divided into several carpels	Husk
Inner hull	Paper-like inner husk	do.	Husk
Seed	Shell covered kernel resembling a nut	Kernel and seedcoats	Nut
Shell	Rough, hard covering of the kernel	Hardened outer epidermis of inner integument of the ovule	Seedcoat
Reddish dust	Dust released on hulling	Disintegrated outer integument of ovule	---
Pellicle	Thin papery layer surrounding the kernel	Thin reticulate paper-like layer just inside the shell	---
Kernel	Cream-colored, oil-bearing tissue	Endosperm and embryo	"Meat" as of a nut
Embryo	Embryonic plant surrounded by endosperm	Cotyledons and radicle	---

The term "meal" is also applied to different products, namely, the ground seed fed to the press or solvent extractor, the ground cake obtained from hydraulic or continuous screw presses, and the residue discharged from continuous or batch solvent extractors.

Likewise the term "press cake" is applied to at least two products, namely, the unground cake produced by pressing ground tung seed in hydraulic or continuous presses, and the cake removed from plate and frame or other types of filter presses. These products should be distinguished by specifying the type of cake, such as hydraulic press cake, screw press cake, filter press cake, etc.

Both tung oil obtained from the fruit of _A. fordii_ and abrasin or mu oil from the fruit of _A. montana_ owe their distinctive properties to the fact that they are composed principally of glycerides of α-eleostearic acid (9,11,13-octadecatrienoic acid). A section of the bibliography is concerned with the literature on the chemistry of eleostearic acid and its derivatives.

An asterisk (*) following a reference indicates that the publication or patent has not been examined by the authors.

The patent dates have been taken from the original patents in most cases. Their significance with respect to different countries is as follows:

Country	Date
Canada	Accepted
France	Délivré
Germany	Patentiert im Deutschen Reiche
Great Britain	Accepted
Netherlands	Dagteekening van het octrooi
Switzerland	Patent eingetragen
United States	Granted (or issued)

The complete titles of the journals referred to in abbreviated form may be found in the List of Periodicals Abstracted by Chemical Abstracts published by the American Chemical Society, Columbus, Ohio, 1946.

Microfilms or photoprints of most of the publications cited in the bibliography may be obtained from the Library of the U. S. Department of Agriculture, Washington 25, D. C. Copying charges are $1.00 for microfilms of 50 pages or fraction thereof from a single article or book and $1.00 for photoprints of 10 pages or fraction thereof from a single article or book.

United States patents may be purchased from the Commissioner of Patents, Washington 25, D. C. at $0.25 each. Photostats of foreign patents may also be purchased from the Commissioner of Patents at the rate of $0.20 per print.

News items and notes pertaining to the tung industry in the United States which have not been included in this bibliography can be found in Tung World, published monthly by Tung World Publishing Company, Gulfport, Mississippi, and American Tung News, published monthly by the American Tung Oil Association, Poplarville, Mississippi.

The authors wish to acknowledge the advice of K. S. Markley and Frank G. Dollear in the preparation of this bibliography.

CONTENTS

PATENT LITERATURE

GENERAL

Anonymous

THE TUNG OIL (CHINESE WOOD OIL) TREE.
Drugs, Oils & Paints 32, 413 (1917): C.A. 11, 2156 (1917).

"An unprinted paper of the Bur. of Plant Ind. giving general information on the habitat, conditions for growth, and growing expts. in the U. S. of the tung oil tree." From C.A.

The oil constitutes about 24% (by wt.) of the seeds, or about 40% of the kernels from which the shells have been removed.

Anonymous

CHINESE WOOD OIL.
Drugs, Oils & Paints 33, 193-4 (1917): C.A. 12, 316 (1918) (no abstract).

This reviews briefly the tung tree in China, the processing of its fruit and the use of the oil in China. The U. S. Dept. of Agriculture has found that the tung tree can be successfully cultivated in several Southern states. Increased production of soybean oil may increase the markets for tung oil for use in blends with soybean oil.

Anonymous

TUNG OIL IN CHINA.
U. S. Com. Rep., (Feb. 9, 1921): J. Soc. Chem. Ind. 40, 110 R (1921)

"Tung oil, or Chinese wood oil, is obtained from the nut of certain species of *Aleurites* which grow luxuriantly in hilly districts and seem to thrive in poor soil. The oil is usually extracted in the interior and shipped to Hankow, where it is stored. Its high price often leads to adulteration, soya bean, groundnut, sesame and cottonseed oils being used for this purpose. The exports from China from 1913 to 1919 were as follows: 1913, 37,598 tons: 1914, 26,164 t.; 1915, 18,473 t.: 1916, 30,665 t.: 1917, 23,890 t.: 1918, 29,098 t.: 1919, 36,515 t. There is room for considerable improvement in the methods of cultivation, harvesting and expressing, and the installation of modern machinery would, it is stated, increase the production by at least 10%. Attempts to cultivate the tung tree in the United States are said to have been successful." From J. Soc. Chem. Ind.

Anonymous

CHINESE TUNG OIL SEEDS.
Bull. Imp. Inst. 28, 267-73 (1930): C.A. 25, 221 (1931).

"A sample of nuts of *Aleurites fordii* from China consisted of 46% shell and 54% kernels. The latter contained 4.5% H_2O and on extn. with petr. ether yielded 55.9% (58.5% on the dry basis) of a yellow oil having the following characteristics: d^{15}_{15} 0.9428, acid value 0.44, sapon. value 192.3, I no. (Wijs, 3 hrs.) 179.2%, unsaponifiable matter 0.9%, n_{40} 1.5155, heat test (Browne) 11 min., solidifying pt. of fatty acids 30.0°. These agree with the requirements of the British and American specifications, except that the unsaponifiable is slightly above the max. desirable. The residual meals left after extn. of the oil from the entire kernels and the whole nuts, resp., had the following compn.: H_2O 10.3, 9.2:

crude proteins 37.9, 22.4: fat 0.4, 0.5: N-free ext. 35.9, 20.9: crude fiber 7.8, 42.1: ash 7.7, 4.9: nutrient ratio 1:1.0, 1:1.0: food units 132, 78. They would be valuable as feeding stuffs, provided they are proved harmless to animals: and both meals would be suitable for use as fertilizers. Two samples of nuts of *Aleurites montana* from China consisted of 43.5 and 47.5% shell and 56.5 and 52.5 kernel. The latter contained 4.5 and 5.9% H_2O and 59.8 and 56.3% oil (62.6 and 59.8% on dry basis). The oils had the following characteristics: d_{15}^{15} 0.9381, 0.9405: acid value 12.1, 1.5: sapon. no. 191.5, 192.6: I no. (Wijs, 3 hrs.) 163.1, 170.0: unsaponifiable matter 0.6, 0.7: n_{40} 1.506, 1.509: heat test (Browne) 24, 20.5 min.: solidifying pt. of fatty acids 38.2, 41.1°. These agree with the requirements of the British and American specifications, except that the n is lower and the time required for polymerization considerably greater. The compn. of the residual meal from the extn. of the kernels only was: H_2O 9.7, 12.8: crude proteins 37.9, 47.9: fat 1.6, 0.7: N-free ext. 33.4, 24.7: crude fiber 7.1, 6.8: ash 10.3, 7.1%: nutrient ratio 1:1.0, 1:0.5: food units 132,146. The compn. of the residual meal from the extn. of the whole nuts in 1 sample was: H_2O 10.1, crude proteins 15.9, fat 0.8, N-free ext. 19.3, crude fiber 49.1, ash 4.8, nutrient ratio 1:1.3, food units 61. Provided that the meal from the kernels possesses no toxic properties it should prove of value as a feeding stuff, but the meal from the undecorticated nuts would be of much less value. Both meals should be suitable for use as fertilizers." From C.A.

Anonymous

TUNG OIL, ITS OCCURRENCE, PRODUCTION, AND USES.
Farve og Lak, 1936, No. 8, 14-16: Brit. Chem. Abstracts 1937, B, 152.
"An Historical review." From Brit. Chem. Abstracts.

Anonymous

TUNG SEED AND OIL FROM (BRITISH) EMPIRE SOURCES. III.
Bull. Imp. Inst. 35 (2), 147-57 (1937): C.A. 31, 8225 (1937).
"The characters of the fruit, nuts, and kernels, and the consts. of the oil are tabulated and discussed for *Aleurites fordii* from Assam, Burma, South Africa, Southern Rhodesia, Kenya, Nyasaland, Caprus, Australia, Argentina, and U.S.A., and for *A. montana* from Southern India, Burma, Ceylon, Hong Kong, South Africa, Kenya, Nyasaland and British Honduras." From C.A.

Anonymous

THE ALEURITES TREES.
Publication I.R.H.O. (1945)*; Oleagineux 1, 117 (1946) (abstract).
"The plant, its culture. Treatment of the product (native and modern methods). Production, exportations, importations, consumptions, markets, packing for shipment, price. Uses and by-products." Translated from Oleagineux.

Andes, L. E.

INTRODUCTION OF WOOD OIL INTO GERMANY.
Farben-Ztg. 1913, 2186-7.
Tung oil was certainly imported into Germany in 1897 and was probably introduced earlier. Reference is made to early patents on the utilization of tung oil (e.g. Knoche, 1895) and to early reports on its properties (e.g. Davies and Holmes, 1895).

Arocena, Pedro
TUNG (ALEURITES FORDII).
Chacra 13 (151), 58 (May, 1943)*: Bibliog. of Agr. 3, E, 77 (1943).

Ashby, M.
THE TUNG OIL INDUSTRY OF THE UNITED STATES.
Bull. Imp. Inst. 38 (1), 5-32 (1940): Oleagineux 1, 117 (1946) (abstract).

"Regions of culture in the U.S.A. Species cultivated, soil conditions, climate and topography, cultural practices, yields, diseases, deficiencies and physiological troubles, research work (selection, crossing, vegetative propagation), treatment of harvests. Commercial aspects of the tung oil industry. 5 plates of photographs, bibliography." Translated from Oleagineux.

Barry, T. H.
OIL FROM THE SPECIES ALEURITES.
Chem. Age (London) 7, 166-7 (1922): C.A. 16, 3549 (1922).
"The members of the group are found mainly in China, Japan, and the islands of the Archipelago. A. fordii is a species which appears likely to prove suitable for cultivation under the supervision of the white race. The oil is used by the Chinese for a variety of purposes. A. montana is common in southern China. It is doubtful if an authentic sample has ever been examd. by a chemist. A. cordata is the Japanese species. The oil does not polymerize and its sp. gr. (0.935) is lower than that of the other oils from the species. A. moluccana and A. trilobia were considered as distinct species but leaves of both types together with leaves of the transitional stages have been found on the same tree. It is the source of candle nut or lumbang oil which has a sp. gr. of 0.925 and I no. of 150. The yield from the nuts is 60%. A. tristperma is the source of soft lumbang oil. The tree is confined to the Philippines. The oil sets up when mixed to form a paint with red lead. The general properties of the oil are intermediate between linseed and tung oil. The sp. gr. is 0.938 and the I no. 145. A. luscifera is found in the Antilles and Ceylon and yields a kind of gum lac as a result of the sting of an insect but no oil is obtained from it." From C.A.

Barry, T. H.
RECENT DEVELOPMENTS IN THE CULTIVATION OF CHINA-WOOD OIL.
Chem. Age (London) 15,490-1 (1926): C.A. 21, 332 (1927).

The cultivation of tung oil trees has been successful in Florida, Georgia, and Alabama. Seedlings transferred during the dormant season (Dec.-Feb.) grow into sturdier trees than those transplanted at other seasons. Cow peas and Beggar weed can be grown in tung orchards to furnish cattle food and soil nitrogen. Besides the oil, there is produced a meal, too toxic for cattle food. The tree also yields useful lumber.

Blackmon, G. H.
THE TUNG OIL TREE IN FLORIDA.
Florida Dept. Agr. State Mktg. Bur. For Sale, Want and Exchange Bull. 2 (3), 1,6 (Nov. 2, 1942)*: Bibliog. of Agr. 1, E, 57 (1942).

"Description and cultivation of the tung tree (Aleurites fordii Hemsl.) and manufacture and utilization of tung oil." From Bibliog. of Agr.

Blackmon, G. H.

THE TUNG-OIL INDUSTRY.

Bot. Rev. 9 (1), 1-40 (1943):* Biol. Abstracts 17, 1551, Abs. No. 17, 162 (1943).

"The tung tree (Aleurites fordii) and related species are described, along with notes on the origin of the tung tree and its introduction into the United States: areas suitable for production, cultural and nutritional problems, harvesting and oil extraction, uses of the oil, and the progress of research; and plantings in countries other than the U. S. and China. The bibliography includes 143 references." From Biol. Abstracts.

Blackmon, G. H.

TUNG OIL. A GIFT OF CHINA.

Econ. Botany 1, 161-75 (1947): C.A. 41, 6416 (1947).

"Discusses production, uses, and sources, in terms of one species, Aleurites fordii." From C. A.

Blin, Henry

CHARACTERISTICS, PRODUCTION AND USES OF ABRASIN OIL.

Mat. grasses 20, 8370-2 (1928): C.A. 23, 1291 (1929).

"Characteristics, production and uses of tung oil are described." From C. A.

Boekenoogen, H. A.

THE CHEMISTRY OF OILS AND FATS.

N.V.A. Oosthoek's Uitgevers Mij-Utrecht 1948, pp. 357-61 (in Dutch).

In section 208 there is a general discussion of source, composition and physical properties of Chinese wood oil (Aleurites fordii) with a slight mention of the oils of A. trisperma, A. cordata and A. montana.

Brookes, E. S.

TUNG OIL. MISSISSIPPI'S NEW AGRICULTURAL INDUSTRY.

Mississippi Dept. of Agr. Bull. No. 1, 24 pp. (June, 1933).

The tung industry in Mississippi is reviewed with regard to its establishment, soil and climatic requirements, cultural practices, crushing plants, present importance, and economic opportunities.

Burnside, F.

THE WOOD OIL INDUSTRY.

Drug, Oils & Paints 39, 284-6 (1924): C.A. 18, 1212 (1924).

Wood oil, also known as nut oil in the U.S.A., is obtained from the nut of two varieties of Chinese trees and used for many coating and preserving purposes. In China the nuts are hand-picked and the husks removed after being softened by rotting or with boiling water or being cracked open by roasting. The kernels are taken to crude native mills where they are crushed, steamed, and pressed to release the oil. The latter is generally shipped in paper-lined, wicker baskets to the coast for export in barrels or tankers.

Burnside, F. W. and Mackay, R. C.
CHINA WOOD OIL. ITS PRODUCTION, EXTRACTION AND FUTURE OUTLOOK.
Am. Paint J. 9 (11), 56, 58, 60, 62, 64 (1925).

Tung yu (also called wood oil and China nut oil) is obtained from Aleurites fordii and Aleurites montana. The trees generally grow wild with little or no attention. The fruit are freed from hulls after the latter have been softened by fermentation or cooking and the kernels roasted or air dried. After grinding the kernels to a meal and steaming the meal a wedge press is used to express the oil. Chinese exportation of this oil is hampered by the inefficiency of the collection and transportation methods, adulteration, and burdensome, illegal taxes. A loss of American markets, which now account for 85% of Chinese tung oil exports, is threatened by the increasing production of tung oil in the United States.

Chang, B. T.
WOOD OIL, ONE OF CHINA'S IMPORTANT EXPORTS.
Chinese Economic Journal 4 (3), 198-205 (March 1929).

This article describes the native Chinese methods of cultivating the trees of Aleurites fordii and A. montana, the processing of the fruit and the marketing of the oil. Export data for 1927 are included.

Chang, Chao-yuan C.
CHINA TUNG OIL AND ITS FUTURE.
China Vegetable Oil Corp., Hong Kong, 129 pp. (1940).

The book contains the following chapters: I. The China Tung Oil Industry; II. Trade Returns of Tung Oil Exports; III. Inherent Weakness of Chinese Production and Distribution; IV. Potential Threat from Foreign Plantations; V. Interchangeability of Drying Oils: VI. Compatibility and Synthetic Substitutes; VII. Price: The Dominating Factor; VIII. Foreign Comments and Opinions; IX. Conclusion.

Chang, Y. C.
TUNG OIL.
Science (China) 4 (3), 247-53 (1918) (in Chinese).

Change, B. T.
WOOD-OIL INDUSTRY IN CHINA.
Paint Varnish Production Mgr. 11, (2), 18-20, 22 (1934):
C.A. 28, 6325 (1934).

"Wood oil is obtained from Aleurites montana (mu yu shu, wood-oil tree, giant tree, one-thousand year tree) and A. fordii (tung yu shu, tung-oil tree, dwarf tree). The habitat and cultivation of the trees, the commercial aspects of the oil, and its many uses in China are described." From C.A.

Cheng, Fa-Wu
THE TUNG-OIL INDUSTRY OF WAN-HSIEN.
Science (China) 17, 417-45 (1933): C.A. 27, 3348 (1933).

"Wan-hsien (Szechuan) is the center of the tung-oil industry in West China. Production data and procedures for official tests are given. Refractive index is measured for tung oils with 2.5, 5.0, 7.5, and 10.0% of stillingia, rape-seed and tobacco oils as adulterants. Refractive index alone is shown to be inadequate for detecting adulterants within the desired standards of purity." From C.A.

Chiu, K. Y.
TUNG OIL.
Science (China) 16, 250-70 (1932) (in Chinese).*

Chiu, K. Y.
TUNG OIL.
Science (China) 16, 444-69 (1932) (in Chinese.*

Chopp, C. C.
CHINA WOOD OIL OR TUNG YIU.
Paint Oil & Drug Rev., 14 et seq. (June 1912).

This review of the Chinese tung oil industry covers the culture of the trees, processing of the fruit and uses of the oil and byproducts. The ground kernels are usually steamed then pressed with wedge presses which release about 80% of the oil. The press cake is either used as fertilizer or burned to an ash or soot and made into a caulking paste by the addition of tung oil. Cultivation experiments are underway in the United States, Hawaiian Islands and Puerto Rico.

Cochran, H. L.
THE TUNG-OIL TREE IN GEORGIA.
Ga. Agr. Expt. Sta., Circ. 108, 1-8 (1936): C.A. 30, 7755 (1936).

"The tree thrives best on the lighter, fertile soils of rather high water-holding capacity. The soil should be slightly acid. Excess of lime causes the development of a chlorotic condition in the leaves. The addn. of $ZnSO_4$ prevents certain forms of chlorosis and die-back. Approx. 0.25 lb. per tree is sufficient. The $ZnSO_4$ may be added either to the soil around the tree or as a spray to the leaves. From 300 to 400 lb. of good grade mixed fertilizer per acre is recommended for tung-tree orchards. Tung trees at Cairo, Ga., after 9 years yielded at the rate of 4900 lb. of nuts per acre (70 trees) which in turn yielded 980 lb. of tung oil." From C.A.

Coll, A.
TUNG-NUT TREE. A GOLD MINE.
Paint Varnish Production Mgr. 33, 8, 13 (Apr. 1929).

Extravagantly optimistic for Florida's new tung industry.

Concannon, C. C.
TUNG OIL PRODUCTION IN AMERICA. I. ITS HISTORY AND PROGRESS.
Cotton and Cotton Oil Press 37 (47), 3-5 (Nov. 21, 1936): (49), 6-7, 15 (Dec. 5, 1936).

The present dependence of the United States upon China for tung oil is undesirable since tung oil is an essential ingredient of paints, varnishes, linoleum, oilcloth, printing ink, electrical goods, etc. Culture of tung trees in the U. S. began in 1902 with the planting of seeds sent from China by Consul General Wilcox. The suitability of the climate and soils of the South for the raising of tung trees is attested by the existence of over 75,000 acres of tung groves in Florida, Mississippi, Georgia, Alabama, Louisiana, and Texas. Oil production in 1934 was 300,000 to 400,000 lbs., but the 1936 crop is expected to reach 2,000,000 lbs. Air-dried fruit contain about 20% of oil.

Dage, Z. C.
THE TUNG-TUN RESEARCH INSTITUTE.
Inspection and Commerce (China) 4 (10), 15 (1933).

The Tung-Tun Research Institute has been organized by the China Oil Color and Paint Manufacturers' Association and other interested parties to conduct research on the culture of the tung tree, the processing of the fruit, the utilization of the oil and the study of tung oil substitutes.

Deering, W. H.
TUNG OIL (CHINESE WOOD OIL).
J. Imp. Inst. 2, No. 20, 303 (1896)*; J. Soc. Chem. Ind. 15, 661 (1896).

"This is a glyceride oil giving on saponification 96-1/2% of fatty acids, which, at ordinary temperatures, are hard and crystalline: it requires 1.18% of caustic potash for neutralization and 19.12% for total saponification. The bromine absorption is 98%. It is a golden-yellow, clear, viscous oil; when exposed to air in a thin film it dries to a white, opaque, solid film in 20 hours, raw linseed oil usually requiring 60 hours. Heated to 500° F. with or without oxides of lead and air stream, it jellified in about 10 minutes, the rapid change being probably due to polymerization rather than to oxidation. Tung oil will probably be valuable in the manufacture of linoleum." From J. Soc. Chem. Ind.

De Long, G. C.
THE USES AND PRODUCTION OF TUNG OIL.
J. Geog. 41 (8), 309-12 (Nov. 1942)*; Bibliog. of Agr. 1, E, 75(1942).

"Growth of tung and utilization of tung oil with emphasis on tung production in the United States." From Bibliog. of Agr.

Eaton, B. J.
TUNG OIL OR CHINESE WOOD OIL AND CANDLENUT OIL FROM ALEURITES SPECIES.
Agr. Bull. Federated Malay States 7, 162-5 (1919); C.A. 14, 361(1920).

Preliminary attempts to raise *Aleurites fordii* in the Federated Malay States were unsuccessful. Growth of *Aleurites moluccana* was more successful, but yields (estimated at 600 lbs./acre) and prices were too low to make the crop economically attractive. The crude pressing methods of the Chinese are mentioned. They obtain a white oil for export by cold pressing of tung nuts then press hot to secure additional dark oil for local use. Data are tabulated for a comparison of the properties of the oil from *A. moluccana* and from *A. cordata*.

Echegaray, M.
THE TUNG OIL TREE. ITS CULTIVATION. THE FRUIT. EXTRACTION AND UTILIZATION OF ITS OIL.
Rev. mens. asoc. rural Uruguay 1937 (5), 39-42; (6), 42-4; C.A. 31, 8234 (1937).

"A review." From C.A.

Fonrobert, Ewald

TUNG OIL AS A RAW MATERIAL FOR VARNISHES AND SYNTHETIC RESINS. I AND II

Paint Manuf. 5, 364-7 (1935): 6, 4-7 (1936); C.A. 30, 1593 (1936).

"A paper dealing with the cultivation, yield, quality and chem. compn. of tung oil. The quality of a tung-oil stand oil as a varnish ingredient increases proportionally as its tendency to frost decreased. "Curing" of tung oil requires heating the oil to a temp. of 270-280°, and this temp. should be attained as rapidly as possible. The α-eleostearic acid triglyceride is the essential constituent of tung oil on which its desirable varnish properties depend, as in contrast to the β-glyceride it shows less tendency to crystallize or "throw out." This α-form changes over readily and rapidly into the β-form on heating or under chem. influence. For varnish prepn. the tung oil should receive a treatment to minimize this action. Rapid heating causes the rate of polymerization to exceed that of transformation. II. Ibid. 6, 4-7 (1936). An outline is given of the prepn. of tung-oil stand oils, of mixed tung-linseed stand oils, and the Am. method of heating the raw materials required for the varnish in one operation. The Albertol tung-oil varnishes prepd. by the Europen method are paler in color, have less tendency to skin and yield somewhat better-flowing and slightly harder films. The varnishes cooked by the Am. method are more gas proof, show less tendency to wrinkle on stoving and when combined with the harder Albertols are a trifle more alkali-resistant. Alkylphenol and alkyd resins are briefly discussed. The frosting tendency of tung oil is minimized by adding an amt. of 1-2% of the tung oil in solid form, after having dissolved it previously in a varnish solvent." From C. A.

Gardner, H. A.

REPORT OF PROGRESS ON CULTURAL WORK ON TUNG OIL GROVES, WITH A NOTE REGARDING PERILLA AND CHIA EXPERIMENTS.

Paint Mfgs. Assoc. U. S. Circ. No. 241, 1-30 (June 1925); C.A. 19, 3027 (1925)

A brief review touching upon the planting and growth of seedlings, fertilizer tests and the development of equipment for the extraction of the oil from the kernel.

Gardner, H. A .

OBSERVATIONS ON AN AUGUST INSPECTION OF FLORIDA TUNG OIL GROVES, AND ON THE QUALITY OF AMERICAN OIL SUBMITTED TO VARIOUS VARNISH MAKERS.

Am. Paint Varnish Mfrs. Assoc. Cir. No. 336, 620-36 (1928); C. A. 22, 3541 (1928).

"This inspection report indicates a healthy condition of the Florida tung trees with this year's crop possibly doubling last year's. Details as to soil, planting, and cultivation are given together with information regarding cost factors. Reports from 25 varnish manufrs. show the oil to be superior to the imported oil." From C. A.

Gardner, H. A.
THE TUNG-OIL INDUSTRY IN THE SOUTH.
Ind. Eng. Chem. 24, 687-90 (1932): C.A. 26, 3939 (1932).
"A review of the history and present status of the industry in Florida and vicinity together with a discussion of soil and climate requirements, culture, harvesting, husking, and pressing." From C.A.

Gardner, H. A., Butler, P. H., and Scofield, F.
TUNG OIL CULTURE.
Sci. Sect. Nat. Paint, Var. Assoc., Inc., Sept. Spec. Circ. 126 pp. (1941): Brit. Chem. Abstracts 1941, B, III, 319.
"Available information concerning the growing of tung trees, yields, costs, pests, etc. from experimental plantations in the United States, etc., is collected with numerous photographs and tabulated data. Notes on soils (M. Drosdoff) and budding (G. F. Potter, S. Merrill, jun., and R. H. Sharpe) are included." From Brit. Chem. Abstracts.

Gardner, H. A., and Scofield, F.
VEGETABLE DRYING OILS FOR THE PAINT AND VARNISH INDUSTRY.
Natl. Paint, Varnish Lacquer Assoc. Sci. Sect. Circ. No. 602, 209-63 (1940): C.A. 35, 2344 (1941).
The culture and characteristics of 20 oil producing plants are described along with data on the economics, uses and properties of their oils. Included in the group are: Aleurites fordii and Aleurites montana, the two which yield Chinese tung oil: Aleurites cordata (Japanese tung oil): Aleurites trisperma (soft lumbang oil): Aleurites moluccana (lumbang or candle-nut oil).

Gerard, A.
CHINA WOOD OIL.
Bull. inst. pin No. 42, 257-60 (Nov. 1927): C.A. 22, 1052 (1928).
"Brief review of its origin, compn., treatment and methods of testing and analysis." From C.A.

Gerard, A.
CHINA WOOD OIL.
Chimie & industrie Special No. 587-90 (Apr. 1928): similar to Bull. inst. pin. No. 42, 257-60 (Nov. 1927): C.A. 22, 1052 (1928).
A brief review of its origin, compn., treatment and methods of testing and analysis.

Gerard, A.
CHINA OIL.
Peintures, pigments, vernis 5, 592-6 (1929): C.A. 23, 4087 (1929).
"A review of the origin, compn., properties and analysis of China oil." From C.A.

Greene, R. S.
CHINESE WOOD OIL.
Daily Consular and Trade Reports 15 (145), 1226-7 (June 20, 1912).
Chinese extraction and marketing methods and exports for 1910-12 are given. The U. S. Dept. of Agriculture has found that the wood-oil trees will produce a fair crop of fruit in the Gulf States and California.

Guerin, P.

WOOD OIL TREES OF CHINA AND JAPAN.
La Quinzaine coloniale No. 24, 862-3 (1913): Mat. grasses 7, 4201 (1914): C.A. 8, 3244 (1914) (no abstract).

A general review covering the various species of Aleurites and the production, uses and properties of Chinese wood oil (Aleurites fordii).

Haller, W.

INTRODUCTION OF WOOD OIL INTO GERMANY.
Farben-Ztg. p. 2230 (1913).

In 1894 and 1895, H. was purchasing wood oil in 3000-6000 kg. lots. Earlier in the 1890's he secured tung nuts and small shipments of oil of variable quality. A patent application, which was drafted but not filed, described the boiling of pure wood oil at 210-200°C. and of boiling together wood oil with other oils or resins.

Hausman, M. J.

TUNG OIL.
Am. Paint J. 14, No. 9, 17-19, 22 (1936)*: C.A. 31, 6486 (1937).

"A general account of the production and uses of tung oil, with special reference to the economic position in America." From C.A.

Heckel, G. B.

HECKEL'S REMINISCENCES AND COMMENTS. 46. NEW CROPS IN OLD FIELDS. THE TUNG TREE.
Am. Paint J. 13 (16), 66, 68, 70, 72, 74, 76, 78 (1926).

The early history of the infant tung industry in America is related from the personal point of view of the author. Great opportunities for further expansion of the industry are predicted.

Heintzleman, P. S. and Arnold, Julean

THE CHINESE WOOD-OIL SITUATION.
Daily Consular Reports No. 31, p. 307 (July 30, 1923).

The supplies of tung oil that will be available for export can not be accurately predicted now because of lack of information as to the amounts actually produced and the amounts used locally and because of political disturbances. Large amounts of oil adulterated with tallow, sesamum oil, or tea oil have been coming into Hankow.

Henry, A.

CHINESE WOOD-OIL.
Chem. and Druggist, 60 (1166), 873-4 (1902): J. Soc. Chem. Ind. 21, 881 (1902).

"This oil is obtained by pressure from the seeds of Aleurites cordata. Steud, of the order Euphorbiacaceae, a tree indigenous to China and Japan. The seeds contain about 35% by weight of oil. A small tree will bear 100 or 200 lb. of fruits, each one containing three or four large seeds. The trees soon come into bearing, and little labour is required either in planting the trees or in collecting the fruits. Two kinds of oil are known, the cold-drawn, or white t'ung oil, which is the variety imported into England, and the hot-pressed, or black t'ung oil. The author considers that the tree is very suitable for planting over large tracts in the United States and in certain British colonies, as Ceylon and the Nilgiris, in Natal, and perhaps in the mountainous parts of the West Indies. It can be tried in barren, mountainous regions, where farming or ordinary planting would be impossible. (See also this Journal, 1897, 195; 1898, 674; 1900, 156, 359; and 1901, 261, 485.)" From J. Soc. Chem. Ind. 21, 881 (1902).

Ho, K. and Liu, H.
BIBLIOGRAPHY ON TUNG TREE AND TUNG OIL.
Government Testing Bureau of Hankow, China. vii.+ 175 pp., 1937.

An extensive bibliography of articles and patents dating from 1876 to 1936. There are about 1100 entries, some being duplicates appearing under more than one heading. No abstracts or references to abstracts.

How, Bang
POST-WAR OUTLOOK FOR THE TUNG-OIL INDUSTRY.
Paint Varnish Production Mgr. 24, 178-83 (1944): C.A. 38, 4816 (1944).

"A brief history of the use of tung oil in paints is presented. The chem. constitution and varnish-making properties are discussed." From C.A.

Hsu, Chih-Fang
TUNG OIL PRODUCTION OF CHEKIANG PROVINCE.
Science (China) 16, 1158-63, 1306-20 (1932)*: C.A. 27, 432 (1932).

"Production figures and chem. analyses." From C.A.

Imperial Institute (with the cooperation of the tung oil sub-committee of its advisory committee on oils and oilseeds).
THE PRODUCTION OF TUNG OIL IN THE EMPIRE.
Issued by the Empire Marketing Board, London, No. 31, (1930).

The British tung industry is reviewed under the following headings: (1) sources and production, (2) cultivation in the Empire, (3) cultivation in the U. S., (4) further developments in the Empire, (5) methods of cultivation, (6) growth of trees and yield, (7) plantation costs, (8) utilization of nuts and (9) the future outlook.

International Institute of Agriculture
THE TUNG OIL TREES (ALEURITES) AND THE TUNG OIL INDUSTRY THROUGHOUT THE WORLD.
Rome, [Printing Office 'C Colombo] 1938, 237 pp.

This constitutes an excellent general review for the five species, *A. fordii*, *A. montana*, *A. cordata*, *A. moluccana*, and *A. trisperma*. In the first section, Aleurites cultivation is covered under the following headings: history, botanical description, method of distinguishing the species, area of natural extension, soil and climate, selection, varieties, propagation, transplanting, cultivation, care, pruning, manuring, harvesting, dimensions, and characteristics of fruits, seeds, and kernels, yields, diseases and pests, utilization of by-products. The next section discusses the present (1938) state of cultivation in each of 60 countries. Section 3, Technological Study of Chinese Wood Oils covers the following phases for the oil: extraction, preparation, properties, specifications, and identification, characteristics, industrial applications (also properties and uses of bancoulier oil). The final section is devoted to the production and trade in Chinese wood oils. Its headings include: wood oil production, market organization in China, measures for encouraging the development of wood oil trade in China, the great exporting ports, regulations governing exportation, consuming countries, and exports of wood oil from China.

Jean, F.
ELAEOCOCCA OIL.
Rev. de Chim. Ind. 9, (102), 161-3 (1898): J. Soc. Chem. Ind. 17, 772-3 (1898).

"Under this title the author gives a description of the properties and uses of Tung oil (Japanese Wood-oil). (This Journal, 1897, 195; 1898, 674.) He states that it is derived by cold expression from the seeds of the elaeococca vernica, a member of the euphorbiaceae, which grows in China and Cochin China, 100 parts of the decorticated nuts yielding about 35 parts of oil. It is not to be confounded with the oleoresinous "wood-oils" of Cochin China or the oil of Gurjun. Of these wood-oils there are three qualities — white, dark, and black — the densities of which vary from 0.960 to 0.966. Their drying properties are inferior to those of Tung-oil, nor do they solidify under the influence of heat.

The author has obtained the following results with specimens of Tung-oil imported into France: Density at 15° C., 0.940: refractive index, 1.80°; flashing point, 260°C.: acidity as H_2SO_4, 0.784%. Mention is also made of the remarkable drying properties of the oil, and the curious polymerisation which it undergoes on heating (cf. Jenkins, this Journal, 1898, 674).

On account of its siccative properties, this oil can be employed without preliminary oxidation in the manufacture of varnishes. When boiled with oxide of lead, and dissolved in turpentine, it yields an excellent varnish without the addition of any resin. It can also be used for rendering paper, etc. impervious. Paper thus treated is transparent and can be written upon with ordinary ink. The substitution of this oil for boiled linseed in oil paints would offer many advantages, especially where rapid drying is of importance, as for instance in the painting of ships and of metal work." From J. Soc. Chem. Ind.

Jensen, S. J. F.
OBSERVATIONS UPON THE KWANGSI WOOD OIL PRODUCTION.
Am. Paint J. 20, 16-7 (Mar. 2, 1936).

A brief review of the culture of the tung trees and the extraction and marketing of the oil in Kwangsi Province, China.

Johnson, P. R. and Yarnell, S. H.
THE TUNG OIL TREE IN TEXAS.
Texas Agr. Exp. Sta. Circ. 75, 1-16 (1935)*: Biol. Abstracts 11, 1264, Abs. No. 11, 969 (1937).

"Included in this circular of general information are data on temp. requirements, survival of trees near 0° F., size and wt. of seed, oil content of seed and yields." From Biol. Abstracts.

Jordan

EMPIRE TUNG OIL.
Paint Manuf. 5, 100-1 (1935).
The hulling of tung fruit, the pressing of the kernels in expellers and the solvent extraction of the oil are discussed. The press cake is unsuitable for feeding animals because of its unpalatability and the presence of an irritant. The revised British Standard Specifications will recognize oil from A. montana and provide for its sale.

Karsten, Erich

FATTY OILS AS RAW MATERIALS FOR COATINGS.
Farben, Lacke, Anstrichstoffe 3, 29-35 (1949)*: C.A. 43, 5202 (1949).
"Oils, their compn., properties, the mechanisms of drying, heat-bodying, and blowing, and the properties of processed (linseed, chinawood) oils, are discussed." From C.A.

Kilby, W. Wilson and Potter, G. F.

TUNG CULTURE IN SOUTHERN MISSISSIPPI (REVISED).
Mississippi State College Agricultural Experiment Station Bulletin No. 464. June 1949.
A thorough review consisting of the following chapters: (1) Introduction, (2) History of the Experimental Tung Field, (3) Location and soil for tung growing, (4) Land preparation, (5) Planting stock, (6) Stratifying seed and establishing the nursery, (7) Planting the orchard, (8) Culture, (9) Fertilization of young trees, (1) Experiment with fertilizers for tung, (11) Fertilizer for cover crops, (12) Fertilizer for mature bearing trees, (13) Pruning, and (14) Harvesting and storing tung fruits.

Knight, Henry G.

TUNG OIL RESEARCH AS AID TO NEW SOUTHERN INDUSTRY.
Paint, Oil Chem. Rev. 101 (9), 5-6, 19 (1939): C.A. 33, 8426 (1939).
Problems being studied are (1) development of superior high-yielding strains or varieties of trees, (2) recovery of the oil from the nuts, (3) utilization of byproducts.

Knight, Henry G.

TUNG OIL REMAINS INDUSTRY'S BEST DRYING OIL.
Mfrs. Record 110 (6), 34-5, 64 (1941).
A general report on the production of tung oil from fruit raised in 6 Southern states and some problems that have arisen. Scientists of the U. S. Dept. of Agriculture are studying soil and fertilizer requirements of the trees and the drying, hulling, and oil-extraction of the tung fruit. A tabulation of domestic oil production shows that it has increased from 100,000 lb. in 1932 to about 5,000,000 lb. in 1940.

Legrand, S.

PRESENT-DAY ASPECTS OF THE CHINA WOOD OIL INDUSTRY.
Rev. prod. chim. 40, 513-9 (1937): C.A. 32, 811 (1938).
"A review of the developments during the last decade in the production and applications of China wood oil." From C.A.

Levy, Pierre

CHINA WOOD OIL.

Recherches et Inventions **12**, 138-44, 171-81, 239-43, 272-82 (1931): C.A. **26**, 322 (1932).

A general and rather thorough review. Following a brief introduction by A. Vila, Levy reviews I, Origin and Extraction, touching on a botanical study of *Aleurites* trees, the culture of *A. montana* and *A. fordii*, local trade in tung oil in the far East, and use of the wood and presscake. Under II, Properties of Tung Oil, constants are compared for commercial Chinese Wood Oil, American tung oil and Japanese wood oil. Limits within which the constants must fall for acceptable materials are tabulated for the American (Am. Soc. for Testing Materials), .. British and Australian specifications. Analytical methods measure the refractive index, the optical dispersion, gelation by heat, iodine, $SnCl_2$, or HNO_3, as well as qualitative tests using the Mg soap or maleic anhydride or phthalic anhydride adducts. Part III, Chemical constitution, reviews the chemical composition, the study of the cooking of the oil and its drying. Derivatives mentioned include bromides, esters, anhydrides and metallic salts. Part IV, Industrial Uses, discusses the manufacture of paints, varnishes, driers, etc.

Levy, Pierre

ALEURITES OR CHINA WOOD OILS.

Recherches et inventions **14**, 340-52 (1933): C.A. **28**, 3917 (1934).

"Examn. of oils of known origin and purity showed that for tung (*Aleurites fordii*) oil n_D^{20} is greater than 1.5160, $n_{436} - n_{471}$ is greater than 0.0310, $n_f - n_c$ is greater than 0.0185, the corresponding values for oil of *A. montana* are: 1.5100, 0.0310, 0.0185. In the I no. detn. by the usual methods, 7 days is required to obtain a complete reaction, and the values obtained by the usual procedure vary with time, wt. of sample taken and amt. of reagent added. The true I no. can be obtained by exposing to Br for 2 hrs. a thin film 7 x 7 cm. and weighing 0.05-0.30 g., heating at 50-60° to const. wt. and multiplying the increase in wt. by 127/80. The results are independent of the wt. of the film and the time of reaction. Genuine oils of *Aleurites* gave by this method I nos. of 220-234. The ratio of the Verdet const. of China wood oil to the Verdet const. of water varies from 1.563 to 1.595: the accuracy of the detn. is about the same as that of n. The changes produced by heating are qualitatively (but not necessarily quantitatively) the same in air, CO_2 or in vacuum: d. and viscosity increase: n, I no. and magnetic rotatory power (as measured by the ratio of the Verdet const. of the oil to that of water) decrease with increase in time or temp. of heating. On drying in air and light, films of China wood oil have a dull, "frosty" surface which the microscope shows to be due to innumerable minute wrinkles or folds in the surface: when the films are dried in the dark, drying is much slower (6-8 weeks) and the thinner films are nearly or completely free from "frostiness": in light, but in a dry atm. (H_2SO_4 desiccator), drying requires about 3 weeks and only the thin films exhibit "frostiness"; in a dry or moist vacuum, drying requires up to 1 yr., the surface is smooth: there is a loss in wt. of 1-3%; and there is an ethereal odor on opening the tubes. Pressed oils do not solidify even when exposed several months to sunlight or the light of an elec. filament lamp: oil obtained by extn. with petr. ether solidifies in from a few days to 1 yr. in the dark, in from a few days to 1 month in sunlight, and in a few hrs. when exposed to the light of a Hg-arc lamp. X-ray diffraction diagrams indicate that the solidified oil has a cryst. structure. Oils showing little or no tendency to solidification can be frozen, kept for a long time (up to 10 months) at low temp. (-5°), and liquefied by raising to atm. temp.: under the same treatment, oils having a strong tendency to solidification do not liquefy on raising to atm. temp. Comparative drying, cooking, solidification and tech. tests with oils of A. fordii and of A. montana of known origin and purity revealed practically no difference between the 2." From C.A.

Levy, Pierre

OIL OF ALEURITES MONTANA FROM INDOCHINA.
Recherches et inventions 16, 332-5 (1935): C.A. 29, 5291 (1935).
"A review of the properties and merits of Aleurites montana for paint and varnish manuf., showing the advantages there would be to developing its production in the French colonies." From C.A.

Levy, Pierre

DRYING ALEURITES OILS USED COMMERCIALLY.
Recherches et inventions 19, 11-58 (1939): C.A. 33, 7600-1 (1939).
"A study of the transformations which take place in the industrial treatment of these oils, comparing the properties and suitability of oil of Aleurites fordii (tung Oil)(I) and A. montana (abrasin oil) (II). The methods generally used for detg. the I no. of aleurites oils give an apparent I no. lower than the true I no. calcd. from the chem. compn. of the oil. True I no. can be detd. by measuring the increase in wt. of a thin film of the oil on treating with Br vapors and calcg. to the I equiv. of the absorbed Br. The increase is due entirely to addn. of Br without any substitution. The true I nos. thus found are 228-234. This detn. is particularly suited to the detection of adulteration and to the study of transformations which take place on heating aleurites oils. The isomerization of liquid α-eleostearin in fresh oils into solid β-eleostearin is generally attributed to the action of light or of certain catalysts. According to recently published work, it can occur spontaneously in extd. oils. L. found that this isomerization can take place in the dark and in absence of foreign substances. It does not occur in extd. oils only, but in pressed oils as well. The function of light and of moisture on the wrinkling of the films during drying is not clearly brought out in previous investigations. These factors are not the determining cause of wrinkling. Both I and II dry in the dark or in a perfectly dry atm., but much more slowly, the surface of the dried oil is then perfectly smooth, provided the film is sufficiently thick. This is interpreted by assuming that, in this case, oxidation proceeds evenly throughout the thickness of the oil resulting in progressive hardening thereof, and avoiding formation of surface film, the deformation of which is responsible for wrinkling. When I and II are heated close to the gelling point, as is done in the com. treatment of these oils, the only apparent change in the compn. is a loss of moisture. Probably the only transformation in the

structure of the glycerides consists in a mutual satn. of 3 of the 9 double bonds of the eleostearin. This was confirmed by a complete elementary analysis of the oils and by the detn. of the true I no., sp. refraction and acid no. When I and II are heated in the presence of driers, wrinkling can be more easily avoided as the layer of oil is thicker and as a consequence dries more slowly. The mutual satn. of the double bonds of the eleostearin is probably the reason for the lower tendency to wrinkle. In addn., catalytic action of driers is also considered to favor even progression of oxidation throughout, and consequently its progressive hardening before a surface film forms. If, however, the oil layer is thin the surface film forms rapidly, resulting in a wrinkled appearance. The properties of I and II are very similar, there being a slight difference in d, n, true I no., and rate of transformation when heated. Therefore II can be used for producing varnishes as good as those from I, provided that its slower transformation when heated is taken into consideration. In the preliminary treatment of the oil." From C.A.

Lin, D. Y.

CHINESE WOOD OIL.
Far Eastern Rev. 15, 598-601 (1919): Drugs, Oils & Paints 35, 292-3 (1920): Natl. Paint, Varnish Lacquer Assoc. Sci. Sect. Cir. No. 195, 232-41 (1924): C.A. 14, 850 (1920).

A general review is given which covers: the wood oil tree, cultivation of wood oil tree, cultivation in foreign countries, ages of fruitage, the fruit, extracting the seeds, extracting the oil, composition, properties, and uses of the oil, adulteration and the difference between Chinese and Japanese wood oil.

Longenecker, M. C.

TUNG TREE NUTS, FOUND ONLY IN INACCESSIBLE PARTS OF CHINA, IS BASE OF ENAMEL.
Automotive Indus. 50 (7), 325-6 (1924).

Tung oil, produced in Szechwan Province of China, is the basis of Chinese lacquers, of all American-made spar varnishes, and of the new automobile finishes. Enamels used on automobiles must be carefully compounded, flowed on to the automobile body at a uniform temperature of 70 to 80° and baked at 360° (primer) or 275° (final coat).

Loon, J. van

THE OLDER DRYING OILS.
Verfkroniek 11, 69-70 (1938): C.A. 32, 5645 (1938).

"This discussion of the compn., properties and uses of perilla, linseed and tung oils emphasizes the desirability of knowing more about the part played by their unsaponifiable components in detg. their properties." From C.A.

Lord, E. L. and Williamson, B. F.

THE TUNG OIL TREE.
Pepper Printing Co., Gainesville, Fla., 1924, 48 pp.

A comprehensive review of the culture of the tree with detailed recommendations for the establishment and care of a tung orchard. A botanical study of the Aleurites trees, the processing of the fruit and the composition, uses and marketing of the oil are also discussed.

McClure, E. A.
TUNG OIL IN THE YANGTZE VALLEY.
Lignan Science J. 9 (3), 233-65 (1930) (in English).

A review of the tung oil industry in the Yangtsze Valley in China touching upon the varieties and the culture of the tung trees, the processing of the fruit and the marketing, storage behavior, adulteration and uses of the oil. 35 references.

Mackay, R. C.
CHINESE WOOD OIL.
Can. Chem. Met. 8, 289-91 (1924): C.A. 19, 901 (1925).

The production of wood oil from A. montana and A. fordii in China is described with particular attention to the hulling and pressing methods and transportation difficulties. Oil exports from Hankow have increased from 89,530,000 lbs. in 1921 to 137,673,400 lbs. in 1923. The author warns that if the Chinese people continue their current practices of excessive prices, taxation, and adulteration they will lose their American markets to the American producers who are making a very promising start.

McKinney, Robert S.
TUNG OIL.
U. S. Dept. Agr. Bur. Agr. Ind. Chem. AIC-94, 13 pp. (1946):
C. A. 41, 2256 (1947).

"A review of the production, uses, and chem. and phys. properties of tung oil, together with statistical data on its consumption, imports, and prices in the U. S. in stated years. 65 references."
From C.A.

McNally, J. C.
"TUNGSHU" TREE AND ITS FRUIT. SIMPLE METHODS OF MANUFACTURE.
Daily Consular & Trade Reports. Feb. 15, 1909. No. 3407 pp. 5-6,
Dept. of Commerce and Labor, Bur. of Manufactures, Washington, D.C.
Oil, Paint Drug Reptr., p. 9 (Feb. 15, 1909).

A brief description of the tung tree, its culture in China, the native methods of processing the fruit, the uses of the oil and its marketing in China.

Margaillan, L.
NEW INVESTIGATIONS OF THE OIL SEEDS OF THE TROPICAL COUNTRIES.
Ann. musée colonial Marseille 7, No. 3, 5-32 (1929); Chem. Zentr.
1930, I, 3621-3; C.A. 25, 4424-5 (1931).

"The seeds of Trau (Aleurites montana) from Tonkin consist of 37% skin and 63% kernel. The latter contains 59.4% of a yellow oil (extd. with low-boiling petr. ether), n_D^{30} 1.5116, dispersion 0.0324. After some time this oil solidifies, m. 45°. At higher temps. and under the influence of light the fat polymerizes. The gelatinous polymerization product is insol. in fat solvents and is attacked by alkali. The same change occurs in old seeds, as shown by the changing consts." From C. A. (abridged).

Mathews, A. L.

POSSIBILITIES FOR THE TUNG OIL INDUSTRY IN FLORIDA.

E. O. Painter Printing Co., Deland, Fla., 49 pp. (July 1929).

The tung oil industry in Florida is covered in this review, which contains sections on (1) the product, (2) its origin and history, (3) history of tung oil in U. S., (4) consumption and demand, (5) developing the tung oil grove, and (6) cost of production, yields, and profits. A prosperous future for the tung industry in Florida is predicted.

Moldenke, H. N.

VITAL VEGETABLE OILS.

Vegetarian News (London) 24, 113-7 (1944)*; Biol. Abstracts 19, 1248, Abs. No. 11,500 (1945).

"A reprinting, in somewhat abbreviated and modified form, of an article by the same author and with the same title in Natural History 53, 231-237 (1944). Some of the original illustrations -- but not all -- are reproduced, and many of the data concerning oiticica, chia, and castor oils are omitted. The statement is made that tung oil is the most important of all vegetable oils." From Biol. Abstracts.

Morrell, R. S. and Wornum, W. L.

THE PROGRESS OF THE PAINT AND VARNISH INDUSTRY DURING 1928.

Ind. Chemist 5, 12-5 (1929): C.A. 23, 1516 (1929) (no abstract).

Articles pertaining to tung oil include those regarding yellowing by Eibner (Chem. Umschau 1927, 34, 183) and Munzert (Farben Ztg. 33, 2849 (1928). Gardner (Am. Paint & Varnish Manuf. Assoc. Circ. No. 328) reported successful tung culture at Gainesville, Fla. The British Paint & Varnish Research Assoc. are investigating growing Aleurites seeds in the British Colonies. Eibner and Rossman (Chem. Umschau, 35, 197 (1938)) find evidence that succinic acid is a secondary and not a primary oxidation product of eleostearic acid, thus supporting the 3-double-bond structure for the latter.

Mosher, R. B.

METHOD OF PRODUCING WOOD OIL.

Daily Consular and Trade Reports. June 26, 1911, No. 148, p. 1351 - Dept. of Commerce and Labor, Bur. of Manufactures, Washington, D.C.: Oil, Paint Drug Reptr., p. 28d. (July 3, 1911)*.

The nuts of the wood oil tree are roasted, ground and pressed. The oil is filtered and shipped to dealers who expose it to light and air so that sediment settles out. This is used locally for purposes like waterproofing boats while the clear liquid is exported.

Motte, Jean

ALEURITES.

Ann. musée colonial Marseille 1933 (2), 1-36 (1933)*: Biol. Abstracts 9, 1836, Abs. No. 16, 603 (1935).

"Geographic distribution of Aleurites fordii, A. montana, and A. cordata: culture and harvest of fruit: and extraction and characteristics of the oils are discussed. The practical conclusion is that in precocity, productivity, size of seed, quantity and quality of oil produced A. fordii should have precedence in establishing a plantation." From Biol. Abstracts.

Mundy, C. W. A.

DRYING OILS.

Oil Colour Trades J. 114, 1277-8, 1284 (1948): C.A. 43, 1197 (1949).

"Linseed oil is, and is likely to remain, the most important drying oil. Oils discussed also include: stillingia, tung, and dehydrated castor. *Aleurites montana* is an oil of the tung-oil type now being supplied from Nyasaland. It is a high-quality oil and there is a prospect that English needs may be met entirely from this source within 10 yrs. Subjects also discussed include: nonyellowing, interchangeability of drying oils, rubber-seed, and tobacco-seed oils. The chem. constitution of an oil is a matter of importance in assessing its value as a drying oil and in the fitting of new oils into our drying-oil economy." From C.A.

Newell, W.

PRELIMINARY REPORT ON EXPERIMENTS WITH THE TUNG OIL TREE IN FLORIDA.

Florida Agr. Exp. Sta. Bull. No. 171, pp. 193-234 (May 1924).

Following a botanical description of the *Aleurites fordii* tree it is compared with other *Aleurites* species. The wood-oil industry in China is described as well as the uses of the oil. The last part is devoted to recommended cultural practices and methods for the control of insect pests.

Newell, W., Mowry, H., and Barnette, R. M.

TUNG OIL TREE.

Florida Agr. Expt. Sta., Bull. 221, 5-63 (1930): C.A. 25, 2309 (1931).

"The Fla. acreage in tung-oil trees is about 5000. The fruits on examn. gave 55% hulls, 45% meat, 49% oil in the meat and 32-9% of oil in the seeds. Fully matured and thoroughly air-dried fruits consist of approx. 56% seed and 44% hulls. The tree thrives best in an acid, well drained soil. Lack of N in the soil is the principal limiting growth factor in Fla. but a well-balanced mixed fertilizer gives max. growth and yields of nuts. A tung-oil expression plant is located at Gainesville. The oil is graded as cold Pressed Fla. No. 1 and Fla. No. 2. The appearance of the former is pale and clear with a sp. gr. at 15.5° of 0.941, acid no. 0.5, sapon. no. 193.8, I no. 166, A.S.T.M. heat test 10.75 and n_{25} 1.519. Hulls and pomace remain after extn. of the oil. Pomace contains about 6% of N and compares favorably with castor-bean pomace as a fertilizer. The hulls contain a little N and K and are valuable chiefly as a mulching material. For varnish manuf. the oil gives a clearer and faster drying finish than the ordinary imported Chinese oil." From C. A.

Oucheouka and Limancheng

CHINA WOOD OIL.

Bull. inst. pin No. 36, 111-7 (1927): C.A. 22, 173 (1928).

"Review of its origin, production, phys. and chem. properties, compn. and constitution, and applications. Tests carried out have indicated its suitability as a paint and varnish material, both raw and heated with metallic resinates." From C.A.

Parker, R. N., Rau, M. G., Robertson, W. A. and Simonsen, J. L.
OILS AND FATS FROM THE SEEDS OF INDIAN FOREST PLANTS. VI. OIL FROM THE SEEDS OF ALEURITES MONTANA, WILSON.
Indian Forest Records 10, 11-22 (1923): C.A. 18, 2818 (1924).

"The oil had the following characters: d^{15}_{15} 0.9467, n^{15}_{D} 1.494, acid value 3.4, sapon. value 203, unsaponifiable matter 0.6%, I value 141.4, insol. fatty acids 94% (solidifying point 54-54.5°). The principal fatty acid present in the oil was β-eleostearic acid (m. 73°). The α-isomeride was apparently completely absent. The β-eleostearic acid was brominated in $CHCl_3$ soln. and an unstable dibromo deriv. (m. 95°) obtained. On bromination in AcOH soln. a mixt. of a solid and a liquid tetrabromo acid was obtained. The solid product, needles, m. 115°, was not identical with the tetrabromo acid from linolic acid. The liquid acids present in the oil were identified as oleic and linolic acids; linolenic acid was absent." From C.A.

Penfold, A. R.
AUSTRALIAN TUNG OIL.
J. Oil & Colour Chemists' Assoc. 31, 299-303 (1948)*: J. Am. Oil Chemists' Soc. 25, 422 (1948) (abstract).

"The oil exceeds Australian standard specifications in all tests and is reported to be of excellent quality. It is believed that the introduction of mechanical harvesters and the establishment of local decorticators would stimulate the lagging production. Cold expressed oils prepared in the laboratory often solidified within 36 hours even in the dark. In several instances fatty Substances (m.p. 39°C.) were separated which rapidly polymerized to rubber-like solids when purification was attempted." From J. Am. Oil Chemists' Soc.

Penfold, A. R. and Morrison, F. R.
TUNG OIL FROM AUSTRALIAN GROWN TREES OF ALEURITES FORDII, HEMSLEY.
Tech. Museum, Sydney, Bull. No. 12, (revised) 21 pp. (1931): C.A. 26, 3683-4 (1932).

"The culture and breeding of the tree are discussed: satisfactory oil is not obtainable before the 4th yr., the yield from the 5th to 9th yrs. bring 400-800 lb./acre. Oils from trees up to about 10 yr. old are pale, have d_{15} 0.938-0.941 (av.) and n_{25} 1.5135-1.5202, and give good results in the Browne heat test (8-1/2-12 min.). Seeds with an excessive water content cannot be satisfactorily expressed. Extn. with light petroleum tends to yield a semi-solid fat on account of isomerism. A non-gelling abnormal oil (n_{25} 1.5061) extd. by ether from a seed with high water content (5-yr. oil plantation) yielded, on cooling, an acidic cryst. substance m. 52°, sol. in EtOH, mol. wt. 308 (calculated as monobasic acid), which polymerized rapidly." From C.A.

Penfold, A. R. and Morrison, F. R.
TUNG OIL FROM AUSTRALIAN-GROWN TREES OF ALEURITES FORDII, HEMSL, WITH A NOTE ON A. MONTANA.
Tech. Museum, Sydney, 1940, Bull. 12, 34 pp.: Brit. Chem. Abstracts 1940, B, 754 (1940).

"Discussions of the cultivation conditions of tung trees and methods for their improvement, yields, etc. are based on observations of plantations in New South Wales and Queensland." From Brit. Chem. Abstracts.

Penfold, A. R., Morrison, F. R., and Smith-White, S.

CULTIVATION OF THE TUNG OIL TREE, ALEURITES FORDII. II. HEAVY YIELD OF FRUIT OBTAINED ON THE NORTH COAST OF NEW SOUTH WALES.

J. Proc. Roy. Soc. N. S. Wales 75, 148-156 (1942)*: Brit. Chem. Abstracts 1943, B, III, 48.

"Tung oil trees in two paddocks yielded (air-dry basis) 2.66 and 3.98 tons of fruit per acre. The oil content of the whole fruit was 20% and of the kernels, 60%. Oils from an average sample of the kernels from the two paddocks had $d_{15.5}^{15.5}$ 0.940, n_D^{25} 1.5164, acid val. 0.72, sap. val. 193.4, I val. (Wijs, 2 hr.) 164.4, Browne heat test 12 min." From Brit. Chem. Abstracts.

Phillips, M. O.

TUNG OIL: FLORIDA'S INFANT INDUSTRY.

Econ. Geog. 5 (4) 348-57 (1929).

A review covering the introduction of the tung tree into the U. S., its culture, pests, and the extraction and uses of the oil. P. hopes that the Florida tung industry will make the U. S. independent of China as a source for the oil.

Potter, G. F.

RESEARCH ON PROBLEMS OF TUNG PRODUCTION AND IMPROVEMENT, 1938-1946.

Proc. Am. Soc. Hort. Sci. 50, 443-7 (1947).

An historical review of research on the culture of the tung tree and of its benefits to the tung industry.

Potter, G. F. and Crane, H. L.

TUNG ORCHARDING IN THE POST-WAR PERIODS.

Proc. Amer. Tung Oil Assoc. 1945, pp. 21-26.

Suggestions for increasing tung orchard profits are listed. These include selection of good trees, fertilizing, cultivating, mechanizing, terracing, etc.

Rhodes, F. H. and Ling, T. T.

CHINESE WOOD OIL.

Ind. Eng. Chem. 16, 1051-5 (1924): C.A. 18, 3482 (1924).

"A review of the methods of cultivation and the distribution of Chinese wood oil trees, extn. of oil from the fruits, production statistics, phys. and chem. properties of the oil, etc." From C.A.

Rowe, D. E.

TUNG OIL AS APPLIED TO THE PAINT TRADE IN ENGLAND.

Oil & Soap 15, 45-6 (1938): C.A. 32, 3174 (1938).

"The factors which have hindered the use of tung oil in England are discussed: the question of durability of the finish, varying climatic conditions and price." From C.A.

Scott, John M.

TUNG OIL.

Florida Dept. Agr., Bull. 11, (New Series) 1-33 (1929).

A description of the tung-oil industry of Florida including planting and cultivation of the trees, harvesting the nuts, pressing the oil, etc. The Florida oil is practically neutral and of light color, whereas the Chinese oil, because of the crude method of handling, contains 5-8% free acid and is dark in color. The American press-cake contains less than 6% of oil, while the Chinese contains about 22%. The residue contained 6.4% of NH_3, 3.7% P_2O_5 and 1.3% K_2O, and is a valuable fertilizer. Consts. of Florida tung oil are: $d_{15.5}$ 0.9417, acid no. 0.1, I no. (Hübl) 170.1, sapon. no. 192.4, unsapon. matter 0.23%, Browne heat test (min.) 9-10.

Shanghai Bur. of Inspection & Testing of Commercial Commodities.
PLAN FOR ESTABLISHMENT OF A TUNG OIL RESEARCH INSTITUTION IN CHINA.
Inspection & Commerce (China) 4 (6), 7-8 (1933).

The Shanghai Bureau of Inspection & Testing of Commercial Commodities has been urged to undertake a program of research designed to (1) promote tung tree culture by scientific agricultural methods, (2) improve the yield and quality of the oil produced by the latest pressure extraction systems, (3) lower the cost of production by applying modern business methods, (4) reduce transportation costs and charges, and (5) develop new uses for tung oil.

Skinner, R. P.
CHINA WOOD OIL.
Daily Consular & Trade Reports, Aug. 25, 1908. No. 3262, p-5, Dept. of Commerce and Labor, Washington, D. C.: Oil, Paint Drug. Reptr. p. 17 (Oct. 5, 1908)*.

China wood oil is obtained from Elaeococca verrucosa and must not be confused with the product of Dipterocarpus turbinatus which is also called wood oil. The oil is used for paints, wood preservation and lighting. The oil solidifies if exposed to light.

Smithers, G. F., Jernigan, T. R., Alf, A. and Child, J. I.
THE CHINESE OIL TREE.
Consular Reports (Commerce, Manufactures, etc.) 54, No. 203, 477-83 (Aug. 1897).

Separate reports deal with the tung industry in Shanghai (Jernigan), Canton (Alf), Chungking (Smithers) and Hankow (Child).

Smithers, G. F.
CHINESE OIL TREE.
Consular Reports. Feb. 1898. No. 209. pp. 280-2 Dept. of Commerce and Labor., Washington, D. C.

The fruit of the tung-tsz shu (botan. Aleurites vernicia) is extracted in China in manually operated wedge presses yielding an oil used for waterproofing boats, other wood, and cloth, and is burned for light and to furnish soot for ink. Mixed with lime, sand, and clay the oil hardens to a tough material used in making forts.

Stevens, G. H. and Armitage, J. W.
PATENTS, TECHNOLOGY AND BIBLIOGRAPHY OF CHINA WOOD OIL (TUNG OIL).
Compiled and Published by George H. Stevens, Irvington, N. J.
and J. Warren Armitage, Newark, N. J., 1914. 2 Vols. of two parts
each 1722 pp.

Vol. I, parts 1 and 2, is composed of reproductions of original patents and of translations of all or parts of those not printed in English. Classified by countries, there are the following: U. S., 56: British, 58: German, 33: French, 27: Austrian, 5: Belgian, 1. Vol. II, parts 1 and 2, is composed of copies of articles published in English and translations of foreign ones, all dealing with the subject of tung oil.

Stingley, Dale V.
DOMESTIC SOURCES OF DRYING OILS.
Am. Ink Maker 18 (10), 27-9, 45 (1940): C.A. 35, 332 (1941).
The printing ink industry in the U. S. consumed in 1939 2,105,000 lbs. of tung oil out of a total tung oil consumption of 90,720,000 lbs. Of the latter, 1.2% was domestic oil while 98.8% was imported. Corresponding figures are given for linseed, perilla, castor, soybean, and fish oils. Physical properties and acid compositions are tabulated for tung and 11 other vegetable oils.

Stoutamire, R.
PRODUCING TUNG OIL IN FLORIDA.
Florida Dept. of Agr. Bull. No. 11, 43 pp. (Aug. 1935).
A thorough survey of the culture of the tung tree covering the following subjects: (1) introduction into Florida, (2) the oil and its uses, (3) market demands, (4) the tree and its fruit, (5) acreage and distribution, (6) soil consideration, (7) selecting seed, (8) culture and fertilization, (9) planting and maintenance costs, (10) yields and profits, (11) pests, (12) uses of tung oil, etc.

Sun, F. C.
TUNG OIL.
Agr. Assoc. of China J. 1932 (103), 29-86 (1932) (in Chinese).

Swearington, Lynn
THE AMERICAN TUNG INDUSTRY COMES OF AGE.
U. S. Dept. Com., Dom. Com 29 (24), 3-7, 11, processed. (June 11, 1942)*: Bibliog. of Agr. 1, A, 53 (1942): ibid. 1, E, 62 (1942).
"The location of the tung belt in America, uses of tung oil, pre-milling and milling problems, and the tung crop as an aid to diversification." From Bibliography of Agr.

Tersand, R.
CHINA WOOD OIL.
Mat. grasses 26, 10287-9, 10344-6 (1934): C.A. 29, 2002 (1935).
"A brief review of the origin and phys. and chem. properties of China wood oil." From C. A.

Tkatchenko, Boris

CULTURE OF TUNG TREE IN U.S.S.R.
Rev. intern. botan. appl. et agr. trop. 28, 32-48 (1948)*:
C.A. 43, 5204 (1949).

"A description of the ecologic conditions of the Russian tung belt. Selected *Aleurites fordii* is cultivated in Caucasian coast area of the Black Sea. The drying of fruits is substituted by a fermentation which softens epicarp and mesocarp so that the kernels can be freed from the flesh by washing. Losses in oil due to this fermentation are only 0.06-0.09%. Russian tung oil has d_{25} 0.9405-15, n 1.5210-60, acid value 0.50-0.98, sapon. value 194-8, I value 166-72. 55 references." From C.A.

Toch, Maximilian

A VISIT TO CHINA'S WOOD OIL REGION.
Paint, Oil and Chem. Rev. 78 (23), 12-3 (Dec. 3, 1924).

A report on facts learned while serving as Honorary Professor at Pekin Technical College. In the one Chinese wood oil refinery the oil is strained and heated with infusorial earth or substitutes to clarify and bleach it. In China Hankow oil is considered no better than Canton or Hong Kong oil. Adulteration, usually done en route to market with machine oil, can be detected by measurements of specific gravity and refractive index. The oil is called wood oil because the tree and the fallen nuts are used for fuel and not because it is used for varnishing wood. T. suspects that tung oil produced in America may differ in properties from Chinese oil due to a response of the tree to a new environment.

Uphof, J. C. Th.

CHINESE TUNG-OIL TREE IN FLORIDA.
Tropenpflanzer 29, 185-90 (1926)*; Biol. Abstracts 1, 700, Abs. No. 7481 (1927).

"A description and properties of the tung-oil tree are given. Individual healthy seed contain 31-49% of oil. The harvest of certain individual trees is very heavy. Seeds germinate in 3-8 weeks. Trees require a well drained soil and are planted 25 x 25 to 30 x 30 feet. Very little is known about the fertilizer requirements. The best time for planting seed is February." From Biol. Abstracts.

Vila, A.

COLONIAL OILS AND THEIR UTILIZATION IN MODERN PAINTS.
Recherches et inventions 14, 332-9 (1933): C.A. 28, 3917 (1934).

"An outline of work carried out recently on the chemistry of China wood oil and on its production in the U.S." From C.A.

Ward, E. N.

THE CHINESE WOOD OIL TREE.
Agr. Gaz. N. S. Wales 29, Pt. 6, 437-9 (1918): C.A. 13, 78 (1919).

"An article calling attention to the ease with which this valuable tree can be induced to grow in N. S. Wales. The oil obtained from it is a valuable substitute for linseed oil. The seed contains about 58% of the oil." From C.A.

Wen, Hsiang-Shing
TUNG OIL IN KWANGSI.
Chemistry (China) 3, 73-87 (1936)*: C.A. 30, 4699 (1936).
"A review." From C. A.

Wen, Hsiang-Hsing
TUNG OIL FROM WAN-HSIEN.
Chemistry (China) 3, 550-70 (1936)*: C.A. 31, 891 (1937).
"A general review covering (1) the production, (2) species and culture, (3) transportation, (4) trade, (5) refining, (6) price fluctuations and (7) taxes of the tung oil produced in the Wan-Hsien district, Szechuan province, China." From C.A.

Wen, Hsiang-Hsing
TUNG OIL FROM CHUNG-CHING.
Chemistry (China) 3, 729-45 (1936)*: C.A. 31, 558 (1937).
A general survey covering (1) the production, (2) export and trade,(3) quality, (4) transportation, (5) price fluctuations, and (6) refining of tung oil produced in the Chung-Ching district, Szechuan province, China.

Wilcox, L. S.
WOOD OIL AND WOOD-OIL TREE OF CHINA.
Daily Consular and Trade Reports, Mar. 15, 1905. No. 2206, pp. 2-6, Dept. of Commerce & Labor, Washington, D. C.; Oil, Paint Drug Reptr., p. 10, (Mar. 20, 1905).
The botanical classification is reviewed with many conflicting names listed. The culture of the tree in China, its growth habits and the processing of its oil are discussed. The oil is used for protective coatings, the pressed meal for fertilizer, the wood for lumber, and the fiber of the tree for a cloth. Oil selling for \$.0375-\$.04 per lb. is exported to the U. S., mostly in barrels. The shipping rate to New York is \$11.56 per long ton.

Willimott, S. G.
TUNG OIL IN CYPRUS.
Bull. Imp. Inst. 38, 409-18 (1940): C.A. 35, 6472 (1941).
"A description of tests carried out in Cyprus on the cultivation of Aleurites fordii from seed obtained from the Royal Botanic Gardens at Kew, Formosa, and Atlanta, Ga. The fruit obtained were of normal content with a satisfactory oil content of normal compn." From C. A.
Yields and physical and chemical properties of the oil are given.

Wilson, E. H.
CHINESE AND JAPANESE WOOD-OIL TREES AND THEIR PRODUCTS.
Bull. Imp. Inst. 11, 441-61 (1913)*: Farben-Ztg. 19, 422-6 (1914); C.A. 8, 582 (1914).
Illustrated article describing the different types of "Aleurites" (fordii, montana, and cordata), and carefully differentiating between their products. The A. fordii and montana are Chinese trees while the A. cordata is Japanese. In general the Japanese oils have lower ds. (d_{15} 0.9349-0.9400), lower n_D^{20} (1.5034-1.5083) and lower viscosities (1230-1620 secs. in a redwood viscosimeter

at 15.5°) than the Chinese products, which show the following consts.: d_{15} 0.9406-0.944: n_D^{20} (1,525-1.5207: viscosity 1605-2178 secs. The Japanese oil does not gelatinize at 250°, being thus easily distinguished from tung-oil.

Wood, E. C.

TUNG OIL. A NEW AMERICAN INDUSTRY.

U. S. Dept. of Commerce, Washington, D. C., 67 pp., June 1949.

"This booklet surveys the development of the tung-oil industry in the United States, discusses the chief industrial uses of the oil, and summarizes the status of production in China and other countries.

In 1932, when the American tung-oil industry was in its infancy, the United States Department of Commerce published a comprehensive study of tung oil which included a description of the first steps in the development of the industry in this country. The present booklet brings that earlier material up to date, particularly emphasizing the rapid strides made in what today is a thriving American industry." From the Foreword of the booklet.

It contains 5 chapters entitled: (1) Establishment of United States industry, (2) United States production and trade, (3) Tung oil in industry, (4) Chinese tung oil industry, and (5) Developments in other foreign countries.

Wulf, Heinrich.

INTERESTING DATA ON WOOD OIL.

Farben-Ztg. 45, 487-8 (1940): C.A. 35, 2345 (1941).

"The origin, manuf., drying properties, effect of heat, and com. applications are discussed. Com. wood oil lacquers contain not only wood oil but also some linseed oil. Likewise, com. linseed oil lacquers contain also varying amts. of wood oil as the combination of both oils has better properties than either oil by itself." From C.A.

Yuyee, K. S.

TUNG OIL PRODUCTION IN CHEKIANG.

Inspection & Commerce (China) 4 (10), 20-2 (1933).

Chekiang produces yearly about 200,000 piculs of tung oil paler in color and more in demand than the oil from the upper Yangtsze districts. Plantings are usually confined to the '3-year tung' variety planted on rocky hillsides and waste land. Corn is commonly planted as a cover crop for the first three years after the tung kernels are planted. The tung fruit are picked during the Han Lo cycle, and kept damp for 10 days in heaps covered with grass until the hull softens and bursts open. The kernels are dried, crushed and pressed twice according to a flow chart included in the article. Chekiang could benefit from adoption of modern methods of cultivation and processing.

Zhutsishvili, G. Z.

THE CULTIVATION OF THE TUNG OIL TREE IN THE SOUTHERN STATES OF THE U. S.

Bull. of Batum Subtropical Botan. Garden 1, 175-205 (1936)*: Biol. Abs. 12, 1556, Abs. No. 16, 688 (1938) (no abstract).

II. TREES

(a) Varieties, Propagation, Diseases, Anatomy and Physiology

Anonymous

TUNG OR WOOD OIL.

Pharm. J. 78, 128 (1907); C.A. 1, 1164 (1907).

Mr. W. B. Hemsley attributes tung or wood oil, not to *Aleurites cordata*, as has been done, but to *Aleurites fordii*, Hemsl., which he now describes for the first time. Some tung oil may also be obtained from *Aleurites trisperma*, a native of the Philippines.

Anonymous

NEW COLONIAL AND OTHER TANNING MATERIAL.

Bull. Imp. Inst., London, Eng. 2 (3), 423-4 (July-Sept., 1913).

Statements that the barks of *Aleurites cordata* and *A. triloba* are rich in tannin are incorrect. Samples from Hong Kong (1909) yielded 6.03% and 5.70% extractives. Bark from *A. fordii* contained 11.90% tannin and 8.70% non-tannin extractives. The latter produced a rather harsh, pale-colored leather of medium quality and is suitable for local use only.

Abbott, C. E.

FRUIT-BUD DEVELOPMENT IN THE TUNG-OIL TREE.

J. Agr. Res. 38 (12), 679-95 (1929)*; Biol. Abstracts 5, 194, Abs. No. 1964 (1931).

"Fruit-bud differentiation in the tung-oil tree (*Aleurites fordii*) occurs at any time between May 10 and October 1, with the majority of the buds differentiating during the latter half of June. Inflorescence differentiation in 1926 was clearly evident by June 14, and in 1927 by May 10. The early blossom-bud formation in 1927 indicates that the time of differentiation is hastened materially by a shortage in the amount of available soil moisture. The time of differentiation varied with the vigor of the trees; those that were growing vigorously differentiated floral parts later in the season than those of less vigor. The indications are that the % of pistillate flowers depends upon the vigor of the tree, more ♀ flowers being produced on trees making vigorous growth than on trees showing less vigor." From Biol. Abstracts.

Angelo, Ernest

SOME OUTSTANDING SEEDLING PROGENIES OF TUNG.

Proc. Am. Soc. Hort. Sci. 42, 315-7 (1943)*; Biol. Abstracts 18, 375, Abs. No. 3413 (1944).

"Selections were made in the fall of 1938 throughout the tung region of the U. S. These selections were of trees grown from seedlings and were made on the basis of yield, character of fruit, tree type, etc. After a tree had been selected and the necessary data taken, a sample of fruit was collected and stored in the laboratory. From a portion of this fruit, several thousand seedling trees were grown during the summer of 1939. Approx 53,000 of these were transplanted in Jan. and Feb., 1940, to 2 orchards in Louisiana. A temp. of 17° on Nov. 14, 1940, caused severe injury to many trees of some progenies. In Nov., 1942, yield records were taken on 18 of the progenies. These data show considerable variation in yield and coeff. of variability. Seedlings of the selection L-51 produced an average of 9.43 lbs. of fruit per tree with a coeff. of variability of 73. The lowest yielding progency recorded in this study was from the selection L-41, with an average yield of 0.11 lbs. per tree and a coeff. of variability of 200. Many of the progenies closely resembled the female parent in tree shape and in size of fruit. This study indicates the importance of care in selecting seed to be used in producing trees for the establishment of a commercial orchard. It further indicates the importance of testing seed from a selection before one can be certain that a wise selection has been made." From Biol. Abstracts.

Angelo, Ernest
A PRELIMINARY REPORT ON SEEDLING PROGENIES OF TUNG.
Proc. Am. Tung Oil Assoc. 1943, pp. 1-4.
Similar to "Some Outstanding Seedling Progenies of tung" by Ernest Angelo (Proc. Am. Soc. Hort. Sci. 42, 315-7 (1943).

Angelo, E., Brown, R. T., and Ammen, H. J.
POLLINATION STUDIES WITH TUNG TREES.
Proc. Am. Soc. Hort. Sci. 41, 176-80 (1943)*; Biol. Abstracts 18, 375, Abs. No. 3412 (1944).
"By means of microscope slides smeared with petroleum jelly, tung pollen was found to be carried by the wind as far as 100 ft. Tests were made to determine the importance of honey bees in the pollination of tung flowers. It was found that some pollination in tung may take place without the aid of insects but undisturbed flowers exposed to bees, flies and other flying insects set such a significantly large number of fruits as to indicate that tung flowers are largely insect-pollinated. Kraft paper bags proved satisfactory in preventing pollination and for use in controlled crosses and selfing. Pistillate flowers with corollas removed did not set fruit as well as did those with corollas attached. Covering the entire tung tree by means of a wooden frame over which a light grade of muslin is stretched makes a convenient method of carrying on controlled crosses and selfing. A study was made to determine the effectiveness in fertilization of pollen of flowers of 4 ages. Pollen from flowers that had been open 1 day and the anthers of which were beginning to shed pollen gave the best set of nuts." From Biol. Abstracts.

Angelo, Ernest, Lagasse, F. S., and Painter, J. H.
PROGRESS REPORT ON BREEDING AND IMPROVEMENT OF TUNG.
Proc. Am. Tung Oil Assoc. 1941, 23.

Angelo, E. and Potter, G. F.
THE ERROR OF SAMPLING IN STUDYING DISTRIBUTION OF THE ROOT SYSTEMS OF TUNG TREES BY MEANS OF THE VEIHMEYER SOIL TUBE.
Proc. Am. Soc. Hort. Sci. 37, 518-20 (1939).

A statistical analysis has been made of the variance of 100 samples of tung tree roots taken with the Veihmeyer soil tube and the results used in a discussion of various sampling procedures.

Bailey, L. H.
MANUAL OF CULTIVATED PLANTS, 255-6.
Macmillan Co., New York, 1924, 851 pp.

A botanical description of the *Aleurites fordii* and *A. moluccana* trees.

Blackman, G. H.
REPORT ON YIELDS OF TUNG TREES FROM SELECTED PARENTAGE.
Proc. Am. Tung Oil Assoc. 1944, 53-6; Biol. Abstracts 19, 1539, Abs. No. 14,183 (1944).

"The Florida Expt. Station has conducted a propagation exp. in which the progency of 2 trees, designated as Florida-2 and Florida-9, or F-2 and F-9, have been compared with budded trees of these clones. The yield records for 22 yrs. from 1922 to 1943, inclusive, show a significant difference in favor of the seedling trees over the budded trees." From Biol Abstracts.

Blackmon, G. H.
LEGUMES IN TUNG PRODUCTION
Proc. Am. Tung Oil Assoc. 1945, 27-30.

A review of cover crops for use in tung orchards.

Blackman, G. H., and Dickey, R. D.
FERTILIZER RATIO EXPERIMENTS WITH TUNG.
Proc. Am. Tung Oil Assoc. 1946, Part I, 8-12.

"There should be about the same percentages of nitrogen and potash in fertilizer for tung under conditions comparable to those existing in the orchard in which this investigation is being conducted." From the author's summary.

Boyd, O. C.
A BACTERIAL DISEASE OF TUNG-OIL TREE.
Phytopathology 20 (9), 756-8 (1930)*; Biol. Abs. 5, 1904, Abstract No. 19,439 (1931).

"This disease of *Aleurites fordii* occurs on leaves, petioles, and trunk. On the leaves the spots are angular, sharply delimited by the veins, brown to black on the upper side and yellowish on the under, and surrounded by a slightly water-soaked, faintly yellowish halo of indefinite width. The lesions may coalesce and form large areas of dead, easily broken tissue, thus imparting a torn and ragged appearance to the leaf. The accompanying lesions on the petioles are long, brown and extend into the cortex; those on the bark round to oblong, brown to black in color, extending into the wood. In no case did trees 4 yr. or older show marked injury, regardless of the health and rapidity of growth. The organism is unnamed." From Biol. Abstracts.

Brown, R. T. and Fisher, E.
PERIOD OF STIGMA RECEPTIVITY IN FLOWERS OF THE TUNG TREE.
Proc. Am. Soc. Hort. Sci. 39, 164-66 (1941); Biol. Abstracts 17, 858, Abstract No. 10,063 (1943) (no abstract).

Pistillate flowers of tung were receptive from the time the corolla opened until it had been open 9 days.

Clayton, E. E., Smith, T. E., Shaw, K. J., Gaines, J. G., Graham, T. W., and Yeager, C. C.
FUNGICIDAL TESTS ON BLUE MOLD (PERONOSPORA TABACINA) OF TOBACCO.
J. Agr. Res. 66 (7), 261-76 (1943); Biol. Abstracts 17, 1568, Abstract No. 17,346 (1943).

"Studies on the control of the blue mold disease of tobacco have shown that some of the vegetable oils have marked fungicidal value. Some of the most effective oils were soybean, linseed, cottonseed, tung, oiticica and peanut. The non-fungicidal oils included olive, castor, palm, coconut, chaulmoogra, beef tallow, pine and paraffin. Fungicidal properties appeared to be associated with the presence of linoleic, linolenic, eleostearic and licanic glycerides." From Biol. Abstracts (abridged).

Dickey, R. D.
COLD INJURY TO DORMANT BUDS OF TWO TUNG VARIETIES AND ITS EFFECT ON YIELDS
Proc. Am. Soc. Hort. Sci. 52, 115-6 (Nov., 1948)*

Dickey, R. D and Blackmon, G. H.
COLD DAMAGE TO TUNG IN THE GAINESVILLE AND MONTICELLO, FLORIDA, AREAS IN 1950.
Proc. Am. Tung Oil Assoc. 1950, 1-5

Six days of freezing temperatures in Feb., 1950, following 7 weeks of warm weather caused severe damage to tung orchards. In the Gainesville area practically all fruit and many trees were lost. In the Monticello area damage was less extensive because of the higher nutritional level of the orchards.

Dickey, R. D. and Reuther, W.
FLOWERING, FRUITING, YIELD AND GROWTH HABITS OF TUNG TREES.
Bull. Univ. Florida Agr. Exp. Sta. 343, 1-28 (1940)*; Biol. Abstracts 14, 1050, Abs. No. 11,095 (1940).

"There is a considerable difference in bearing ability of seedling tung trees which is due to the difference in the genetic constitution of the tree." From Biol. Abstracts (abridged).

Dunn, S. T.

CHINESE WOOD OIL (PASSAGE FROM REPORT ON THE BOTANICAL AND FORESTRY DEPARTMENT, HONG KONG, FOR 1905).

Kew, Eng., Botanical Gardens 9, pp. 398-99 (1906).

Comments on progress made toward clearing up the confusion regarding different species of Aleurites.

Fernholz, D. L. and Hines, Lee

PRELIMINARY STORAGE EXPERIMENTS WITH POLLEN OF TUNG (ALEURITES FORDII HEMSL.).

Proc. Am. Soc. Hort. Sci. 40, 251-4 (1942)*; Biol. Abstracts 18, 1286, Abs. No. 11,664 (1944).

"Pollen of tung, Aleurites fordii, was gathered either as entire flowers, as anthers, or as pellets collected by bees and removed by means of a trap at the hives. The latter could not be germinated; in flowers held in paper bags at 5° C., however, pollen remained viable for 24 days. Storage of anthers in vials at the same temp. also maintained the viability of the pollen for periods up to 21 days, those from unopened flowers having the highest % of germination at all times, in comparison with those from opened flowers gathered from the trees or from the ground. Room temps. were unsatisfactory for storage. Rel. humidity had little influence on longevity of pollen, though it did on the % of germination obtained on a medium consisting of 1% of agar with 10% of sucrose in water; high humidity was most favorable." From Biol. Abstracts.

Fernholz, D. L.

COLD RESISTANCE OF BUDS, FLOWERS AND YOUND FRUITS OF TUNG.

Proc. Am. Soc. Hort. Sci. 41, 124-6 (1942)*; Biol. Abstracts 18, 2162, No. 20,393 (1944).

"Frosts cause little or no permanent injury to the tung tree, Aleurites fordii, yet may destroy the blossoms. As tung buds pass from the dormant to the open cluster stage, they become increasingly susceptible to injury. A temp. of 28° F. caused no injury to dormant buds, but seriously injured buds at the open cluster stage due to the exposure of the tender pedicels and peduncles. By the time the flowers opened, they were considerably more resistant. The ovaries became increasingly susceptible until after pollination. About 3 or 4 weeks after bloom, the young fruits became slightly more resistant". From Biol. Abstracts.

Fernholz, D. L. and Potter, G. F.

INJURY TO TUNG TREES BY LOW TEMPERATURES OCCURRING IN NOVEMBER, 1940.

Proc. Am. Soc. Hort. Sci. 40, 225-30 (1942); Biol. Abstracts 17, 1551 (1943).

"The very cold weather coming before the tung trees were dormant caused severe injury, but the trees made a remarkable recovery during the 1st growing season." From Biol. Abstracts.

Forbes, A. P. S.
SOME TUNG OIL DISEASES IN NYASALAND.
Nyasaland Tea Assoc. Quart. J. 4 (4), 6-10 (1940)*; Biol. Abstracts 15, 582, Abs. No. 6623 (1941).

Leaf spot, dieback, collar crack, collar rot, and decline disease of unknown cause are discussed.

Cheo, M. T., Lui, C. Z., and Ma, T. L.
THE TUNG-OIL TREE MEASURING-WORM, BUZURA SUPPRESSARIA GUEN. (LEPIDOPTERA).
Chedah Agr. Quart. 1,137-205 (1937) (English summary)*; Rev. Applied Entomol. 27A, 614 (1939)*; C.A.34 1805 (1940).

"Biol. data are given for this defoliating pest and cultural practices for its control are outlined. Pb arsenate and pyrethrum were effective larvicides, but the latter is too costly to be practical." From C. A.

Delp, L. A.
SALAMANDERS. THEIR DAMAGE AND CONTROL.
Proc. Am. Tung Oil Assoc. 10, 74-6 (1944)*; Biol. Abstracts 19, 1539, Abs. No. 14,185 (1945).

"The use of chloropicrin, a tear gas, sold under the trade name of Larvacide, was found economical and effective in the control of salamanders in tung orchards. The runways were opened and about one-half teaspoonful placed in both sides of the runway. This was done with the aid of a long glass tube with a rubber bulb attached." From Biol. Abstracts.

Dickey, R. D.
THE IMPORTANCE OF TUNG SEED SELECTION.
Proc. Am. Soc. Hort. Sci. 41, 127-30 (1942)*; Biol. Abstracts 18, 375, Abs. No. 3414 (1944).

"A study of 133 trees from unselected seed and 130 and 143 No. 2 and No. 9 seedlings respectively indicated that marked increase in yield could be accomplished by use of seedlings from selected seed. The No. 2 and No. 9 trees were 11 yrs. old and averaged 78.6 and 73.4 lbs. of nuts per tree respectively, while the unselected 18-yr.-old seedlings averaged 57.7 lbs. When characters such as habit of growth, similarity of inflorescence to parent tree, shape and size of fruit, time of fruit fall, and size of crop were considered, 56.9% of No. 2 seedlings and 59.4% of No. 9 seedlings were very true to type. Only 3.1% of No. 2 and 4.9% of No. 9 seedlings were unlike the parents in all the characters considered." From Biol. Abstracts.

Ermel, M. W.; Sanders, D. A.; and Swanson, L. E.
TOXICITY OF FOLIAGE OF ALEURITES FORDII FOR CATTLE.
J. Amer. Vet. Med. Assoc., 101, 136-137, (1942)*; Brit. Chem. Abstracts 1943, A, III, 679.

"Cattle died after eating foliage of the tung oil tree (Aleurites fordii). Affected cattle showed gastro-enteritis; similar symptons followed feeding two heifers with macerated leaves of the plant." From Brit. Chem. Abstracts.

Hemsley, W. B.
ALEURITES.
Roy. Botan. Garden, Kew, Bull. Misc. Inform. 1906, 20-1
A comparison of different species of Aleurites.

Hemsley, Wm. B.
THE WOOD-OIL TREES OF CHINA AND JAPAN.
Roy. Botan. Gardens, Kew, Bull. Misc. Inform. 1914, 1-4*
A discussion of species of Aleurites.

Henry, Max
STOCK LOSSES IN TUNG OIL PLANTATIONS.
Agr. Gaz. N. S. Wales 54, 217 (May 1, 1943)*; Bibliog. of Agr. 3, H, 35 (1943).

Hillier, J. M.
XXII. CHINESE WOOD OIL.
Roy. Botan. Gardens, Kew, Bull. No. 4, 117-21 (1906).

Recent investigations by W. B. Hemsley show that the tung yu tree (source of the true Chinese wood oil) is not A. cordata, as was generally accepted, but is a new species, A. fordii. The growth habits of the trees, the expression of oil from the fruits and the marketing of the oil are discussed. Details of the exportation of oil from Hankow are given for 1905.

Hines, Lee
THE DISEASE SITUATION IN TUNG.
Proc. Am. Tung Oil Assoc. 1940, 12-13*

Hines, Lee
A LOCAL EPIDEMIC OF THREAD BLIGHT ON TUNG.
Proc. Am. Tung Oil Assoc. 1941, 46*

Johnston, Frederick A., Jr., and Sell, Harold M.
CHANGES IN CHEMICAL COMPOSITION OF TUNG KERNELS DURING GERMINATION.
Plant Physiol. 19, 694-8 (1944); C.A. 39, 2312 (1945).

"Sucrose is a readily available reserve carbohydrate and is utilized rapidly during the entire process of germination. Oil is the principal reserve food material in the tung kernel and gives rise to reducing sugars and starch as germination progresses. Formation of the latter substances takes place rapidly at the time of high lipase activity and is accompanied by the formation of free fat acids. This suggests that the glycerides of tung oil are hydrolyzed before being converted into carbohydrates. The protein reserve is hydrolyzed throughout the germination period to give sol. N products." From C. A.

Kilby, W. W.
RECENT RESEARCH IN BREEDING AND SELECTION OF TUNG.
Proc. Am. Soc. Hort. Sci. 52, 81-7 (Nov., 1948)*.

Frappa, C.
AN AFFLICTION OF ALEURITES FORDII IN THE PLANTATIONS OF ITASY.
Insp. Gen. des Serv. Agr. B. Agr. 1 (4), 24-5 (Oct. 1948).
Madagascar.*

Ginkul, S. G.
THE TUNG OIL TREE.
Bull. Appl. Bot., Genet. & Plant Breed. Ser. (10) 2, 137-53 (1935) (in Russian)*; Biol. Abstracts 11, 997, Abs. No. 9368 (1937).
A discussion of the characteristics of different species of Aleurites.

Gocholashvili, M. M.
THE FROST RESISTANCE OF SUBTROPICAL PLANTS.
Bull. Acad. Sci. URSS Cl. Sci. Math. et Nat. Ser. Biol. 1940 (4), 522-35 (1940)*; Biol. Abstracts 17, 589, Abs. No. 6966 (1943).
"The Chinese tung oil tree (Aleurites fordii) is more frost resistant than the Japanese specie (A. cordata) but the frost resistance of both is increased by cutting the roots which reduces the leaf moisture content (by transplanting the sensitive young trees)." From Biol. Abstracts.

Hamilton, Joseph
THE EFFECT OF LENGTH OF ROOT, SIZE OF TOP AND WATERING AT PLANTING ON THE GROWTH OF ALEURITES FORDII.
Proc. Am. Soc. Hort. Sci. 42, 371-4 (1943)*; Proc. Am. Tung Oil Assoc. 1943, 9-13, Biol. Abstracts 18, 375, Abs. No. 3417 (1944).
"Seedling tung trees dug with the root system largely intact and the top left unpruned had, by the end of the first season after transplanting, gained 13.8 sq. cm. in cross sectional area of the trunk. When both tops and roots were pruned (standard practice), the gain was 4.3 sq. cm.; when top only was pruned, it was 6.8 sq. cm. Watering at time of planting had no significant effect." From Biol. Abstracts.

Hamilton, J. and Dickey, R. D.
GROWING AND TRANSPLANTING NURSERY TREES OF ALEURITES MONTANA IN FLORIDA.
Proc. Am. Soc. Hort. Sci. 42, 375-9 (1943)*; Biol. Abstracts 18, 375, Abs. No. 3418 (1944).
"Plantings at Bradenton, Florida, of A. montana seed made on Dec. 5 and Jan. 20 gave better stands and growth than those made Feb. 20 or Mar. 20. A planting depth of 4-5 inches appeared superior to 2 inches. A weed mulch delayed germination compared to no mulch. Using the inverted T method, buds of A. fordii and A. montana inserted on montana stock in Sept. took well. Both nursery and transplanted trees seem very susceptible to drought, which appears to be the cause of most failures." From Biol. Abstracts.

Kilby, W. W. and Parker, M. D.
THE GROWTH PERIOD IN SHOOTS AND FRUITS OF MATURE TUNG TREES.
Proc. Am. Soc. Hort. Sci. 39, 161-3 (1941); Biol. Abstracts 17, 858, Abs. No. 10,068 (1943) (no abstract).

Growth measurements were taken at 1-2 week intervals in a 7-yr.-old orchard in Southern Mississippi from Apr. 17 to Aug. 21, 1940.

Lagasse, F. S.; Potter, G. F.; and Blackmon, G. H.
RELATIVE VARIABILITY OF FRUITS OF SEEDLING AND BUDDED TUNG TREES.
Proc. Am. Soc. Hort. Sci. 52, 107-11 (1948).

The fruit from seedling trees were consistently more variable than those from budded trees originating from the same parent.

Large, J. R. and Hines, Lee.
THE THREAD BLIGHT SITUATION IN 1942.
Proc. Am. Tung Oil Assoc. 1942, 30-33*

Large, J. R.
EXPERIMENTS ON THE CONTROL OF THREAD BLIGHT IN TUNG ORCHARDS.
Proc. Am. Tung Oil Assoc. 1943, 24-9; C.A. 39 2615 (1945).

"Summer spray applications of Bordeaux mixts., 6-2-100 and 6-6-100 both plus 1-100 summer oil greatly decreased thread blight (Corticium koleroga (Dke) Hohn. also known as C. stevensii Burt.) infection in a tung orchard near Varnado, Louisiana. A 0.1% Et Hg oleate spray was not so effective as the Bordeaux mixt. The 6-2-100 Bordeaux plus oil caused some injury to the tung foliage. On the basis of these expts. and results obtained by J. H. Painter in a tung orchard near Lamont, Fla., it appears that the best Bordeaux formula for controlling thread blight in tung trees is a 6-2-100 without oil sprayed in June. Under severe infection conditions an addnl. application in July may be required." From C. A.

Large, J. R.
ROOT-ROT OF TUNG AND ITS CONTROL.
Proc. Am. Tung Oil Assoc. 1943, 34-7; C.A. 39 2614 (1945).

"Tung nursery trees, although weakened and stunted by nematodes the first year, will usually outgrow the infestation when planted in the permanent orchard, but may be more subject to winter injury than healthy trees. To prevent nematode infestation of tung in the nursery the trees should be planted on new land or in soil that has been in grass pasture for at least 2 years. Peanuts, velvet beans, crotalaria, oats, and rye tend to reduce the nematode population." From C.A.

Large, J. R.
RECENT OBSERVATIONS ON THREAD BLIGHT, CORTICIUM STEVENSII, OF TUNG AND SOME NATIVE PLANTS IN THE SOUTHEASTERN UNITED STATES.
Plant Dis. Rep. 27, (10/11) 223-4 (1943)*; Biol. Abstracts 18, 182, Abs. No. 1641 (1944).

"Thread blight, known to attack tung oil tree in Florida, Louisiana, and Mississippi, was found in addition on the following plants in the last 2 named states: sweet gum (*Liquidambar styraciflua*) black gum (*Nyssa sylvatica*), dogwood (*Cornus florida*), wild crab apple (*Malus augustifolia*), blackberry (*Rubus sp.*), columbine (*Aquilegia canadensis*), American holly (*Ilex opaca*), and gallberry or inkberry (*I. glabra*). Infective swamp trees are probably the source of inoculum for tung orchards. Sanitation and spraying have given reasonable control of the disease on tung. The most effective time of spraying is in June, just as the hyphae emerge from the overwintering sclerotia." From Biol. Abstracts,

Large, J. R.
ALCOHOLIC FLUX OR WHITE SLIME FLUX ON TUNG TREES.
Plant Dis. Rep. 28 (1), 35-6 (1944)*; Biol. Abstracts 18, 1902, Abs. No. 17,805 (1944).

"A foamy exudate is seen bubbling from cracks in the bark near the crotch of the tree in late summer (Sept.). Later, an icicle-like mass of gelatinous flux extends down the trunk of the tree from the canker. Eventually, death of the tree results due to girdling. A bacterium and an Actinomycete are possibly implicated in the etiology." From Biol. Abstracts.

Large, J. R.
WEB BLIGHT OF SEEDLING TUNG TREES TENTATIVELY IDENTIFIED AS THE RHIZOCTONIA STAGE OF CORTICIUM MICROSCLEROTIA.
Phytopathology 34 (7), 648-9 (1944)*; Biol. Abstracts 18, 2173, Abs. No. 20,500 (1944).

"In June 1942 and again in 1943, lower leaves of tung trees in nurseries in Miss. and La. were observed to be covered with mycelium. Cultures of diseased tissues developed distinct Rhizoctonia features. Microscopic measurements of sclerotia found on infected leaves averaged 150 x 200. Bean plants innoculated with sclerotia developed web blight symptoms; on reisolation the organism was identical to the culture from tung seedlings. The small size of the sclerotia, the growth of the fungus in water-agar cultures, and the general similarity of the symptoms on diseased tung trees to those described for web blight of beans suggeste that this is the *Rhizoctonia* stage of web blight, *Corticium microsclerotia*." From Biol. Abstracts.

Large, J. R.
TUNG DISEASES, 1945.
Proc. Am. Tung Oil Assoc. 31-7 (1945); Rev. Int. Ind. Agr. 7 (4-5) 45 (2224) (1946); Oleagineux 1, 176 (1946).

"Diseases and physiological abnormalities of aleurites trees. Symptoms, causes and remedies for diseases of fungus of bacterial origin." Translated from Oleagineux.

Large, J. R.
PARASITIC DISEASES OF TUNG.
Plant Disease Rept. 33, 22-30 (Jan. 15, 1949)*; Assoc. Southern Agr. Workers, Proc. 45, 123 (1948)*.

Large, J. R.
ROUGH BARK OF TUNG, A VIRUS DISEASE.
Phytopathology 39, 718-20 (1949); Oleagineux 5, 207 (1950) (abstract).

"A disease that causes rough bark and willowy twisted branches of tung, Aleurites fordii Hemsl., is described. The disease, which has been named "rough bark" has been found in two widely separated orchards one in Louisiana and one in Mississippi. Implanting buds from diseased shoots into healthy stocks has induced the disease in suckers developing both above and below the implanted rough bark bud. In the absence of other casual organisms, the transmission of rough bark disease from the affected bud through the healthy rootstock to suckers indicates that this disorder is a virus disease." Summary of article in Phytopathology.

Large, J. R.; Drosdoff, M.; Painter, J. H.; Sell, H. M.; and Gilbert, S. G.
TUNG TREE DISEASES.
Proc. Am. Tung Oil Assoc. 1943, 24-9, 34-7, 50-53, 54-6; Expt. Sta. Rec. 92 (2), 228 (1945); Oleagineux 1, 48 (1946) (abstract).

These articles comprise: (1) attempts to control Thread Blight, (2) the root knot and means of control, (3) potassium deficiencies of tung trees and (4) copper deficiencies of tung trees.

Large, J. R.; Fernholz, D. L.; Merrill, S., Jr.; and Potter, G. F.
LONGEVITY OF TUNG SEED AS AFFECTED BY STORAGE TEMPERATURES.
Proc. Am. Soc. Hort. Sci. 49, 147-150 (1947).

Data are presented in graphical form which show that low temperature (34-36° F.) prolong viability.

Li, Lae-Yung
THE INFLUENCE OF STRATIFICATION OF TUNG SEEDS UPON EMERGENCE AND ESTABLISHMENT IN THE NURSERY.
New Zealand J. Science and Tech. 25A (1), 43-8 (1943)*; Biol. Abstracts 20, 201, Abs. No. 1714 (1946).

"Stratified and non-stratified seeds of tung at various temps. displayed the following results. Stratified seeds completed emergence sooner than non-stratified seeds and established more seedlings. Seeds stratified at 32° F. and at 38° F. emerged quicker and gave somewhat better establishments than those stratified at 60° F. Temps. of 32° and 38° F. gave no significantly different results." From Biol. Abstracts.

Lizer y Trelles, C. A.
COCCID NOTES I.
Rev. Soc. Ent. Argentina 11 (4), 319-35 (1942)*; Biol. Abstracts 17, 897, Abs. No. 10,550 (1943).

Hemiberlesia diffinis has been reported on tung trees.

McCann, Lewis P.
THE STRUCTURE OF THE TUNG FRUIT.
Proc. Am. Tung Oil Assoc. 1941, 11*

McCann, L. P.
DEVELOPMENT OF THE PISTILLATE FLOWER AND STRUCTURE OF THE FRUIT OF TUNG (*ALEURITES FORDII*).
J. Agr. Res., Washington, *65* (8) 361-78 (1942); Agron. Trop. No. 1-2, p. 88 (1947); *Oleagineux* *2*, 344 (1947).

A study of the growth of the terminal buds of aleurites, of the types of inflorescence, of the formation of dormant buds; of the growth of the fruit, of the structural development of the seed, of its embryo and its endosperm, of the structure of the mature fruit and of its vascular anatomy.

McCann, L. P.
EMBRYOLOGY OF THE TUNG TREE.
J. Agr. Res. *71* (5), 215-29 (1945)*; Biol. Abstracts *19*, 2453, Abs. No. 22,533 (1945).

"A study of the terminal buds, flowers and fruit of the tung tree (*Aleurites fordii*) was made on samples collected near Bogalusa, La., from Sept., 1938, to June, 1942. The tung ovule is anatropous, except the nucellus protrudes through and beyond the micropyle. The megaspore mother cell is hypodermal in origin and subsequent divisions result in the formation of a normal 8-nucleated embryo sac. The egg nucleus is fertilized between 24 and 36 hrs. after pollination and then rests for 1-2 weeks before dividing. At 2-4 weeks after pollination embryos were in the 8-celled stage. Most embryos were in the 32-cell stage at 6-10 weeks after pollination as there is a shor rest period at this period of development which occurs the latter part of May and early June. Rapid cell division of the embryo begins after July 1, and full size is attained by late Aug. Endosperm development begins about 52 hrs. after pollination with the first division of the 3*n* fusion nucleus. Subsequent development occurs slowly until about mid-June. Rapid endosperm development is concurrent with that of the embryo and both fill the seed by late Aug. Morph. details of the formation and physiol. functions of the various tissues are discussed." From Biol. Abstracts.

McCulloch, L. and Demaree, J. B.
A BACTERIAL DISEASE OF THE TUNG-OIL TREE.
J. Agr. Res. *45* (6), 339-46 (1932)*; Biol. Abstracts *7*, 1534, Abs. No. 15,305 (1933).

"A leaf spot of *Aleurites fordii* in Georgia was first reported in 1929. Characteristic brown, angular spots are formed; severe infection causes defoliation. Heat and moisture favor its development. The bacteria remain alive and infectious over winter (in Georgia) in fallen tung-oil leaves. Leaves and petioles of *Ricinus communis* are slightly susceptible and several varieties of *Phaseolus* are very susceptible. The causal organism, *Bacterium aleuritidis* (p. 346), belongs to the green fluorescent group but in certain characters differs from the hitherto reported species." From Biol. Abstracts.

Mendes, P. T.

PRELIMINARY NOTES ON THE HYBRIDS OF TUNG.
Rev. Agric. (Piracicaba) 20 (7/8), 274-6 (1945)*; Biol. Abstracts 20, 482, Abs. No. 4300 (1946).

"A hybrid of Aleurites fordii ♀ x A. montana ♂ is described. In the young plant the characters of A. montana seemed to predominate but later in life the hybrids showed morphological characters intermediate between the 2 spp. It is hoped to produce a type adapted to Brazilian conditions." From Biol. Abstracts.

Mendes, T. P.

OBTAINING TUNG GRAFTS.
Rev. Agric. (Piracicaba) 21 (3/4), 158-63 (1946)*; Biol. Abstracts 20, 2213, Abs. No. 20,923 (1946).

"Successful culture of tung (Aleurites fordii ?) depends in large part on the quality of the transplants which in turn goes back to seed quality. Practical advice is given on sowing the seed and on proper cultural methods." From Biol. Abstracts.

Merrill, S., Jr.

CHARACTERISTICS IN THE NURSERY OF TUNG PROGENIES FROM OPEN-POLLINATED SEED OF ONE HUNDRED SIXTY-NINE PARENT TREES.
Proc. Am. Soc. Hort. Sci. 43, 149-54 (1943)*; Biol. Abstracts 18, 1566, Abs. No. 14,393 (1944).

"Seed from 169 open-pollinated parent tung trees was planted in an exptl. area in a lattice design. Data were obtained on germination of the seed, and on height, trunk diam., and branching of the nursery plants at the end of the first season. Analyses of variance show that differences between the progenies with respect to germination, height, trunk diam., and % of branched trees are much greater than might be anticipated as a result of random sampling from a single population. The progenies differed inherently in the characteristics studied. Bartlett's ^{2} shows that the variances for height and diam., calculated separately for each of 165 progenies, are heterogeneous. These 165 progenies differed significantly in uniformity of these 2 characteristics." From Biol. Abstracts.

Merrill, S., Jr.

THE BUDDING OF TUNG (ALEURITES FORDII HEMSL.).
Proc. Am. Soc. Hort. Sci. 44, 227-35 (1944)*; Proc. Am. Tung Oil Assoc. 1944, 35-42; Biol. Abstracts 18, 1871, Abs. No. 17,512 (1944).

"Nursery stands of 75-95% may be had by budding tung at the optimum season, mid-Aug. to early Sept. and protecting the buds from cold injury by banking with earth from Nov. to March. All scion clones seem to bud equally well, but some rootstocks (the progenies from open-pollinated seed of individual parent trees) give better stands than others and rootstocks appear to differ in the opt. season for budding; those that bud well early in the season tend to bud poorly late in the season and vice versa. The best stands are obtained during the period when the rootstocks are making their most rapid growth. T-budding proved superior to patch-budding. Soil texture and fertility, if adverse to seedling growth, decrease the stand but climatic factors do not seem to play an important role excepting indirectly they affect the growth of the rootstock." From Biol. Abstracts.

Merrill, S., Jr.
GERMINATION OF EARLY-PLANTED AND LATE-PLANTED TUNG SEEDS AS AFFECTED BY STRATIFICATION AND VARIOUS SEED TREATMENTS.
Proc. Am. Soc. Hort. Sci. 49, 151-157 (1947).
Proper stratification accelerated emergence, the results depending in part on the parentage of the seed.

Merrill, S., Jr.
BREAKAGE OF TUNG TREES BY HURRICANE WINDS IN RELATION TO VARIETY, PRUNING METHOD, AND CROP.
Proc. Am. Soc. Hort. Sci. 51, 145-51 (1948).
Most varieties suffered less when allowed to form a natural head than when pruned to vase form. McKee seedlings, trained to a natural head, suffered very little damage.

Merrill, S., Jr.; Angelo, E.; and Greer, S. R.
CARE IN TRANSPLANTING REDUCES MORTALITY AND IMPROVES GROWTH IN TUNG TREES.
Proc. Am. Tung Oil Assoc. 1945, 1-4.
"To insure good stands and satisfactory growth tung trees must not be allowed to dry out after they are lifted from the nursery and before planting in the orchard." From the authors' summary.

Merrill, S., Jr.; Slick, W. A.; Brown, R. T.; and Painter, H.
EFFECT OF PLANTING DATE ON GERMINATION OF TUNG NUTS IN THE NURSERY.
Proc. Am. Soc. Hort. Sci. 39, 153-6 (1941); Biol. Abstracts 17, 859, Abs. No. 10,073 (1943) (no abstract).
The most advantageous planting season is in late Feb. or March.

Mowry, H.
VARIATION IN THE TUNG OIL TREE.
Florida Agr. Exp. Sta. Bull. No. 247, 1-32 (May, 1932).
Studies were made of the variations in fruits and yields of tung-oil trees.

Neff, M. S.; and O'Rourke, E. N., Jr.
F-578, A PROMISING NEW TUNG PROGENY.
Proc. Am. Tung Oil Assoc. 15 (2), 48-51 (1949).
"Because of their ability to crown freely and to increase rapidly the number of terminals, seedling tung trees of F-578 parentage produced over 30 pounds of fruit at the end of the fourth year in the orchard. In two comparative tests seedling trees of this progeny ranked first in production in a planting that included 53 budded varieties and 5 other seedling progenies. The F-578 is herewith added to the list of recommended seedling progenies." From the author's summary.

Neff, M. S., and O'Rourke, E. N.
FIBROUS ROOTS. IMPORTANCE AND DISTRIBUTION.
Proc. Am. Tung Oil Assoc, 1950, 6-7.

In old tung orchards large masses of fibrous roots, present near the soil surface, are vitally important for the absorption of moisture. To minimize damage to fibrous roots cultivation should be frequent and shallow.

Neff, M. S. and Painter, J. H.
FACTORS AFFECTING BRANCHING AND GROWTH OF NEWLY TRANSPLANTED TUNG TREES TRAINED TO VASE FORM.
Proc. Am. Soc. Hort. Sci. 52, 75-80 (Nov., 1948); Proc. Assoc. Southern Agr. Workers 45, 124 (1948) (abstract).

Neff, M. S. and Potter, G. F.
FACTORS AFFECTING GROWTH OF NEWLY TRANSPLANTED TUNG TREES DURING DRY WEATHER.
Proc. Am. Soc. Hort. Sci. 47, 153-60 (1946); Proc. Am. Tung Oil Assoc. 1946, 47-53; Biol. Abstracts 21, 705 (1947); Oleagineux 2, 533 (1947).

"Although the av. annual rainfall is about 50 inches in southern Georgia and western Florida spring droughts occurred that were extremely detrimental to growth of newly transplanted tung trees in 1943, 1944, and 1945. Rate of growth declined during the dry weather even under the most favorable cultural and fertilizer conditions. Hoeing the trees 10 extra times as a supplement of the standard practice of 4 disk harrowings and 2 hoeings, minimized the effect of dry weather on the growth rate and effected an av. total shoot growth for the season of 1783 cm. per tree, which was 91% greater than that of trees receiving the standard culture only. Mulching with 1 bushel of sawdust per tree was less effective than the supplementary 10 extra hoeings, but increased growth rate during dry weather somewhat and effected a total shoot growth for the season of 1352 cm. per tree, 45% greater than that of the checks. Leaves of the mulched trees were pale green toward the end of the season. Heavy early applications of fertilizer tended to aggravate the effect of drought on growth rate and significantly decreased total shoot growth for the season. They also increased the incidence of a foliage disorder known as "pepper spot." Late fertilizer applications had a tendency to promote late fall growth." From Biol. Abstracts.

Painter, J. H. and Brown, R. T.
EFFECT OF DIFFERENT METHODS OF GIRDLING TUNG BRANCHES.
Proc. Am. Soc. Hort. Sci. 37, 511-4 (1939-40)*; Biol. Abstracts 14, 1470, Abs. No. 15,320 (1940).

The best method is the removal of a strip of bark 1/8 in. in width.

Painter, J. H. and Neff, M. S.
TUNG TREES OF VASE FORM PROVE MORE PRODUCTIVE IN EARLY YEARS THAN THE NATURAL HEAD TYPE.
Proc. Am. Tung Oil Assoc. 1943, 5-8.

At least in the early life of the tung trees, those trained to the vase form out-yield those trained to the natural-head form. It is possible that the vase-form trees will maintain a superiority in yield over the naturally headed trees for several years.

Painter, J. H. and Neff, M. S.
RESULTS OF EXPERIMENTS ON PRUNING AND TRAINING TUNG TREES.
Proc. Am. Tung Oil Assoc. 1945, 5-9.

Vase-form trees have out-yielded the other types.

Painter, J. H. and Neff, M. S.
VASE-FORM TRAINING AS A CORRECTIVE MEASURE FOR POTENTIAL "CARTWHEEL" TUNG TREES.
Proc. Am. Soc. Hort. Sci. 47, 175-7 (1946)*; Biol. Abstracts 21, 971, Abs. No. 9987 (1947).

"One-year-old tung trees, pruned to one bud, and which failed to branch the first season, usually throw out a whorl of branches the 2d season. Such trees, commonly called "cartwheels," are structurally weak. Trees cut back to 12 in. or 24 in. without further pruning formed very satisfactory low vase-form trees. From 1942 to 1945, the vase-form trees have consistently out-yielded the natural-head type and the "cartwheel" trees, although with increasing age the difference in yield is a smaller % of the total yield. The difference between the vase-form trees and the "cartwheel" trees allowed to sucker freely has declined rather consistently from 1943 to 1945. The av. total yield of air-dry fruit per tree for the 1942-5 period was 59.4 lbs. for the "cartwheel" trees, 34.4 lbs. for the natural-head trees, and 90.5 lbs. for the vase-form trees. The yields of the natural-head trees may not be expected to equal that of the vase-form, in the near future. Production of fruit is in proportion to the size and bearing area of the trees." From Biol. Abstracts.

Painter, J. H. and Neff, M. S.
HOW TO GROW A GOOD VASE FROM TUNG TREE.
Proc. Am. Tung Oil Assoc. 14, 35-9 (1948).

Complete directions are given for selection of stock, cutting back and subsequent care.

Painter, J. H. and Sharpe, R. H.
PRELIMINARY EXPERIMENTS ON PRUNING AND TRAINING OF ONE-YEAR SEEDLING TUNG TREES.
Proc. Am. Tung Oil Assoc. 1941, 34; Proc. Am. Soc. Hort. Sci. 38, 215-218 (1941).

Perry, B. A.
CHROMOSOME NUMBER AND PHYLOGENETIC RELATIONSHIPS IN THE EUPHORBIACEAE
Am. J. Botany 30 (7), 527-43 (1943)*; Biol. Abstracts 17, Abs. No. 22,999 (1943).

Chromosome numbers are determined for *Aleurites* and others.

Plakidas, A. G.
DISEASES OF TUNG TREES IN LOUISIANA.
La. Agr. Expt. Sta., Bull. 282, 2-11 (1937); C.A. 31, 6805 (1937).
"Intervenal browning of tung leaves is not due to a deficiency of any of the common food elements. Bronzing is due to a deficiency of Zn in the soil. Other diseases are described." From C.A.

Podtiaguin, B.
ENTOMOLOGICAL NOTES.
Rev. Soc. Cient. Paraguay 6 (4), 1-24 (1944)*; Biol. Abstracts 19, 2213, Abs. No. 20,210 (1945).
"Includes a list of insects attacking cotton, rice, yerba mate, tung and wheat with some notes on same and on methods of prevention." From Biol. Abstracts (abridged).

Potter, G. F.
SOME FACTS ABOUT NURSERY STOCK, BUDDED AND SEEDLING.
Proc. Am. Tung Oil Assoc. 14, 29-34 (1948).
A discussion of the variability of seedlings, advantages of budding and of seeding and characteristics of some of the newer varieties of each type.

Potter, G. F.
OBSERVATIONS ON COLD INJURY TO TUNG TREES IN LOUISIANA AND TEXAS, OCCURRING IN LATE MARCH 1948.
Proc. Am. Soc. Hort. Sci. 53, 114-8 (1949).
"The tung trees in northerly experimental plantings were subjected to a rigorous test in the March 1948 freeze. The evidence indicates that the more cold resistant varieties, if well cared for, can be planted without undue risk in northern Louisiana and eastern Texas. It may be expected that risk of loss will diminish as the trees grow older." From the summary.

Potter, G. F.; Angelo, E.; Painter, J. H.; and Brown, R. T.
A STATISTICAL STUDY OF VARIATION IN TUNG FRUITS.
Proc. Am. Soc. Hort. Sci. 37, 515-517 (1939).

Potter, G. F.; Crane, H. L.; Large, J. R.; and Merrill, S., Jr.
PLANT ONLY THE VERY BEST TUNG TREES.
Proc. Am. Tung Oil Assoc. 1945, 16-20.
Only seed from trees that have been "progeny tested" should be used for planting.

Potter, G. F.; Merrill, S.; and Sharpe, R. H.
THE BUDDING OF TUNG TREES.
Natl. Paint, Varnish Lacquer Assoc., Sci. Sect. Circ. No. 622, p. 156-60 (1941); Proc. Am. Tung Oil Assoc. 1941, 18.
A report on the merits and techniques of bud grafting.

Rhoads, A. S.
DISEASES AFFECTING TUNG OIL PLANTATIONS IN FLORIDA.
Plant Dis. Rep. 27 (19), 484-6 (1943)*; Biol. Abstracts 18, 813, Abs. No. 7352 (1944).

"The following 2 diseases of tung-oil are discussed: Clitocybe root rot (*Clitocybe tabescens*)* * *and thread blight (*Corticium stevensii-Pellicularia koleroga*), controlled effectively by spraying." From Biol. Abstracts (abridged).

Ritchie, A. H.
REPORT OF THE ENTOMOLOGIST.
Tanganyika Territ. Dep. Agr. Ann. Rept. 1934, 73-83 (1935)*; Biol. Abstracts 10, 1494, Abs. No. 13,989 (1936).

"Young tung plants (*Aleurites* sp.) when girdled by *Sthenias cylindrator* produce low-branched types of trees." From Biol. Abstracts (abridged).

Sanders, D. A.; Emmel, M. W.; and Swanson, L. E.
TUNG TREE, *ALEURITES FORDII* HEMSL., FOLIAGE POISONING OF CATTLE.
Florida Agr. Exp. Sta. Tech. Bull. No. 376, 8 pp. (Sept., 1942)*; Bibliog. of Agr. 1, D, 19 8 (1942).

Sell, H. M. and Gilbert, S. G.
THE FATTY ACIDS OF DORMANT TUNG BUDS.
J. Am. Oil Chemists' Soc. 24, 420-2 (1947).

"The methyl esters of the fatty acid in the wax of dormant tung buds were prepared and fractionated in a column packed with a spiral screen. Myristic, palmitic, linoleic, oleic, and stearic acids were identified in some of the fractions. * * * It is believed that the mutual solubility of these fatty acids may have facilitated penetration of the α-naphthylenacetic or indole-3-acetic acid in Crisco and lanolin emulsions, into the bud tissue and in this way increased their effectiveness in prolonging dormancy." From summary of article.

Sell, H. M.; Reuther, W.; Fisher, G.; and Lagasse, F. S.
EFFECT OF CHEMICAL TREATMENTS IN PROLONGING DORMANCY OF TUNG BUDS.
Botan. Gaz. 103, 788-93 (1942)*; C. A. 36, 4861 (1942).

"The dormancy of tung buds may be prolonged for the purpose of avoiding late frosts by treating with α-naphthalenacetamide in a lanolin emulsion to the surface of dormant buds. Direct injection of growth substances into the bud scale sheath or its application by a sprayer was not effective." From C. A.

Sell, H. M.; Taylor, H. A.; and Potter, G. F.
EFFECT OF CHEMICAL TREATMENTS IN PROLONGING DORMANCY OF TUNG BUDS. II.
Botan. Gaz. 106, 215-23 (1944)*; C. A. 39, 1243 (1945).

"By the application of an emulsion of lanolin (I) dormancy in tung buds was prolonged so that the buds stayed 12 days longer in a state not injured by a temp. of 28° F. The treatment killed 7.5% of the buds. An emulsion of Crisco was half as effective as I and produced less injury. Of 28 substances tested in I, only α-naphthaleneacetic acid, α-naphthaleneacetamide (II), α-naphthalenethiacetamide and 3-indoleacetic acid prolonged dormancy more than did I alone. The percentage of dead buds by these effective treatments ranged from 12.5 to 52.5%. Repeated applications of II were more effective than single applications in prolonging dormancy and also killed more buds. Injury was greater with higher concns. of II. The indications are that 2 applications of 0.25% of II in I made about 30 and 15 days prior to bud expansion would give best results in prolonging dormancy." From C. A.

Sharpe, R. H.; and Merrill, S., Jr.
EFFECT OF STRATIFICATION AND TIME OF PLANTING ON GERMINATION OF TUNG SEED.
Proc. Am. Soc. Hort. Sci. 40, 286-91 (1942)*; Biol. Abstracts 17, 1559, Abs. No. 17,244 (1943).

"Stratification of hulled tung seeds hastened and improved germination. It was of especial value with seed from certain parent trees that naturally germinate very slowly. Stratification of the whole fruit resulted in much poorer and slower germination than when the seeds were hulled and then stratified. Planting in Jan. rather than in March hastened and improved germination in the case of dry-stored seed, but did not particularly benefit stratified seeds. By use of stratification, plantings may be delayed until the advent of warm weather with subsequent reduction of time between planting and germination dates, thus allowing better weed control. Better results are obtained by stratifying at moderately cool temps. than by stratifying in cold storage." From Biol. Abstracts.

Shear, C. B. and Crane, H. L.

GERMINATION OF NUTS OF THE TUNG TREE AS AFFECTED BY PENETRANTS, SUBSTRATA, DEPTH OF PLANTING, AND STORAGE CONDITIONS.

Bot. Gaz., 1943, 105, 251-256 (1946); Brit. Chem. Abstracts 1946,

"Seed soaked in 1% morpholine for 48 hr. germinated 12-18 days earlier, and that soaked in water 16-30 days earlier, than did unsoaked seeds." From Brit. Chem. Abstracts.

Sitton, B. G.

THE EFFECTS OF DIFFERENT METHODS OF GIRDLING BEARING AND DEFRUITED TUNG BRANCHES.

Proc. Am. Soc. Hort. Sci. 53, 119-24 (1949).

Wounds on girdled tung branches healed better if the girdle was made by merely scoring with parallel knife cuts, as compared with the removal of a strip of bark. Wounds made in the shape of a helix healed better than those made as a closed ring. Wax or electrician's tape prevented dessication of the wounds. Girdling did not significantly affect the number of fruit set the following season.

Sitton, B. G. and Loustalot, A. J.

NITROGEN PROMPTLY INCREASES YIELDS OF TUNG OIL.

Proc. Am. Tung Oil Assoc. 1945, 10-15.

Both the number of fruit and the yield of oil per fruit were increased.

Smee, Colin

TWO MEALY BUG SCALE INSECTS ON TUNG.

Nyasaland Agr. Quart. J. 4 (1), 20-6 (1944)*; Biol. Abstracts 19, 404, Abs. No. 3788 (1945).

"Of the 2 kinds of mealy-bug so far found to infest tung trees in numbers, the long tailed mealy-bug (Pseudococcus adonidum) appears to have been checked by parasites, and predators, but the pernicious mealy-bug (P. perniciosus), which has recently appeared on this crop, might become a pest of some importance. Planters are recommended to continually survey their plantations for this pest and suggestions are made for checking its development in tung plantations." From Biol. Abstracts.

Smith-White, S.

STUDIES ON THE TUNG OIL TREE (ALEURITES FORDII HEMSL.).

J. Proc. Roy. Soc. New South Wales 74, 42-73 (1940); Brit. C.A. 1940, B, 754 (1940).

A study was made on tung trees grown at Bargo, New South Wales, in which marked variation was observed in growth habits, proportion of staminate flowers to pistillate flowers per cluster, yields and size of fruit and properties of kernels. Pollen occurred in abundance. The planting of budded stock may offer a method of improving present groves but a more satisfactory means would be the development of high yielding seed strains.

Stockar, A.
DIPLOID CHROMOSOME NUMBER OF SOME SPECIES OF "ALEURITES."
Rev. Argentina Agron. 13, 253-5 (1946)*; Biol. Abstracts 21, 1578, Abs. No. 16,291 (1947).

"Aleurites fordii, A. montana, A. cordata and A. trisperma are reported with a diploid chromosome number of 22. the last sp. has been unreported previously. A. moluccana is a tetraploid with 44 chromosomes. Photomicrographs, measurements and technique are described or illustrated." From Biol. Abstracts.

Taylor, A. L. and McBeth, C. W.
ROOT-KNOT RESISTANT CROPS. ROOT-KNOT AND SEEDLING TUNG TREES. ROOT-KNOT SUSCEPTIBEL GRASSES.
Georgia Coastal Plain Expt. Sta. Bull. 31, 118-23 (1940)*.

Tskhoidze, V.
DETERMINING THE VIABILITY OF TUNG-OIL TREE SEEDS BY STAINING.
Bull. of Batum Subtropical Botan. Garden 1, 91-6 (1936) (in Russian with English summary)*; Biol. Abstracts 12, 1555, Abs. No. 16,684 (1938).

"Determination of the viability of seeds in Aleurites fordii and A. cordata is important, because of the long duration and the uneveness of their sprouting. Nelyubov's method of coloring, slightly modified, was applied to the tung-oil tree seed. For both spp. of tung the best results were obtained by staining embryos in indigo-carmin in conc. of 1:2000, 1:3000, and 1:4000. The viability of a sample of 100 seeds can be detd. in 2 hrs." From Biol. Abstracts.

Venkatarayan, S. V.
PHYTOPHTHORA ARECAE, PARASITIC ON ARECA TOPS, AND A STRAIN OF P. PALMIVORA BUTL. (P. FABERI MAUBL.) ON A NEW HOST, ALEURITES FORDII.
Phytopathology 22 (3), 217-27 (1932)*; Biol. Abstracts 7, 38, Abs. No. 509 (1933).

"* * P. palmivora from A. fordii (tung-oil tree), in mixed cultures, seemed to hybridize with the ♂ strain of P. arecae." From Biol. Abstracts (abridged).

Watkins, J. V. and Blackmon, G. H.
LEAF BUD CUTTINGS FOR MULTIPLYING TROPICAL SHRUBS.
Proc. Am. Soc. Hort. Sci. 37, 1109-11 (1939-40)*; Biol. Abstracts 15, 546, Abs. No. 6102 (1941).

Methods of propagating tung trees are discussed.

Webster, C. C.
CULTIVATION OF TUNG OIL TREES (ALEURITES FORDII AND A. MONTANA).
Trop. Agric. Trinidad, 16, 267-271 (1939)*; Brit. Chem. Abstracts 1943, B, III, 30.

"A. montana grew more quickly, matured earlier, and gave greater yields of seed than did A. fordii." From C.A.

Webster, C. C.
NOTES ON THE CULTIVATION OF TUNG OIL TREES. III. POSSIBILITIES FOR THE PRODUCTION OF IMPROVED PLANTING MATERIAL.
Nyasaland Tea Assoc. Quart. J. 5 (2), 6-10 (1940)*; Biol. Abstracts 15, 1806, Abs. No. 19,625 (1941).
Selection and grafting are discussed.

Webster, C. C.
A SIMPLE METHOD OF BUDDING TUNG TREES.
Nyasaland Agr. Quart. J. 1 (1), 8-9, 11-2 (1941)*; Bibliog. of Agr. 1, D, 53 (1942).

Webster, C. C.
A NOTE ON POLLINATION IN BUDDED PLANTATIONS OF TUNG TREES, ALEURITES MONTANA.
Nyasaland Agr. Quart. J. 3 (3), 17-9 (1943)*; Biol. Abstracts 19, 380, Abs. No. 3571 (1945).
"Observations on fruit-setting of *A. montana* indicated that 5% of male trees in a budded plantation will insure satisfactory pollination, provided that some of the male trees have an early flowering habit." From Biol. Abstracts.

Webster, C. C.
TUNG NOTES AND ABSTRACTS.
Nyasaland Agr. Quart. Jour. 5 (2), 37-9 (1945)*; Biol. Abstracts 21, 972, Abs. No. 9999 (1945).
"Stratification may provide a means of storing *Aleurites montana* seeds without any great loss of viability. Seeds stratified in either moist sand or moist sawdust, when planted after 3-1/2 months' storage, began to emerge from the ground in 14 days and gave a total germination of 80%. Seeds stored in cloth bags in a dry room for the same period began to come up 37 days after planting and only gave a final germination of 52%." From Biol. Abstracts.

Webster, C. C.
THE IMPROVEMENT OF TUNG IN NYASSALAND.
East Afr. Agr. J., Kenya, No. 165 (Jan, 1946); Agron. Trop. 2 (1-2) 72-6 (1946); Oleagineux 2, 344 (1947).
After several years of checking selected trees are grafted on "franc" and the clones established in comparitive test fields. The main part of the clones can be classified in two types.

Webster, C. C.
IMPROVED PLANTING MATERIAL OF THE TUNG TREE. A PROGRESS REPORT.
E. African Agr. Jour. 11 (3), 165-9 (1946)*; Biol. Abstracts 21, 1213, Abs. No. 12,468 (1947).
"The improvement of the tung tree by selection, artificial crossing, and selfing is discussed." From Biol. Abstracts.

Webster, C. C.
THE EFFECT OF SEED TREATMENTS, NURSERY TECHNIQUE AND STORAGE METHODS ON THE GERMINATION OF TUNG SEED.
E. African Agr. J. 14, 38-48 (July, 1948)*.

Webster, C. C.
TUNG NURSERY WORK.
Nyasaland Agr. Quart. J. 7, 83-92 (Oct. 1948)*.

Webster, C. C. and Selby, M. F. H.
A PROGRESS REPORT ON THE SELECTION AND VEGETATIVE PROPAGATION OF PROMISING TUNG TREES (ALEURITES MONTANA).
Nyasaland Agr. Quart. J. 1 (4), 1-6 (1944)*; Biol. Abstracts 19, 2469-70, Abs. No. 22,698 (1945).

"It has been fairly well established, after 5 yrs. of exptl. work, that budded trees will give better yields than seedlings. The final selection of the best types of plant material must be based on the performance of buddings of the most promising of the selected trees since it is by no means certain that all high yielders will pass on this desirable characteristic to their budded progeny, as in some cases environmental factors rather than inherent ability may be mainly responsible for a high yield." From Biol. Abstracts.

Yin, H. C.
THE ROOTING OF TUNG OIL TREE CUTTINGS WITH THE AID OF HETEROAUXIN.
Bull. Chinese Botan. Soc. 3, No. 1, 121-2 (1937)*; C.A. 34, 467 (1940).

"Formation of roots on tung tree cuttings was greatly increased by soaking the severed ends for 20 hrs. in a soln. contg. 0.2 mg. β-indoleacetic acid per cc. The compd. was slightly injurious at a concn. of 0.4 mg./cc." From C.A.

Yin, H. C. and Liu, C. H.
EXPERIMENTS ON THE ROOTING OF TUNG TREE CUTTINGS.
Am. J. Bot. 35, 540-2 (Oct., 1948)*.

Yu, T. F.; Chiu, W. F.; Cheng, N. T.; and Wu, T. T.
STUDIES ON PYTHIUM APHANIDERMATUM (EDSON) FITZ. IN CHINA.
Lignan Sci. J. 21 (1/4), 45-62 (1945)*; Biol. Abs. 20, 205, Abs. No. 1760 (1946).

Aleurites fordii is reported as a host for P. aphanidermatum.

Zaldastanishvili, Sh.
EFFECT OF MICROCLIMATE ON THE FROST-RESISTANCE OF SUBTROPICAL PLANTS.
Bull. of Batum Subtropical Botan. Garden 1, 131-42 (1936) (in Russian with English summary)*; Biol. Abstracts 12, 1555-6, Abs. No. 16,687, (1938).

"The aim of the expt. was to bring out the influence of soil surface, contour, location, and altitude on frost-resistance of lemon, Unshiu mandarin, and tung-oil tree (Aleurites fordii). The greatest frost injury was in a ravine where the air temp. fell to -7.8° C.; lemon seedlings there were entirely defoliated, and 57%

of the 1st year shoots, and 6% of the 2d year shoots were killed. Lemons budded on Citrus trifoliata lost all their leaves, and 4% of their one-year-old shoots died. The 2-year old branches did not suffer. The Unshiu mandarin and the tung-oil tree were uninjured in all locations. On the open plateau, where the temp. did not fall below -5° C. the lemons suffered chiefly from wind causing mechanical injuries to the leaves Sunburn occurred where lemons were exposed to direct sun-rays after 8 a.m. Under conditions of the mild winter of 1935-1936 the better-sheltered north slope proved the most favorable for the plants." From Biol. Abstracts.

(b) Fertilizers, Deficiency Diseases, Yields

Angelo, Ernest and Kilby, W. W.

BASIC SLAG, LIME AND PHOSPHORUS FOR WINTER COVER CROPS IN TUNG ORCHARDS.

Proc. Am. Tung Oil Assoc. 1942, 36-7.

Bahrt, G. M. and Kilby, W. W.

FERTILIZING TUNG WITH ELEMENTS OTHER THAN N, P, AND K.

Proc. Am. Tung Oil Assoc. 1943, 30-3: C.A. 39, 2612 (1945).

"Soil applications of the elements, Mg, as Epsom salts at the rate of 250 lb. per acre, Mn, as 65% manganese sulfate, at 140 lb. per acre, Zn as zinc sulfate at 40 lb. per acre, Cu as copper sulfate, at 20 lb. per acre, and Fe as ferrous sulfate, at 20 lb. per acre when used singly had no significant influence on the growth of nursery tung trees in 2 expts. in Pearl River County, Miss. and one near Fairhope, Alabama. The expts. were conducted on Bowie and Norfolk soils. Certain combinations of elements proved slightly injurious. E.g., Cu with Mn reduced the height of the trees in one expt. by 7 in. and the cross-sectional area of the trunk by 0.09 sq. in." From C.A.

Bahrt, G. M., Jones, R., Angelo, E., Freeman, A. F., Pack, F. C., and McKinney, R. S.

THE EFFECTS OF ZN AND OTHER TRACE ELEMENTS ON OIL CONTENT OF TUNG FRUITS,

Proc. 10th Ann. Convention Am. Tung Oil Assoc. and United Tung Grower's Assoc. 1944, 98-101: C.A. 39, 2611 (1945).

"Soil applications of 100 lb. per acre of $ZnSO_4$ in 2 tung orchards increased the oil content of tung fruit from approx. 19.5 to 20.5% even though there were no typical Zn-deficiency symptoms present. In 2 other orchards no significant increase in oil content was obtained with the $ZnSO_4$ treatment. Fruit from plots treated with salts of Ba, Co, Cu, Mg, B, V, and Mn at different locations showed no significant differences in oil content." From C.A.

Bahrt, G. M. and Potter, G. F.

EFFECTS OF NITROGEN, PHOSPHORUS, AND POTASSIUM ON GROWTH AND YIELD OF TUNG TREES AND COMPOSITION OF FRUITS.

Proc. Am. Tung Oil Assoc., 1947, Pt. I, 28-33: C.A. 42, 308 (1948).

"High-N fertilizer applications to bearing tung trees on Red Bay fine sandy loam soil near Lucedale, Miss., over a four-year period significantly increased the trunk cross-sectional area, yield of fruit and percentage of kernel in the whole fruit, but decreased the oil content of the kernel significantly. Percentage of oil in the whole fruit was not affected. Increments of applied P increased the P content of the leaves but no response was observed in growth, production, or compn. of the fruit. Increments of K had no significant effect on growth or yield, but increased the oil content of the kernel and one year also increased the kernel content of the fruit and percentage of oil in the whole fruit." From C.A.

Brown, R. T. and Potter, G. F.
RELATION OF FERTILIZERS TO COLD INJURY TO TUNG TREES OCCURRING AT LUCEDALE, MISSISSIPPI, IN MARCH 1948.
Proc. Am. Soc. for Hort. Sci. 53, 109-113 (1949: Proc. Am. Tung Oil Assoc. 1949, Pt. II, pp. 11-17: C.A. 43, 9325 (1949).
"Trees that had received liberal applications of N and K over a period of 7 yrs. suffered practically no loss of bearing surface in the late freeze in March and set a full crop, while the crop of unfertilized trees was reduced 75 to 80%." From C.A.

Brown, R. T. and Potter, G.F.
EFFECTS OF FERTILIZERS APPLIED TO COVER CROPS ON COVER CROP YIELD, ON TUNG TREES, AND ON THE YIELD AND OIL CONTENT OF TUNG FRUIT.
Proc. Am. Soc. Hort. Sci. 54, 53-56 (1949).

Coleman, Russell
BORON CONTENT OF MISSISSIPPI SOILS AND PLANTS.
Better Crops with Plant Food 29 (6), 11-13, 42-3 (1945)*; C.A. 39, 4181-2 (1945).
"Of the plant tissues analyzed, tung-tree leaves contain the largest amt., 48.5 p.p.m. An excellent correlation exists between the amt. of boron applied to the soil, the amt. of I [available boron] in the soil, and the amt. of boron absorbed by plants." From C.A.

Dickey, R. D.
A PRELIMINARY REPORT ON IRON DEFICIENCY IN FLORIDA.
Florida Agr. Exp. Sta. Bull. No. 381, 1-20 (1942): Biol. Abstracts 19, 1539, Abs. No. 14,186 (1946).
"The physiological disorder described is distinct in appearance from bronzing (Zn deficiency) and frenching (Mn deficiency). Thus far, it has been observed in only 3 orchards, where it is confined to small groups of trees in localized areas. The data presented indicate that control can be effected by foliage applications of a 1% iron sulfate soln. Results from soil applications were less conclusive, but in some cases the trouble was controlled by this method. Tentative procedures for spray and soil treatments are outlined, but it is suggested that applications be confined to trees showing symptoms until exptl. results show the desirability of treating the entire orchard. The disorder is associated with both acid and alkaline soils." From Biol. Abstracts.

Dickey, R. D.
IRON DEFICIENCY OF TUNG IN FLORIDA.
Assoc. Sou. Agr. Workers, Proc. Ann. Convention 43, 173-4 (1942): C.A. 37, 1819 (1943).
"Fe deficiency in tung trees is characterized by a leaf chlorosis which is similar in its general pattern to that described for Fe deficiencies of many other plants. Brown staining, necrotic spots and premature leaf fall are present on severely affected trees. Fruit symptoms are yellowish green color, brown staining, premature fall and poor fill. Twig symptoms are dead buds and shoots on affected trees. Diseased trees were cured by spraying with 1% Fe sulfate soln.: soil applications of Fe sulfate were not so effective." From C.A.

Dickey, R. D.
CORRECT TUNG TREE BRONZING.
Florida Grower 56 (10), 21 (1948)*.

Dickey, R. D. and Drosdoff, M.
CONTROL OF MANGANESE DEFICIENCY IN A COMMERCIAL TUNG ORCHARD.
Proc. Am. Soc. Hort. Sci. 42, 74-8 (1943): C.A. 37, 6304 (1943).
"Two lb. of 65% $MnSO_4$ per tree appears to be a satisfactory soil application for correcting severe Mn deficiencies in mature tung trees (*Aleurites fordii*)on Arredonda loamy fine sand soil. The addn. of $MgSO_4$ did not increase the effectiveness of the $MnSO_4$ treatment. $(NH_4)_2SO_4$ alone or in addn. to the $MnSO_4$ was beneficial." From C.A.

Dickey, R. D., Drosdoff, M., and Hamilton, J.
COPPER DEFICIENCY OF TUNG IN FLORIDA.
Florida Agr. Expt. Sta., Bull. 447, 5-31 (1948): C.A. 43, 3552 (1949).
"Cu deficiency of tung is becoming prevalent in the northern peninsular area of Florida. Applications of $CuSO_4$ either to the soil as the dry salt or in soln. or sprayed on the foliage corrected the deficiency. Soil additions of 1 lb. per tree or spraying of a 8-8-100 Cu-lime mixture was required for the most deficient trees. Cu deficiency was more severe when the N applied was high. The application of superphosphate had no adverse effect on Cu uptake by the tung tree. The symptoms are described and illustrated." From C.A.

Dorman, C.
EXPERIMENTS IN MISSISSIPPI WITH TUNG TREES.
Mississippi Farm Res. 4 (2), 6 (1941): Biol. Abstracts 17, 858, Abs. No. 10,064 (1943).
"At the South Mississippi Substation the highest yields were obtained from tung trees fertilized with $NaNO_3$ and cultivated during 4 of their 6 yrs. in the orchard. Where trees were fertilized better yields were obtained where cultivation was given for 4 yrs. rather than the full 6-yr. period. No cultivation was detrimental irrespective of fertilizer treatment." From Biol. Abstracts.

Drosdoff, M.
SOILS AND TUNG TREES.
Natl. Paint, Varnish Lacquer Assoc., Sci. Sect. Circ. No. 622, 161-73 (1941): Proc. Am. Tung Oil Assoc. 1941, 26.
A survey of the soil characteristics required for economic tung farming.

Drosdoff, M.
FERTILIZING TUNG TREES BY LEAF ANALYSIS.
Better Crops with Plant Food 27 (4), 9-13, 49-50 (1943)*: C.A. 37, 4186 (1943).
"Leaf analysis is discussed in relation to specific nutrient requirements and the element or elements responsible for abnormal foliage conditions observed in the field. One of the most important functions of leaf analysis is to anticipate nutrient requirements

of trees before the appearance of any symptoms. In general, normal tung leaves contain from 0.7 to over 1.2% K, and those from trees indicating K deficiency contain less than 0.6%. Further figures are given of the av. chem. compn. of tung leaves for the 1941 season from 3 orchards. In many orchards Zn, Mn and Cu are needed. Trees deficient in Zn have leaves with less than 10 p.p.m. of Zn and those deficient in Mn less than 30 p.p.m. of Mn." From C.A.

Drosdoff, M.
LEAF COMPOSITION IN RELATION TO MINERAL NUTRITION OF TUNG TREES.
Soil Sco. 57, 281-291 (1944)*; Brit. Chem. Abs. 1944,B, III, 223.

"The % Ca and Mn in tung leaves increased and the % K and N diminished as the season advanced. No seasonal trend was apparent in the Mg, P, or Fe contents. The % K in basal leaves was $<$ and the % Ca and Mn $>$ in mid-shoot leaves. In the early season N contents were higher in basal than in mid-shoot leaves: later the order was reversed. Fruiting terminal shoots contained less N but more Ca than did non-fruiting terminals. Differences in soil character had a greater influence on leaf composition than did any other factor examined." From Brit. Chem. Abstracts.

Drosdoff, M.
WHAT'S IN YOUR FERTILIZER?
Proc. Am. Tung Oil Assoc. 1945, 60-68.

A discussion of commercial fertilizers and their values in relation to their composition. Fertilizers should be bought on the basis of cost per unit or cost per pound of plant nutrient material rather than on a cost per ton alone.

Drosdoff, M.
GETTING THE BEST FERTILIZER BUY.
Proc. Am. Tung Oil Assoc. 1948, 21-8.

Tung growers are advised to purchase early and in quantity and to utilize tung press cake and hulls.

Drosdoff, M. and Dickey, R. D.
COPPER DEFICIENCY OF TUNG TREES.
Proc. Am. Soc. Hort. Sci. 42, 79-84 (1943)*; Proc. Am. Tung Oil Assoc. 1943, 54-6: C.A. 37, 6304 (1943).

"A cupping and chlorosis of leaves and defoliation and dieback of shoots in tung were found to be due to Cu deficiency. Recovery and normal growth of trees 1 yr. old were effected by applying 1/6 oz. of $CuSO_4$ in soln. to the soil at the base of the tree or by spraying the trees with $CuSO_4$ soln. (1 or 2%)." From C.A.

Drosdoff, M. and Dyal, R. S.
USING SOILS RESEARCH FOR BETTER TUNG ORCHARDS.
Proc. Am. Tung Oil Assoc. 1942, 6-10.

Drosdoff, M. and Dyal, R. S.
PHYSICAL AND CHEMICAL PROPERTIES OF SOILS OF THE TUNG BELT.
Proc. Am. Tung Oil Assoc. 1944, 18-30: Biol. Abstracts 19, 1539, Abs. No. 14,187 (1945).

"Physical and chem. analyses were made on soil samples representative of the most important soil types on which tung trees are being grown in the Southeast.

The data on the sandy loams from northern and western Florida, Alabama, Mississippi and Louisiana show low pH value and soluble-phosphate content emphasizing the need for lime and phosphate fertilization on most of these soils. The organic matter content of the surface soils has a mean of 2.25%. The base-absorbing capacity of these soils is low and usually does not exceed 10 milliequivalents per 100 g. of soil even where the clay content is high. The absorbed bases are low, with Ca predominating and K being present in the smallest quantity. Absorbed Mg is intermediate. The soils from northern Florida are especially low in K, the K deficiency has been found to be prevalent in tung orchards in that general area. The data on the sands and loamy sands from peninsular Florida show that clay and organic matter are very low, resulting in low base-absorbing capacities. The absorbed bases are low, and many deficiency symptoms are prevalent on trees in the area unless they have been adequately fertilized. Limited data on moisture relations of some representative samples indicate that the amount of available soil moisture at field capacity is low regardless of the organic matter and clay content of the soil." From Biol. Abstracts.

Drosdoff, M., Fisher, E., and Lassiter, J. H.
EFFECT OF FREQUENCY AND METHOD OF CULTIVATION ON THE GROWTH OF ONE-YEAR-OLD TUNG TREES.
Proc. Am. Soc. Hort. Sci. 50, 115-18 (1947): C.A. 42, 8268 (1948).

"Keeping the areas around the trees free of weeds was essential for the best growth. Whether or not the soil was stirred was unimportant. Analyses of leaf samples for N, P, K, Ca, and Mg indicate that lack of nutrients probably was not the limiting factor in the growth of the uncultivated trees." From C.A.

Drosdoff, M. and Kenworthy, A. L.
MAGNESIUM DEFICIENCY OF TUNG TREES.
Proc. Am. Soc. Hort. Sci. 44, 1-7 (1944)*: Biol. Abstracts 18, 1871, Abs. No. 17,506 (1944).

"A marginal leaf scorch observed in a number of tung orchards in peninsular Florida was found to be due to a deficiency of Mg. Although the disorder was partially corrected by applications of N, outstanding control was effected by soil applications of epsom salts made annually over a 2-yr. period at the rate of 8 lbs. per tree on 10- to 12-yr.-old trees and 4 lbs. per tree for 6- to 8-yr-old trees. Leaves from trees severely affected by marginal leaf scorch contained 0.05-0.16% Mg: those from trees treated with $MgSO_4$ and having little or no scorch contained from 0.2 to 0.35% Mg. Applications of KCl tended to accentuate the deficiency. Dolomite was only partially effective over a 2-yr. period." From Biol. Abstracts.

Drosdoff, M. and Lagasse, F. S.
MINERAL NUTRITION PROBLEMS IN FLORIDA TUNG ORCHARDS.
Proc. Florida Acad. Sci. 7, 139-45 (1944)*: C.A. 41, 3897 (1947).
"Tung trees require addnl. amts. of some mineral elements for maintenance of satisfactory growth and production in Florida soils. A geographic soil pattern in North and Central Florida is described. A consideration of evaluation methods for tung tree requirements is discussed. A severe deficiency of soil K has been found to exist in some areas. Other prime mineral requirements in order are Zn, Mn, Cu, Fe, and Mg." From C. A.

Drosdoff, M. and Lagasse, F. S.
EFFECT OF SOIL AND CROP ON ABSORPTION OF MINERAL ELEMENTS BY TUNG TREES.
Proc. Am. Tung Oil Assoc. 1949, Pt. 2, 1-2.
"It was found that a heavy crop lowered the potassium content of the leaves in spite of increased potash applications. The lowering of the potassium level in the leaves was associated with an increase in magnesium content of the leaves even though no magnesium was applied." From the paper.

Drosdoff, M. and Lagasse, F.S.
WHICH SOILS ARE SUITED TO TUNG PRODUCTION?
Proc. Am. Tung Oil Assoc. 1950, 16-8.
Information selected from "Suitability of Various Soils for Tung Production" by Matthew Drosdoff. U. S. Dept. of Agr. Circ. No. 840.

Drosdoff, M., Lagasse, F. S., and Blackmon, G. H.
SYMPTOMS AND CORRECTIVE TREATMENTS FOR MAGNESIUM DEFICIENCY IN TUNG TREES.
Proc. Am. Tung Oil Assoc. 1944, 64-7.
"The marginal leaf scorch which occurs in a number of tung orchards in Florida is due to a deficiency of magnesium. The outstanding improvement and recovery of the affected trees was effected by soil applications of Epsom salt made annually over a two-year period. Leaves from trees severely affected by the scorch contained only 0.05 to 0.16 percent magnesium (dry basis) while those from trees treated with Epsom salt and having little or no marginal scorch, contained from 0.20 to 0.35 percent magnesium. Applications of muriate of potash alone tended to accentuate the magnesium deficiency. Dolomite because of low solubility of its magnesium was only partially effective in correcting the disorder." From the author's summary.

Drosdoff, M. and Nearpass, D. C.
QUICK TESTS FOR POTASSIUM AND MAGNESIUM IN TUNG LEAVES AND DIFFERENCE IN COMPOSITION OF DIFFERENT PARTS OF THE PETIOLE.
Proc. Am. Soc. Hort. Sci. 50, 131-6 (1947): C.A. 42, 8268 (1948).
"Reagents described by Morgan (C.A. 36, 4247) are used in a procedure designed for fresh leaf petioles. Good correlation bet. the results with the quick tests and quant. analyses of the leaf blades was obtained. In all elements tested (K,Mg,Ca,P,and N) except N the top of the petiole, nearest the leaf blade, was higher in pct. compn. on a dry-wt. basis, the middle lowest and the bottom intermediate. The relation of the compn. of the petiole parts to that of the leaf blade varied for the diff. elements and even for diff. levels of the same element, but in genl. there was a high pos. correlation." From C.A.

Drosdoff, M. and Painter, J. H.
CHLORISIS AND NECROSIS OF TUNG LEAVES ASSOCIATED WITH LOW POTASSIUM CONTENT.
Proc. Amer. Soc. Hort. Sci., 41, 45-51, (1942).* Brit. Chem. Abstracts A, III, 613, (1943).

"Interveinal chlorosis and necrosis of tung leaves is associated with a lot K content. Affected leaves are generally but not invariably low in N. Generally, older leaves show the most severe symptoms, the whole margin of the leaf becoming chlorotic in some cases, whilst in others interveinal necrosis develops first near the margin and then extends inwards between the main lateral veins. Later the leaf margin curls, and the leaf becomes brittle and is shed prematurely." From Brit. Chem. Abstracts.

Drosdoff, M., Painter, J. H., Sell, H. M., and Gilbert, S. G.
K DEFICIENCY OF TUNG.
Proc. Am. Tung Oil Assoc. 1943, 50-3; C.A. 39, 2610 (1945)

"A large acreage of tung orchards in western Florida and Southern Georgia was found to be deficient in K and responded to both increased K and N fertilization. Leaf symptoms of K deficiency are yellowing and browning between the veins. In general it was found that in Sept. leaves from K-deficient orchards contained less than 0.5% of K while leaves from healthy orchards contained more than 0.7% K. Soil applications in the spring to trees 4 years old of 5 lb. of KCl or 3 lb. of KNO_3 per tree completely controlled the deficiency pattern, the KNO_3 treatment being particularly effective in stimulating shoot growth and general vigor of the trees. In addn. to affecting the foliage and decreasing growth, K deficiency markedly decreased the percentage of kernel and percentage of oil in the kernel of tung fruit. Kernels from K-deficient trees were higher in sugar and lower in oil than KCL-treated trees with the protein content about the same. A $NaNO_3$ treatment increased the percentage of kernel and protein content but did not significantly affect the oil content of the kernsl. The KNO_3 treatment resulted in both a high oil and high protein content of the kernel and a low sugar content. This expt. indicates that both N and K influence filling of the nuts and K is important in the conversion of the reserve materials into oil." From C. A.

Drosdoff, M. and Potter, G. F.
COLLECTING AND PREPARING TUNG LEAF SAMPLES FOR CHEMICAL ANALYSIS
Proc. 10th Ann. Convention, Am. Tung Oil Assoc. and United Tung Growers Assoc. 1944, 68-9*; C. A. 39, 2890 (1945)

"Composite representative leaf samples should be taken from a uniform area from the same aged trees. Leaves should be taken from the middle of av. length shoots. It is important to dry the leaves carefully, at a temp. not exceeding 70° with proper aeration."
From C. A.

Drosdoff, M., Sell, H. M., and Gilbert, S. G.
SOME EFFECTS OF POTASSIUM DEFICIENCY ON THE NITROGEN METABOLISM AND OIL SYNTHESIS IN THE TUNG TREE (*ALEURITES FORDII*).
Plant Physiol. 22, 538-47 (1947): cf. C.A. 37, 6304: 41, (1943): C.A. 42, 1634 (1948).

"During the growing season the compn. of leaves and fruit of 4-yr.-old tung trees low in N and K was compared with that of trees fertilized with these 2 elements. Leaves of K-deficient trees show 2 stages: early in the season starch and polysaccharides accumulate, while later in the season they tend to disappear to a greater extend than from K-treated trees. Fruit from K-treated trees had a higher oil content than fruit from untreated trees; this is due both to a higher percentage of oil in the kernel and to a higher percentage of kernel. The low oil content and the accumulation of sucrose in kernels of K-deficient trees suggest that K may function in the process of conversion of sugar into oil. Fruit from N-treated trees had a higher percentage of kernel and a higher protein content in the kernel than fruit from untreated trees." From C.A.

Dyal, R. S. and Drosdoff, M.
PHYSICAL AND CHEMICAL PROPERTIES OF SOME IMPORTANT SOILS OF THE SOUTHEAST USED FOR THE PRODUCTION OF TUNG OIL.
Soil Sci. Soc. Am., Proc. 8, 317-22 (1943)*: C.A. 39, 373 (1945).

"Phys. and chem. analyses were made on soil samples representative of the most important soil types in southeastern states on which tung trees are being grown. On the sandy loams, the low pH and sol. P_2O_5 values emphasize the need for CaO and P_2O_5 fertilization on most of these soils. The or.-matter content of the surface soils averages 2.25%. Base-exchange capacity of these soils does not usually exceed 10 milliequiv. per 100 g. of soil even where the clay content is high. This indicates that the kaolinite type of clay mineral predominates. The values for exchangeable bases are low, with Ca predominating and K present in the smallest quantity. Exchangeable Mg is intermediate. The soils from northern Florida are especially low in K and symptoms of K deficiency are prevalent in tung orchards in that general area. The data on the sands and loamy sands from peninsular Florida show that the clay and org. matter are very low; this results in low exchange capacities. The values for exchangeable bases are low and many deficiency symptoms are prevalent on trees in the area. Figures on some representative samples indicate that the amt. of available soil moisture at field capacity is low regardless of the org. matter and clay content of the soil." From C.A.

Fernholz, D. L. and Potter, G. F.
PRELIMINARY EXPERIMENTS ON THE RESISTANCE OF THE TUNG TREE TO LOW TEMPERATURE.
Proc. Am. Soc. Hort. Sci. [1941], 39, 167-172 (1942): Brit. Chem. Abstracts, A, III, 533,(1943).

"Different fertilizer treatments were without effect on the low-temp. resistance of the shoots of tung trees. Individual trees and their progeny produced vegetatively show big differences in cold-resistance, and frost-resistance shows seasonal changes being at a max. in mid-winter." From Brit. Chem. Abstracts.

Fisher, E. G., Lagasse, F. S., and Lassiter, J. H.
A COMPARISON OF WINTER AND SPRING APPLICATIONS OF AMMONIUM NITRATE TO TUNG TREES.
Proc. Am. Soc. Hort. Sci. 50; 142-144 (1947)

NH_4NO_3 applied to tung trees as early as Dec. and Jan. was absorbed in part by the roots within 30 days, and was available when growing season began.

Goddum, L. W., Camp, A. F., and Reuther, W.
SPECTROGRAPHIC STUDIES OF THE COMPOSITION OF TISSUES AND CORRESPONDING SOILS OF NORMAL AND PHYSIOLOGICALLY DISEASED HORTICULTURAL CROPS.
Florida Agr. Expt. Sta., Ann. Rept. 1935, 82 (1936)*; C. A. 31, 7160 (1937)

"A high degree of correlation exists between foliage conditions and Zn content, not only in the physiol. disease of tung trees known as bronzing, but also in a parallel disease of citrus known as frenching. Zn treatment of the soil or the use of Zn sprays on the foliage definitely increases the Zn content of the leaves. Frenched foliage occurring on the same tree as normal foliage gave a lower Zn content. The results support the theory that Zn is a necessary element for normal growth of tung and citrus trees." From C. A.

Gardner, H. A.
AMERICAN TUNG TREE CULTURE.
Ind. Eng. Chem. 19, 266 (1927); C. A. 21, 1193 (1927)

"The extent of tung tree culture in the U. S. is reviewed. The oil is expected to appear on the American market in small quantities before 1928. A yield is anticipated of 400 to 1800 lbs. of oil per acre from trees 3 to 9 years old." From C. A.

Gardner, H. A.
QUESTIONS AND ANSWERS ON TUNG-OIL PRODUCTION IN AMERICA
Natl. Paint, Varnish Lacquer Assoc. Circ. No. 446, 536-618 (1933); C. A. 28, 3601 (1934)

Revision. "In addn. to a general revision, the value of Zn compds. in curing the disease known as bronzing is discussed." From C. A.

Gardner, H. A.
TUNG OIL (TREE) PRODUCTION IN AMERICA.
Natl. Paint, Varnish Lacquer Assoc., Sci. Sect. Circ. No. 446,537-618 (1933); Brit. Chem. Abstracts 1934, B,162

"Production of oil of superior quality to that imported is described. 'Bronzing' a nutritional deficiency disease, is satisfactorily treated by applications of $ZnSO_4$ to soil around trees, or spraying with a Zn-CaO prep. The beneficial effects of treatment with poultry manure are ascribed, in part, to the Zn content of the material." From Brit. Chem. Abstracts.

Gardner, H. A.
ZINC SULFATE FOR TUNG-OIL GROVES
Natl. Paint, Varnish Lacquer Assoc. Circ. No. 452, 47-8 (1934); C.A. 28, 2925 (1934)

"Early expts. on the use of $ZnSO_4$ to combat 'bronzing' of tung-oil trees are briefly reviewed." From C. A.

Gardner, H. A. and Scofield, F.
RECENT DEVELOPMENTS IN GROWING AMERICAN TUNG OIL.
Natl. Paint, Varnish, Lacquer Assoc., Sci. Sect. Circ. No. 622, 153-5, (1941): C.A. 35, 4616 (1941) (no abstract).

A survey of the 1940 domestic production of tung oil and a discussion of yields of fruit per acre in different orchards.

Gilbert, S. G., Lagasse, F. S., Sims, G. T., Hamilton, J., and Nason, A.
THE COPPER-NITROGEN BALANCE IN THE TUNG TREE.
Proc. Am. Tung Oil Assoc. 1945, 55-9; C.A. 39, 4351 (1945).

"Investigations in 2 tung orchards, one a bearing orchard near Morriston, Florida, and another a 1-year-old orchard near Hague, Florida, showed that when tung trees are growing on soils low in available Cu, the application of N accentuates Cu deficiency. A third expt. on 1-year-old trees on two low-Cu soils, different levels of Cu and N being used, showed that when no Cu was applied, the low N applications resulted in only slight Cu-deficiency symptoms while severe symptoms developed from the high N applications. Even where Cu was supplied at the highest level, it was not sufficient to prevent the development of Cu-deficiency symptoms at the high N levels. Evidently this is a case of balance between the N and Cu inside the plant tissues. Physiol. studies on this complex biochem. problem are in progress." From C.A.

Gilbert, S.G., Sell, H.M., and Drosdoff, M.
EFFECT OF COPPER DEFICIENCY ON THE NITROGEN METABOLISM AND OIL SYNTHESIS OF THE TUNG TREE.
Plant Physiol. 21, 290-303 (1946); C.A. 40, 6575 (1946).

"The compn. of the leaves and fruit of Cu-deficient tung trees (Aleurites fordii Hemsl.) was compared with that of normal trees in the same orchard at different times during the growing season, to det. how the metabolic processes were affected. There were no significant differences between leaves from normal and Cu-deficient trees in percentage of nonreducing sugar, but the percentage of reducing sugar in deficient leaves was low and that of starch was outstandingly low, a condition indicating either a decrease in formation or an increase in utilization of reserve carbohydrates in such tissues, or both. The total N of deficient leaves was always higher on both mg. and percentage bases than that of normal leaves at the same sampling date. This difference was due in large measure to the abnormally high amt. of water-insol. N found in deficient leaves. The accumulation of this elaborated N fraction was a characteristic symptom of Cu deficiency and indicated the importance of Cu in the N metabolism of the normal plant. It appears likely that in the absence of sufficient Cu the plant forms abnormal amts. of complex N compds. at the expense of the carbohydrate reserves. The greatest effect of the deficiency on the fruit was the failure of the kernel to attain normal size and to synthesize a normal amt. of oil. This decrease in oil production is of considerable economic importance on soils low in Cu." From C.A.

Gill, J. B.
PASTURE ESTABLISHMENT AND MANAGEMENT.
Proc. Am. Tung Oil Assoc. 1950, 12-5
A discussion of criteria for the selection of pasture crops for planting on tung farms on land unsuited for growing tung trees.

Greer, S. R.
BROAD PROGRAM OF TUNG RESEARCH BY EXPERIMENTAL FIELD.
Mississippi Farm Res. 3 (12), 1,7,8 (1940)*; Biol. Abstracts 17, 858, Abs. No. 10,066 (1943)
"Information is presented on the development and work program of the Exptl. Tung Field started in 1938." From Biol. Abstracts.

Greer, S. R.
SUMMER LEGUMES WITH TUNG TREES IN SOUTH MISSISSIPPI
Missippi Farm Res. 7 (12), 5 (1944)*; Expt. Sta. Rec. 92 (5), 660 (1945); Oleagineux 1, 117 (1946)
'Crotolaria and alyce clover are the principal legumes used as cover crops for aleurites trees. Their application is discussed in relation to the number of plants, fertilizer requirements, forage value for livestock, etc.

Greer, S. R., Ashley, T. E., Potter, G. F. and Angelo, E.
TUNG CULTURE IN SOUTHERN MISSISSIPPI
Bull. Mississippi Agric. Expt. Sta. 409, 1-26 (1944); Biol. Abstracts 21, 195 (1947); Oleagineux 2, 656 (1947)
"The orchard site is the most important factor in establishing an orchard. It should be on high rolling sandy loam with good moisture retaining capacity. The need for summer and winter cover crops and for fertilizing the young trees the first three years is stressed. K and N were found to have increased the oil content of the fruits. Care must be used to see that the fruits are dry before storing." From Biol. Abstracts.

Hamilton, J. and Drosdoff, M.
THE EFFECT OF CULTIVATION, WATERING AND TIME OF FERTILIZATION ON THE GROWTH OF TRANSPLANTED ONE-YEAR OLD TUNG TREES.
Proc. Am. Soc. Hort. Sci. 47, 161-8 (1946)*; Biol. Abstracts 21, 705, Abs. No. 7066 (1947)
"Because of previous planting failures, an exploratory expt. was set up on Norfolk fine sand in the Ocala, Florida, area to determine what the limiting factors were in the growth of transplanted tung seedlings. A 2 x 2 x 2 factorial design was used. The factors under study were: (1) watering versus no watering during the growing season, (2) frequent spading versus infrequent hoeing, and (3) early fertilization versus late fertilization. By far the greatest response in tree growth was to cultivation, and in every instance frequent cultivation (spading) produced satisfactory trees. Watering and later fertilization were beneficial but not in the same order of magnitude as the spading. Further studies are under way to get more information on the beneficial effects of cultivation." From Biol. Abstracts.

Hamilton, J. and Gilbert, S. G.

RELATION OF FERTILIZATION WITH COPPER AND NITROGEN TO COPPER-DEFICIENCY SYMPTOMS, LEAF COMPOSITION, AND GROWTH OF TUNG.
Proc. Am. Soc. Hort. Sci. 50, 119-24 (1947): C.A. 42, 8394-5 (1948).
"In an expt. in which the effect of 3 levels each of N, P, and K, and a uniform level of Cu, on Cu-deficiency symptoms and growth of young tung trees was studied, increasing amounts of N increased the severity of the Cu-deficiency symptoms. The application of K decreased the incidence of the symptoms by a small but significant amt. and P had no effect. None of the fertilizers applied had an effect on shoot growth. In another expt. in which 4 levels each of Cu (0-2 oz. $CuSO_4$ per tree) and N(0.01-0.18 lb. of N per tree, one-half as $NaNO_3$ and one-half as $(NH_4)_2SO_4$) were applied in all factorial combinations, very little Cu deficiency occurred on trees at low rates of N application, regardless of the level of Cu applied, or on trees of high levels of Cu supply, regardless of the level of N. The combination of high levels of N with low levels of Cu resulted in severe Cu deficiency. The N content of the leaves was in direct relation to the rate of application of N, but it was reduced by increases in the Cu applied. The N tended to decrease the cross-sectional area of the trunks but had no effect on the size of the tops. Cu had no consistent effect on growth."
From C. A.

Heckel, G. B.

THE WORK ON MISCELLANEOUS OILS.
Paint Mfrs. Assoc. U. S., Educational Bur., Circ. No. 34, 4 pp. (Mar. 20, 1916).
The tung tree has been permanently established in this country and considerable progress is being made in the study of the oil. The Department of Agriculture, after taking the opinion of consumers, has adopted "tung oil" as the official title for this product.

Heylen, C. L.

EFFECTS PRODUCED BY MANGANESE DEFICIENCY IN THE GROWTH OF TUNG-OIL PLANTS (ALEURITES FORDII) DEVELOPED IN NUTRIENT SOLUTIONS.
Rev. centro estud. ing. quim. Univ. nacl. litoral (Santa Fe', Argentina) No. 14, 39-41 (1939)*: C.A. 34, 6398 (1940).
"The absence of Mn produces a decrease in the comparative height of tung-oil plants. The leaves wither and acquire a chlorotic appearance. Regions characteristic of dead textures are formed. The roots are not as extensive and the sprouts are fragile."
From C.A.

Hoffman, G. P.

EXPERIENCE IN TUNG-TREE CULTURE.
Proc. Florida State Hort. Soc. 1932, 48-52: C.A. 28, 4921 (1934).
"The yield of oil per tree progressively increased from 0.374 lb. in the 3rd year after planting to 0.974 lb. in the 5th year."
From C.A.

Khutsishvili, G., Il'iashenko, K. and Shleifel'd, V.
NEW GREEN MANURES IN AJARIA
Bull. of Batum Subtropical Botan. Garden 1, 107-15 (1936);
Biol. Abstracts 12, 1553-4, Abs. No. 16,668 (1938)
"Various green manures, mainly subtropical leguminous plants, were used for fertilizing lemons, mandarins and the tung-oil tree. The legumes were compared by the tonnage on the green-weight basis, and according to the N content. Results are inconclusive, as trials were short. The green manures improved the coloration of the leaves and increased the citrus crop. The most effective was Vigna catjang, producing as much as 52 kg. of N per ha. Lespedeza kobe and L. coreana both of them being characterized by the high contents of N (up to 0.9%), produced 40-88 kg. of N per ha." From Biol. Abstracts.

Khutsichvili, G. Z.
EFFECTS OF FERTILIZERS ON ALEURITES CROPS
Sovet. Subtropiki 1938, No. 2, 37-40*; Chimie & industrie 41, 571*;
C. A. 33, 4727 (1939)
"The most efficient fertilizers from the standpoint of growth, development and fructification of the plants are: complete mineral fertilizer, N-P combination, and farm manure. The effect of the latter during the first yrs. is notably less than during subsequent yrs. This may be explained by the difference in the dose of active principles as compared with the mineral fertilizers, and also by the slowness of action of the org. substances. The N-K combination produced a decrease in crop yield, either on account of the present of Al ion in the soil or on account of insufficiency of P." From C. A.

Kilby, W. W. and Potter, G. F.
FERTILIZER AS SUPPLEMENTS TO COVER CROPS IN MATURE TUNG ORCHARDS.
Proc. Am. Tung Oil Assoc. 1942, 21-24

Kimbrough, W. D., Miller, J. C. and Wilson, W. F.
FERTILIZER RESULTS WITH TUNG TREES AND RECOMMENDED CULTURAL TREATMENTS.
La. Agr. Exp. Sta. Bull. No. 352, 16 pp. (Aug., 1942)*; Bibliog. of Agr. 1, D, 168 (1942)

Lagasse, F. S., Angelo, E., Bahrt, G.M., Painter, J. H., Crane, H. L. and Potter, G. F.
MINERAL NUTRITION PROBLEMS OF AMERICAN TUNG ORCHARDS
Proc. 10th Ann. Convention Am. Tung Oil Assoc. and United Tung Growers' Assoc. 1944, 1-8; C. A. 39, 2610 (1945)
"Based on leaf, tree, and fruit analysis, soil analysis, sand culture, and field expts., the mineral nutrition problems of tung largely pertain to most economical use of N, P, and K fertilizers. Producing good leguminous crops is the cheapest way to supply N. P is needed in orchards on heavier soil types in North Florida and Alabama, Mississippi, and Louisiana. K is needed in relatively large quantities and especially in the eastern part of the tung belt where soils have a relatively low K content. Lime is needed in certain areas for the production of a good cover crop. Zn applications to the soil are necessary in a more widespread area than any other minor element. Mn, Cu, Mg, and Fe deficiencies have been observed, diagnosed, and corrected in certain limited areas in the tung belt." From C. A.

Lagasse, F. S. and Drosdoff, M.
THE NUTRITION OF TUNG TREES.
Proc. Am. Soc. Hort. Sci. 52, 11-8 (1948): Hort. Abstracts 19 (2), 186 (1949): Oleagineux 5, 143 (1950).
Concerning N-P-K-Mg-Zn-Mn-Fe for the nutrition of tung trees it appears that a suitable balance among these elements and the use of trace elements are very important.

Leonard, O. A.
INFLUENCE OF SOD AND OTHER FACTORS ON THE DISTRIBUTION OF SMALL TUNG ROOTS IN RUSTON SANDY LOAM.
Proc. Am. Soc. Hort. Sci. 42, 11-16 (1943)*: C.A. 37, 6394 (1943).
"Poor tung-root growth in subsoil is believed to be accounted for by low available N and P contents." From C. A.

Loustalot, A. J.
PHOTOSYNTHESIS AS A FACTOR IN THE GROWTH AND PRODUCTIVITY OF TUNG TREES.
Proc. Am. Tung Oil Assoc. 1944, 31-4: Biol. Abstracts 19, 1540, Abs. No. 14,196 (1945).
"Cu and Zn deficiencies reduced the rate of apparent photosynthesis in the leaves of young tung trees. The amt. of reduction was less in the case of Zn deficiency than in Cu deficiency as they occurred in this expt. There was a highly-significant reduction in CO_2 assimilation even with normal-appearing leaves on deficient plants. The highest rates of photosynthesis in the fall occurred about the middle of Oct. and were associated with favorable weather conditions. As a rule the rates were higher in the mornings than in the afternoons." From Biol. Abstracts.

Loustalot, A. J., Burrows, F. W., Gilbert, S. G., and Nason, A.
EFFECT OF COPPER AND ZINC DEFICIENCIES ON THE PHOTOSYNTHETIC ACTIVITY OF THE FOLIAGE OF YOUNG TUNG TREES.
Plant Physiol. 20, 283-8 (1945): C.A. 40, 3507 (1946).
"Cu and Zn deficiencies were definitely assocd. with a reduced rate of apparent photosynthesis in leaves of young tung trees. The amount of reduction was less in the case of Zn deficiency than for Cu. There was a highly significant reduction in CO_2 assimilation even with normal-appearing leaves on deficient plants. The highest rates of photosynthesis in the fall occurred about the middle of October and were associated with favorable weather conditions. As a rule the rates were higher in the mornings than in the afternoons." From C. A.

Merrill, S., Jr., Kilby, W. W., and Greer, S. R.
FERTILIZATION OF TUNG SEEDLINGS IN THE NURSERY.
Proc. Am. Soc. Hort. Sci. 41, 167-70 (1942)*: Biol. Abstracts 18, 2162, Abs. No. 20, 395 (1944).
"Tests were made of (a) commercial fertilizers in a row before planting, (b) tung vs. cottonseed meal similarly applied, and (c) commercial fertilizer as a side dressing. An 8-8-6 fertilizer applied at the rate of 200 lb. per acre either in the row at planting or as a side dressing gave as good results as heavier applications. Tung meal and cottonseed meal gave inferior results." From Biol. Abstracts.

Morrill, S., Jr. and Greer, S. P.
THREE YEARS' RESULTS IN FERTILIZATION OF TUNG SEEDLINGS IN THE NURSERY.
Proc. Am. Soc. Hort. Sci. 47, 181-6 (1946); Biol. Abstracts 21, 705 (1947); Oleagineux 2, 533(1947)

"Application of 20 lbs. N and 10-20 lbs. P_2O_5 per acre increased total shoot growth of seedling tung trees in the nursery by 74 to 109%. Additional increments of N and P_2O_5 produced only slight growth responses. Applied singly, either N or P fertilizer was relatively ineffective. K produced no response. Poultry droppings provided a highly effective fertilizer." From Biol. Abstracts.

Mills, M. P.
AN AMMONIA FERTILIZER FOR TUNG ORCHARDS.
Prog. Farmer, Miss.-Ark.-La. Ed. 64 (4), 120 (Apr., 1949)*

MOWRY, H. and Camp, A. T.
PROPAGATION, PLANTING AND FERTILIZING TESTS WITH TUNG-OIL TREES.
Florida Agr. Expt. Sta., Ann. Rept. 1933, 91-5; 1934, 62-3;*
C.A. 30, 3149 (1936).

"Earlier results on the sp. action of sol. Zn salts in overcoming bronzing of tung trees are fully confirmed. That Zn is the sp. agent involved is proved by obtaining favorable results by spraying bronzed trees with Zn prepns. The beneficial action of chicken manure on bronzing is explained on the basis of a high Zn content. The beneficial effect was obtained by adding 1 lb. of 89% $ZnSO_4.H_2O$ per tree. A 5-8-4 fertilizer mixt. gave very satisfactory growth results on young tung trees." From C. A.

Mowry, H. and Camp, A. F.
PRELIMINARY REPORT ON ZINC SULFATE AS A CORRECTIVE FOR BRONZING OF TUNG TREES.
Florida Agr. Expt. Sta., Bull. 273, 34 pp. (1934)*; C. A. 29, 4124 (1935)

"Bronzing of the tung tree is assocd. with certain soils and soil conditions in North Central Fla. $ZnSO_4$ is a sp. treatment for the trouble when applied either to the soil or as a spray to the foliage. Whether the trouble is due to a Zn deficiency in the strict sense or whether it is a condition that can be corrected by the physiol. action of Zn was not detd. From 0.25 to 0.5 lb. of the $ZnSO_4.H_2O$ per tree proved very effective. The larger amounts are used on the larger trees and the salt is applied to the soil at the base of the tree." From C. A.

Myers, A. T. and Brunstetter, B. C.
SPECTROGRAPHIC DETERMINATION OF MINERAL COMPOSITION OF THE TUNG LEAF AS INFLUENCED BY THE POSITION ON THE PLANT.
Proc. Am. Soc. Hort. Sci. 47, 169-74 (1946)*; C. A. 42, 3464-5 (1948)
"Leaves of a 6-months-old seedling tree from a nutrition expt. were analyzed for Mg, Ca, K, P, Mn, Fe, Al, Cu, and B. Concn. (dry wt. basis) of Ca ranged from 0.6% in the youngest leaf to 4.9% in the next to oldest, K (0.9 to 2.8%) and Mg (0.16 to 0.5%) also increased with age of the leaves while P showed a reverse trend, with a value of about 0.5% in the top leaves and a decrease to about 0.2% in the basal leaves. An increase with age of the leaves, expressed as γ per g., was also found for Al (50 to 900), Fe (70 to 375), Mn (45 to 300), and B (15 to 125). Cu did not show a definite trend with leaf position. These results indicate that the best samples for comparison of effects of nutritional treatments on tung leaf compn. are the fully expanded leaves from the middle nodes of the shoot."
From C. A.

Neerpass, D. C., Drosdoff, M. and Brown, R. T.
EFFECT OF FERTILIZING TUNG TREES WITH POTASH AND OTHER MATERIALS ON THE EXCHANGEABLE CATION CONTENT OF RED BAY FINE SANDY LOAM.
J. Am. Soc. Agron. 40, 771-7 (Sept., 1948)

Neerpass, D. C., Drosdoff, M. and Brown, R. T.
EFFECT OF POTASSIUM APPLICATIONS TO TUNG TREES ON THE EXCHANGEABLE CATION CONTENT OF RED BAY FINE SANDY LOAM.(Abstract)
Proc. Soil Sci. Soc. Am. (1947) 12, 191 (1948)

Neff, M. S., Drosdoff, M. and Sharpe, R.
EFFECT OF DIFFERENT SEEDLINGS ROOTSTOCKS ON GROWTH PRODUCTION AND NUTRIENT ABSORPTION OF TUNG CLONES.
Proc. Am. Soc. Hort. Sci. 52, 97-102 (1948)*; Hort. Abstr. 19(2),186 (1949)*; Oleagineux 5, 143 (1950) (abstract).
Significant differences have been found in Georgia for the following: the number of primary branches, the cross-section of the trunk, the percentage of N, P, K, Ca and Mg in the leaves, the production and the dry weight of the fruit.

Newell, W., Mowry, H., Barnette, R.M., Camp, A. F. and Dickey, R. D.
THE TUNG OIL TREE
Florida Agr. Expt. Sta., Bull. 280, 5-67 (1935); C.A.30, 216 (1936).
"The tung-oil tree, Aleurites fordii, thrives in Fla. on well-drained soils of acid reaction. Excesses of lime and phosphate in the soil are detrimental to growth. The use of $ZnSO_4$ to prevent bronzing is recommended. Complete fertilizers contg. N, P_2O_5 and K_2O in the ratios of 5:8:4 give the best results in the growth and yield of nuts."
From C. A.

Painter, J. H.
MULCHING YOUNG TUNG TREES PAYS DIVIDENDS.
Proc. Am. Tung Oil Assoc, 1947, 36-41.
"Growers who overlook this practice in young orchards are losing an opportunity to grow better trees at less cost." From the author's summary

Painter, J. H., and Drosdoff, M.
RESULTS OF PRELIMINARY TESTS ON CORRECTION OF POTASSIUM DEFICIENCY IN TUNG.
Proc. Am. Soc. Hort. Sci. 42, 65-8 (1943)*; C.A. 37, 6802 (1943)
"Results corroborate the conclusion that certain leaf symptoms discussed in a previous paper (cf. C.A. 37, 6304^4) are caused by lack of K. Expts. now in progress are designed to det. the most economical means of overcoming this difficulty in com. orchards." From C.A.

Painter, J. H. and Jones, R. W.
MULCHING, A VALUABLE TREATMENT FOR YOUNG TUNG TREES IN POTASSIUM DEFICIENT SOIL.
Proc. Am. Tung Oil Assoc. 1943, 19-23
Mulching with *Crotalaria spectabilis*, grown between the rows, caused faster growth of young tung trees and helped to prevent the occurrence of potassium deficiencies. An extensive commercial trial of mulching in young tung orchards is warranted.

Painter, J. H. and Potter, G. F.
MULCHING VERSUS CULTIVATION IN THE YOUNG TUNG ORCHARD
Proc. Am. Soc. Hort. Sci. 42, 17-20 (1943); Brit. Chem. Abstracts 1944, B, III, 250
"Mulching gave increased growth and yield of young tung trees, reduced signs of K deficiency, and postponed defoliation at the end of the season." From Brit. Chem. Abstracts

Potter, G. F. and Crane, H. L.
SOIL MANAGEMENT IN THE TUNG ORCHARD
Proc. Am. Tung Oil Assoc. 1950, 8-15
Carefully planned growth of cover crops, additions of fertilizers and cultivation improve yields from tung orchards.

Potter, G. F., Crane, H. L. and Merrill, S., Jr.
GOOD CARE, HIGH YIELDS, BRING PROSPERITY TO TUNG GROWERS.
Proc. Am. Tung Oil Assoc. 1948, 11-5
"The American tung industry can and will increase yields per acre and by so doing will lower production costs per pound of oil -- " From the authors' summary.

Potter, G. F., Kilby, W. W., and Bahrt, G. M.
EFFECT OF NITROGEN ON BLOSSOM FORMATION IN BEARING TUNG TREES.
Proc. Am. Tung Oil Assoc. 1943, 14-18.

In 1941, 6-year-old tung trees were divided into 3 groups and were given 0, 375, and 850 lbs. per acre of nitrate of soda, resp. The following year the trees that had received no nitrogen had an average of 0.74 pistillate flowers per terminal: those at medium and high levels of nitrogen supply formed, resp., 1.14 and 1.49 pistillate flowers per terminal. These data indicate that it is profitable to fertilize with liberal amounts of nitrogen.

Potter, G. F., Kilby, W. W., Bahrt, G. M., Freeman, A. F., Pack, F. C., and McKinney, R. S.
EFFECT OF FERTILIZERS ON OIL CONTENT OF TUNG FRUITS.
Proc. Am. Tung Oil Assoc. 1943, 38-49.

In some cases applications of potassium had an effect of increasing the percentage of oil in the kernels and in the whole fruit. In other experiments no measurable effects were obtained. These variations may be due to variations in the potassium-supplying power of the soils. Tung trees require a high level of available potassium in the soil for normal tree growth and yield of oil. Fertilizing with liberal quantities of potassium is advisable.

Potter, G. F., Painter, J. H., Bahrt, G. M., Lagasse, F. A., Angelo, E., and Crane, H. L.
SOIL MANAGEMENT IN TUNG ORCHARDS IN THE UNITED STATES.
Proc. Am. Tung Oil Assoc. 1944, 9-17: Biol. Abstracts 19, 1541, Abs. No. 14,203 (1945).

"In the interest of good farm management, both summer and winter cover crops should be used in large orchards in order to avoid peak demands for labor and equipment at certain seasons, e.g., during the relatively short planting season for winter cover crops. Leguminous cover crops turned under when green and succulent decompose quickly and release the max. amts. of N to the tung trees. Leguminous cover crops turned under when mature and woody decompose slowly and a portion of their N content is consumed in the decomposition process: but, as compared with crops turned under while succulent, a higher level of humus is maintained in the soil. As a result, there is a more marked improvement in the water-absorbing, water-holding, and mineral-holding capacity of the soil. Cultivation accelerates decomposition of all forms of organic matter. This results in the release of N and minerals, and corresponding decrease in humus." From Biol. Abstracts.

Potter, G. F., Sitton, B. G., and McCann, L. P.
EFFECT OF DIFFERENT RATES OF APPLICATION OF NITROGEN ON BIENNIAL BEARING IN TUNG.
Proc. Am. Soc. Hort. Sci. 50, 125-30 (1947): C.A. 42, 8393 (1948).

"Application of N increased yields but did not reduce the alternate bearing tendency. Defruiting significantly increased the percentage of oil content of the succeeding crop." From C. A.

Robert, J. C. and Greer, S. R.
TUNG-TREE CULTURE AT SOUTH MISSISSIPPI BRANCH EXPERIMENT STATION.
Mississippi Agr. Expt. Sta. Bull. 310, 12-16 (1935)*: C.A. 30, 6497 (1936).

"The tung tree prefers a slightly acid and at least moderately productive soil. In general, cover crops such as soybeans, cowpeas, vetch and crimson clover, when intertilled with tung trees, were fully as beneficial as complete fertilizers, and furnished org. matter in addn. to N, P, and K." From C.A.

Salter, R. M.
DEVELOPMENTS BY THE BUREAU OF PLANT INDUSTRY.
Am. Fertilizer 104 (5), 7-8 (1946)*; Biol. Abstracts 20, 1949, Abs. No. 18,294 (1946).

"N fertilizer carrying 35-70 lbs. N per acre resulted in an increase of 45-185% in production of tung oil." From Biol. Abstracts.

Schultz, E. F.
COVER CROPPING UNDER TUNG.
Rev. Ind. y Agr. Tucuman 32 (10/12), 239 (1942)*; Biol. Abstracts 18, 2162, Abs. No. 20,398 (1944).

"Since tung is harvested by the collection of fallen nuts the choice of an anti-erosion crop is limited. In Argentina cowpeas should be sown in Oct. to be ploughed in Mar., the tung is harvested from Apr. to June, and from July a grain crop can be sown. Velvet peas are a useful crop during the early years before the trees have borne their first fruit." From Biol. Abstracts.

Sell, H. M., Best, A. H., Reuther, W., and Drosdoff, M.
CHANGES IN CHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITY OF DEVELOPING TUNG FRUIT WITH REFERENCE TO OIL SYNTHESIS.
Plant Physiol. 23, 359-72 (1948); C.A. 42, 8272 (1948).

"Reducing sugar in the hull increased until Aug. Only small quantities were present in the kernel and these completely disappeared in Oct. and Nov. Nonreducing sugar increased steadily in the hull until Sept. In the kernel it attained a max. of 160 mg./ fruit in Aug., thereafter declining slightly. Starch accumulated toward the end of the season in the hull but disappeared completely from the kernel by Nov. 15. On July 15 the kernel contained 0.027 g. of oil per fruit. A period of active oil synthesis ensued, and on Sept. 15 the kernels contained 5.295 g. of oil, or 64% of their dry wt. Even in the early stages no appreciable quantity of free acid accumulated and the characteristics of the oil indicate that from the first it consisted almost wholly of the glyceride of eleostearic acid. Both alc.-sol. and insol. N in the hull declined steadily from July to Nov. In the kernel sol. N declined but insol. accumulated and, calcd. as protein, it constituted 19.9% of the mature tung kernel as of Sept. 15. Pectic acid occurred only in the hull, a marked accumulation occurring between Aug. and Sept. Tannin occurred only in the hull, attaining a max. in Aug. of 8.88% of the dry matter. About 0.7 of the total ash of the whole fruit was found in the hull. Ca remained relatively const. in both hull and kernel throughout the season. Mg showed a downward trend in the hull and accumulated steadily in the kernel until Sept. K was especially abundant in the hull. The preponderance of basic elements in the hull may be related to the presence of large quantities of org. acids. P in the hull declined to a very low level and there was a concomitant increase in the kernel, which suggests a translocation from hull to kernel. Respiratory activity of the kernel attained a max. in Sept. when a respiratory quotient of 1.7 was observed. The low O requirements may be accounted for on the basis of O release incident to the conversion of glucose into the eleostearic acid glycerides; but this high respiratory quotient was not observed in Aug. when oil synthesis was at its peak." From C.A.

Sitton, B. G.
RESPONSES OF BEARING TUNG TREES TO NITROGEN, PHOSPHORUS, AND POTASSIUM FERTILIZERS.
Proc. Am. Soc. Hort. Sci. 52, 25-39 (1948): C.A. 43, 9324 (1949): Proc. Assoc. Southern Agr. Workers 45, 124-5 (1948) (abstract).

"In an extensive expt. in which tung trees were supplied with 3 levels each of N, P, and K, from 1943 to 1946, yields were most directly affected by N, but ultimately highest yields were obtained when K and P were also applied. Oil content of the kernel was decreased by N and increased by K. The percentage of kernel in the whole fruit was increased by both N and K and the net result was a substantial increase in oil in the whole fruit when both N and K were used. Applications of N, P, and K resulted promptly in an increased percentage of these elements in the dry wt. of the leaves: the Mg content tended to be in reverse ratio to the K content. When a high level of N was used in combination with a low level of K, K in the leaves declined steadily over the 4-yr. period and by 1946 dropped close to the deficiency level. Only when K was applied at the high level with N at a low level was the original K content of the leaves fully maintained." From C.A.

Sitton, B. G.
THE EFFECT OF NITROGEN, PHOSPHORUS, AND POTASSIUM UPON THE GROWTH OF NEWLY TRANSPLANTED TUNG TREES.
Proc. Am. Tung Oil Assoc. 15 (2), 3-10, 2a (1949): Proc. Am. Soc. Hort. Sci. 54, 22-8 (1948).

Fertilizing with nitrogen or with phosphorus generally resulted in greater linear growth but the effect of potassium was inconsistent.

Sitton, B. G., Painter, J. H. and Brown, R. T.
INCREASING PROFITS FROM TUNG ORCHARDS WITH POTASSIUM.
Proc. Am. Tung Oil Assoc. 1948, 16-20.

Fertilizing with potassium increases yields of tung oil and protects the tree from leaf scorch and defoliation due to potassium deficiency.

Sitton, B. G., Painter, J. H., Brown, R. T., Gilbert, C. G., and Drosdoff, M.
INCREASING TUNG PROFITS WITH POTASSIUM.
Better Crops with Plant Food 33 (2), 21-4 (1949): C.A. 44, 254-5 (1950).

"On tung-belt soils relatively rich in K, high yields have been attained by applying 0.16 lb. N per tree per yr. of attained age. After 3 to 5 yrs. the oil content of the fruit declined seriously. The application of K at the rate of 0.75 lb. K_2O for each lb. of N used maintained the oil content at approx. 21% in whole fruit having a 15% moisture content. On soils low in available K, the application of both K and N was necessary to maintain oil content and to attain max. yields." From C.A.

Smith, W. M.

PRACTICAL DEVELOPMENT OF COMMERCIAL TUNG ORCHARDS IN AMERICA.
Am. Paint J. 25, 58-63 (July 21, 1941): 25, 52, 54-7, 58, 60 (July 28, 1941).

Tung oil production in this country is an expanding industry, acreages being increased from 43,000 acres in 1930 to 175,000 acres in 1939. In 1937 the 103,125 acres of orchards were distributed as follows: Mississippi, 63%; Florida, 15; Georgia, 3.5; Texas and Alabama together, 1.5. Requirements for soil conditions and cultivation procedures are reviewed.

Taranovskaya, V. G.

THE IMPORTANCE OF SILICATE MELIORATION FOR CITRUS FRUITS OF DIFFERENT KINDS, TUNG AND BASIC FERTILIZER PLANTS.
Sovet Subtropiki 1940, No. 5, 38-43*: Chem. Zentr. 1940, II, 2364-5: C.A. 36, 7210 (1942).

"*** Exptl. results are reported and analyzed to show that silicate treatment of the soil acts essentially to improve the P_2O_5 nutrition of the plants." From C. A. (abridged).

Webster, C. C.

NOTES ON THE PROGRESS OF TUNG EXPERIMENTAL WORK.
Nyasaland Agr. Quart. J. 1 (4), 16-7 (1941)*: Biol. Abstracts 17, 859, Abs. No. 10,077 (1943).

"Yield records from selected trees of Aleurites fordii and A. montana for 1940 and 1941, with the av. yields of the plantations in which they are situated, are summarized in tabular form." From Biol. Abstracts.

Webster, C. C.

TOPWORKING ALEURITES MONTANA.
Nyasaland Agr. Quart. J. 2 (2), 10-5 (Apr. 1942)*: Bibliog. of Agr. 1, D, 53, (1942).

"The results of some preliminary experiments." From Bibliog. of Agr.

Webster, C. C.

A NOTE ON THE CULTIVATION AND MANURING OF TUNG PLANTATIONS (A. MONTANA).
Nyasaland Agr. Quart. J. 7, 58-64 (July 1948)*.

Williamson, B. F.

TUNG-OIL CULTIVATION.
Oil, Paint Drug Reptr. 140 (3),3, 47 (1941)*: C.A. 37, 6394 (1943).

"The culture of tung-oil trees is briefly discussed, with emphasis on the selection of stock giving high oil yields and the adequate use of a complete fertilizer." From C.A.

Wynaert, L.

WOOD OR TUNG OIL FROM ALEURITES.
Bull. agr. Congo Belge 27, 70-102 (1936): C.A. 30, 6115 (1936).

"A general discussion is given of raising Aleurites in the Belgium Congo. Data are given on the H_2O and oil contents of the seeds of Aleurites fordii grown on soil plots which have received different fertilizers. Sixteen fertilizers were tested." From C.A.

Reuther, W. and Burrows, F. W.

EFFECT OF MANGANESE SULFATE ON THE PHOTOSYNTHETIC ACTIVITY OF FRENCHED TUNG FOLIAGE.

Proc. Am. Soc. Hort. Sci. 40, 73-6 (1942)*; C.A. 36, 7066 (1942).

"A pronounced effect of Mn treatment on photosynthesis was not observed. Severely frenched trees tend to produce small leaves and it is possible that the total leaf area is more important in detg. the total photosynthate produced by a tree than the efficiency of the leaf surface per unit are." From C.A.

Reuther, W. and Dickey, R. D.

PRELIMINARY REPORT ON THE FRENCHING OF TUNG TREES.

Florida Agr. Expt. Sta., Bull. 318, 21 pp. (1937); C.A. 32, 7638 (1938).

"A type of chlorosis and necrosis affecting tung-tree foliage is described under the term 'frenching.' Control can usually be secured by the addn. to the orchard soil of 8-10 lb. $MnSO_4$ per acre. Frenching was commonly experienced when the exchangeable soil Mn fell below 2 lb. per acre. Several soils showing only 2.3-3.4 lb. of replaceable Mn per acre supported normal foliage. It seems probable that Mn is deficient in certain soil areas in Fla. Excessive quantities of sol. Mn also produce toxic effects on tung trees." From C.A.

(c) Plantings in Various Countries

Anonymous

AMERICAN TUNG OIL APPRECIABLY NEARER.

Drugs, Oils & Paints 30, 207 (1914).

Trees in the vicinity of Tallahassee are all doing well. American trees are in every way equal to those in China. 40,000 trees are under cultivation in the south and when mature will produce from 1/4 to 1/3 of the present annual requirement. The next two years will show whether or not cultivation of the trees is commercially profitable.

Anonymous

FRUITS AND SEEDS OF *ALEURITES FORDII* FROM KENYA COLONY.

Bull. Imp. Inst. 27, 10-2 (1929); C.A. 23, 2842 (1929).

"Seeds of *A. fordii* trees grown in Kenya Colony from seed from Hankow were composed of 37.9% shell and 62.1% kernel. The kernels contained 4.9% H_2O and on extn. with petr. ether gave 60.4% (63.5% on dry basis) of oil having the following consts., as compared with those of the original Hankow seeds from which the Kenya Colony trees were grown, and with a sample of oil received from China: d^{15}_{15} 0.9433, 0.9405, 0.9414; acid value 0.52, 0.63, 0.43; sapon. value 192.7, 193.5, 195.3; I value (Hübl, 17 hrs.) 172.8, 174.8, 172.0%; unsapon. matter 0.4, 0.3, 0.4%; n_{40} 1.512, 1.513, 1.513." From C. A.

Anonymous

HISTORY OF TUNG PRODUCTION IN SAO PAULO.
Brazilian Business 22 (8), 183-9, 193 (Aug. 1942)*; Bibliog. of Agr. 2, A, 171 (1943).

"Includes tables showing estimated production of tung oil in the State of Sao Paulo for the next five years (1942-1946) and number of tung trees in Sao Paulo, 1941." From Bibliog. of Agr.

Anonymous

TUNG OIL, A NEW VEIN OF WEALTH FOR THE SOUTH.
Acco Press 21 (3), 6-10 (Mar. 1943)*; Bibliog. of Agr. 2, A, 290 (1943).

"A story of how thousands of acres of cut-over pine lands have been made to support new families and contribute to the American way of life." From Bibliog. of Agr.

Anonymous

PROMOTION OF TUNG.
Chacra 13 (152), 14, 73 (June 1943)*; Bibliog. of Agr. 3, K, 148 (1943).

"Notes that a commission has been appointed to organize and direct tung production, industry and trade in Argentina. Private initiative had previously carried out work in this line." From Bibliog. of Agr.

Anonymous

THE PRESENT POSITION OF TUNG OIL PRODUCTION IN THE EMPIRE.
Bull. Imp. Inst. 43 (1), 14-8 (1945); Oléagineux 1, 49 (1946).

The yields are very variable: Union of South Africa: The culture in 1939 gave 15 tons of oil and in 1943, 270 tons. Research takes place at the sub-tropical horticultural station at Nelspruit-Transvaal. British East Africa: *A. montana* appears to furnish interesting results at Sotik (Kenya) while *A. fordii* is found almost everywhere. Nyassaland: there were 6.847 acres of *aleurites* trees in 1943. Indes: There are large possibilities for the extension of its culture. New Zealand: The culture has practically stopped. (translated from Oleagineux).

Anonymous

SEEDS SOLD TO WORLD BY BENNETT.
Tung World 1 (1), 19 (April 1946).

Tung seeds for planting have been shipped to Australia, New Zealand, Belgian Congo, Rhodesia, Northern Transvaal, Brazil, Argentina, Nyasaland, Iran, etc.

Anonymous

TUNG OIL INDUSTRY IN BRAZIL.
Oil & Colour Trades J. 110 (2508), 951 (1946)*; Oléagineux 2, 228 (1947).

Brazil can rapidly become the second world producer of tung oil because of the development of plantations since 1930. There are now 4,000,000 trees compared with 2,000,000 in 1942. Argentina has 1,800,000 trees. (selections translated from Oleagineux).

Anonymous

TUNG OIL, A GROWING INDUSTRY IN THE GULF SOUTH.
United Gas Log 9 (12), 2-9 (Oct., 1948)*.

Amani Agricultural Research Station

TUNG OIL AT AMANI.
E. African Agr. J. 2, 109 (1936).
Growth of *Aleurites montana* trees has been more successful than that of *A. fordii* trees.

B., G. T.

MINOR FOREST PRODUCTS IN MYSORE.
Bull. Imp. Inst. 44 (3), 204-5 (1946); Oleagineux 2, 169 (1947).
The two principal oil seeds which appear to have a commercial importance are the "dhupa" (*vateria indica*) and the *aleurites*, *montana* and *fordii*. Significant work has been done on the former but the author considers that the problem of its extensive use should be examined anew by the Bureau des Recherches Industrielles er Scientifiques. Some small plantations have already been established near Hassan. (translated from Oleagineux).

Barry, T. H.

CHINA WOOD OIL.
Paint Manuf. 1, 24-6 (1931)*; C.A. 25, 4418 (1931).
"A brief review of the culture of the tung oil tree." From C.A.

Biswas, K.

CULTIVATION AND SYSTEMATIC STUDY OF THE TUNG OIL-YIELDING TREES IN INDIA.
J. Sci. Ind. Res., India 4, 260-272 (1945)*; Brit. Chem. Abstracts 1946, B, III, 87.
"A historical review of the attempts which have been made to cultivate Aleurites in different parts of the world is followed by a discussion of the factors affecting yield, including the abnormal sex distribution of the flowers (erratically monoecious, hermaphrodite, or dioecious). Suitable methods are recommended for the cultivation of tung trees and the harvesting of the oil in India. *A. montana* is more suitable than *A. fordii*, except at high altitudes." From C. A.

Bonnet, M. P.

CULTIVATION OF *ALEURITES FORDII* IN INDO-CHINA.
Recherches et inventions 15(241), 271-80 (1934).
A report on seeding and transplanting experiments on *A. fordii* carried out in various parts of Indo-China. Preliminary indications were favorable especially where plantings were made in good soil.

Chevalier, Aug.

THE ALEURITES OF INDO-CHINA, PRODUCERS OF WOOD OIL.
Rev. bot. appl. et agr. trop. 14 (154), 389-99 (1934)*; Biol. Abstracts 10, 2304, Abs. No. 21,903 (1936).
"Discusses the production of wood oil in Indo-China and gives detailed information on *Aleurites moluccana*, *A. montana*, *A. fordii*, *A. cordata* and *A. trisperma*. A wood-oil plantation as a European enterprise in Indo-China is not considered economically sound." From Biol. Abstracts.

D., H.

SOVIETS SPEED UP THEIR OWN TUNG PRODUCTION.
Tung World 4 (1), 9, 12, 14 (1949).

"In spite of unfavorable ecological conditions the acclimatisation of tung in Russia has been attained. New clones of *A. fordii* have been successfully grown which are particularly resistant to frost and which give high yields of oil of good quality." From the summary of the article.

Dacy, G. H.

AMERICAN OIL FROM CHINESE TREES. A NEW INDUSTRY IN THE SOUTH.
Am. Forests & Forest Life 32 (385), 37-9 (1926)*; Biol. Abstracts 2, 1190, Abs. No. 12,738 (1928) (no abstract).

Dept. of Agriculture, Northern Rhodesia

VI. TUNG OIL IN NORTHERN RHODESIA.
E. African Agr. J. 2,109-10 (1936).

Plantings of *Aleurites montana* have thrived but those of *A. fordii* have failed.

Dept. of Agriculture, Nyasaland

V. TUNG OIL IN NYASALAND.
E. African Agr. J. 2 109 (1936).

Growth of *A, montana* has been more satisfactory than of *A. fordii*.

Elden, H. van and Phillips, E. P.

TUNG-NUT GROWING.
Union S. Africa Dept. Agr. . & Forest. Bull. 140, 1-13 (1935)*; Biol. Abstracts 10, 2299, Abs. No. 21,860 (1936).

"A survey of tung nut plantings in S. Africa shows upwards of 203 acres 1-4 yrs. old in many districts. The trees do well on deep sandy loam where rainfall is at least 30 in. Seedlings are very variable, and vegetative propagation of superior vars. and strains is suggested. Very little pruning is required, and the trees respond to good culture. About 2,500 acres is sufficient to maintain an efficient oil press." From Biol. Abstracts.

Engelbeen, B.

THE ALEURITES.
Bull. agr. Congo Belge 37 (2), 255-342 (1946); Oléagineux 2, 106-7 (1947).

After a botanical review of the different species from the point of view of systematic and floral biology the author summarizes the results of acclimatization and selection tests in different countries. *Aleurites fordii* and *A. montana*, the only two species of economic interest, were especially considered. The diseases and enemies observed are described as well as means of combatting them. Much information is furnished on the growth of the seed and its vegetative process as well as on germination beds and nurseries. The author examines the ways of establishing plantations in different countries, harvesting conditions and yields. After giving details on the use and the chemical composition of the oils he studies the commercial aspects of the production of tung oil and finally the first results obtained in Belgian Congo. This excellent study is ended with an important bibliography. (translated from Oléagineux).

Francois, M. Th.
VEGETABLE OILS AND OILSEEDS AVAILABLE IN THE FRENCH COLONIES.
Chimie & Industrie Special No.,904-13 (March 1932); C.A. 26, 3688 (1932).

"A review of the vegetable oil and oil-seed resources of the French colonies with bibliography of 52 references." From C. A.

Tung oil (*A. fordii*) and abrasin oil (*A. montana*) have long been produced in Indo China. They have been tried on Madagascar from which the seeds were exported and processed in France. There is no doubt but that their culture could be developed in the African Colonies whenever it is seriously attempted.

Frost, E. T.
THE TUNG OIL TREE. CULTIVATION EXPERIENCE IN NORTH AUCKLAND.
New Zealand J. Agr. 44 (5), 337-9 (1932);

"After a year's experience with tung plants, one can safety lay down the principles of a summer fallow and adequate shelter as conducive to the best results. Further, if these principles are extended to the plantation subsequently the tung plant should thrive in the congenial climate of North Auckland." From the author's summary.

Furness, R.
OILS, FATS AND SOAP INDUSTRIES IN 1930.
Ind. Chemist 7 (72), 13-5 (1931); C.A. 25, 1401 (1931).

This British Review is chiefly devoted to margarine, Vitamin A in vegetable oils, "bacterial" extraction of fats, synthetic glycerides and soap. It mentions that the possibilities of producing tung oil within the British Empire are being studied with care.

Gardner, Henry A.
TUNG OIL PRODUCTION IN AMERICA.
Paint Mfrs. Assoc. U.S., Circ. 108, 2 pp., (Oct., 1920); C.A. 14, 3803 (1920).

"Tests on oil expressed from a new shipment of tung nuts from Fla., prove to be of excellent quality. Analysis is tabulated. Observations show that the nuts may be successfully grown in Fla." From C. A.

Gardner, H. A.
REPORT ON TUNG OIL DEVELOPMENTS IN FLORIDA.
Paint Mfrs, Assoc. U. S.; Special Circ., 20 pp. (1923); C.A. 18, 335 (1924).

Very satisfactory progress has been made in Florida by a number of experimental tung tree plantings whose history is reported. Estimated costs for starting a grove are tabulated. The quality of American tung oil is good as indicated by analyses such as the following (Florida crop,1920): shells, 55%; meats, 45%; oil in meats, 49%; $d^{15.5}$, 0.9417; acid no., 0.1; I no. (Hübl), 170.1; Sap. no., 192.4; unsaponifiable, 0.23%; Browne heat test, 9-10 min.

Gardner, H. A.
AMERICAN TUNG OIL CULTURE.
Paint Mfrs. Assoc. U. S., Circ. 195, 207-41 (Jan., 1924).
C.A. 18, 1578 (1924).

This contains (1) a report on progress made on the establishment of two experimental tung oil groves at Gainesville, Fla.; (2) an announcement of the organization of the American Tung Oil Corp.; (3) a summary on methods of cultivation of the tung-oil tree; (4) a reprint of Circular No. 123, "Report on Recent Tung-Oil Developments in Florida"; and (5) a reprint of "Chinese Wood Oil," by D. Y. Lin.

Gardner, H. A.
TUNG OIL PROGRESS DURING 1926.
Paint Mfrs. Assoc. U.S. Circ. 289, 155-73 (Oct. 1926).

Many new tung orchards have been planted. Prospects are especially promising for tung culture in Louisiana. There are 12 photographs taken in tung orchards and a map of the Southern states showing the locations of new groves.

Gardner, H. A.
CAMERA RECORD OF TUNG OIL GROWTH IN FLORIDA.
Am. Paint. Varnish Mfrs. Assoc., Sci. Sect. Circ. 312, 337-64 (1927).

"There are presented* * * fourteen illustrations taken on May 17, 1927, at the time of the writer's last trip to the tung oil groves. These illustrations are accompanied* * * with a brief description of the views and an outline of the experimental work that is being conducted. The thriving condition of the trees and the promise of extraordinarily large crops in the future would suggest that additional attention be given to the project of rapidly expanding the tung oil groves in the southeastern part of the United States." From the author's introduction.

Gardner, H. A.
FOREIGN EXPERIMENTAL PLANTINGS OF TUNG OIL.
Am. Paint Varnish Mfrs. Assoc., Sci. Sect. Circ. 342, 56 (Jan. 1929).

The American Tung Oil Corp. has furnished seed for the planting of tung trees in numerous locations in Africa, Asia, New Zealand, Cyrus, Bermuda, etc.

Gardner, H. A.
FOREIGN TUNG-OIL PLANTINGS.
Natl. Paint, Varnish Lacquer Assoc. Circ. 487, 234-41 (1935); C.A. 29, 8366 (1935).

"Batavia is too tropical for *Aleurites fordii* but is well suited to *A. montana*. Parts of New Zealand are apparently suited to *A. fordii*." From C. A.

Gardner, Henry A.
TUNG-OIL CULTURE.
Natl. Paint, Varnish Lacquer Assoc. Circ. 476, 14-112 (1935) (7th revised edition); C.A. 29, 1664 (1935).

"New Material includes notes on recent developments in tung-oil culture in Brazil, Russia, Africa and other countries." From C. A.

Gardner, Henry A.
TUNG OIL IN TROPICAL ISLES.
Natl. Paint, Varnish Lacquer Assoc. Circ. 514, 239-44 (1936); C.A. 30, 7880 (1936).
"Aleurites fordii does not do well in the West Indies, but A. molucanna grows well, and expts. with A. montana show promise. A. trisperma should also thrive. Further exptl. plantings are being made." From C.A.

Gardner, H. A.
CULTURE OF PAINT OIL CROPS FOR THE SOUTH.
Am. Paint J. 22, 51-9 (Feb. 14, 1938)*; C.A. 32, 2766 (1938).
"A brief description of a no. of plants in the U.S.A. which produce drying and semidrying oils. The oils include linseed, perilla, Chia, safflower, soybean, castor, hempseed, sunflower, poppyseed and tung. Walnut, grapeseed and fish oils have suitable properties but the sources do not lend themselves readily to cultivation." From C.A.

Gay, E. C.
TUNG GROWING IN ARGENTINA.
Proc. Am. Tung Oil Assoc. 1946, 6-7.
Tung production has been investigated in Argentina since 1929. Aleurites fordii has proven most satisfactory and is being grown commercially in the provinces of Misiones and Corrientos. Production was 273 tons of oil in 1942 and 20,705 tons (estimated) for 1946. Ants and caterpillars are serious problems while a borer and bronzing cause little damage.

Georgi, C.D.V. and Ashby, H.K.
TUNG OIL ON CAMERON HIGHLANDS (MALAYA).
Malayan Agr. J. 28, 21-26 (1940); Brit. Chem. Abstracts 1940, B, 463.
"Analyses of seeds and oil from Aleurites montana grown in Malaya are recorded. Oil yields in the district examined are poor." From Brit. Chem. Abstracts.

Guzman, V.L.
CULTIVATION OF THE TUNG OIL TREE.
Lima. Peru. Dir. de agr. y ganad. Secc. técnica de propag. agropecuaria. 8 pp. (1942)*; Bibliog. of Agr. 3, D, 69 (1943)

Hayter, C.
TUNG NUT GROWING IN SOUTHERN RHODESIA.
Rhodesia Agr. J. 1947 (44), 248-9*; Hort. Abstracts 18 (1), 61 (1948)*; Oléagineux 3 (8/9), 436 (1948).
"A brief account of past results and of future prospects. Trials made with Aleurites fordii have not given results that appear promising in comparison with those from A. montana. Pointers on its culture." Translated from Oleagineux.

Ho, K.
TUNG TREE AND PLANTATION IN FOREIGN COUNTRIES.
Agr. Assoc. of China J. 1934 (122), 38-59 (in Chinese).

Imperial Institute [Gt. Brit.]
TUNG OIL FROM NYASALAND.
Imperial Inst. Ann. Rept. 1940, 21-2*; Rev. Current Lit. Paint, Colour, Varnish & Allied Ind. 14, 53 (1941)*; C.A. 35, 6818 (1941).
"Exptl. plantings of *Aleurites fordii* and *A. montana* gave oils of satisfactory quality." From C. A.

Imperial Institute [Gt. Brit.]
ALEURITES OILS.
Imperial Inst. Ann. Rept. 1941, 15*; Rev. Current Lit. Paint, Colour, Varnish & Allied Ind. 15, 68 (1942)*; C.A. 36, 5364 (1942).
"Good-quality oils were obtained from tung trees in India and from *A. montana* trees in Honk Kong." From C. A.

Jordan, L. A.
EMPIRE PRODUCTION OF TUNG OIL.
J. Roy. Soc. Arts 83, 539-66 (1935)*; C.A. 29, 4607 (1935).
The development of European markets for Chinese tung oil is discussed with tables showing oil exports from China from 1918-34. The processing of the fruit of *Aleurites fordii* and *A. montana* has remained crude in China, yielding products of variable quality. British users caused experimental plantings of both *A. fordii* and *A. montana* to be made in many parts of the British empire. Analytical results are tabulated showing the composition of the fruit and properties of the oil from 12 of those plantings. Fruit processing tests gave highest yields with expellers of the Anderson type. No use has been found for the press cake other than as fertilizer.

Knight, H. G.
RESEARCH ON TUNG OIL.
Drugs, Oils & Paints 54, 308-9, 310 (1939); C.A. 33, 9015 (1939).
"An address dealing with the tung oil tree growing in the U.S.A." From C. A.

Kuentz, L.
CHINA WOOD OIL. ITS CULTURE IN THE U.S.A.
La Nature 57, (2819), 363-5 (1929).
A short article on the production of this oil in America.

Laurie, M.V. and Sen Gupta, J.N.
NOTES ON CULTIVATION OF THE TUNG OIL TREE (*ALEURITES* SPP.) IN INDIA.
Indian Forest Records (n.s., Silvicult.) 4 (3), 133-59 (1941)*; Biol. Abstracts 18, 2404, Abs. No. 22,770 (1944).
"A detailed account of methods of raising plantations of *A. fordii* and *A. montana*. The latter can withstand higher temp. and heavier rainfall than *A. fordii*." From Biol. Abstracts.

Le Roux, J. C.
TUNG OIL.
Nyasaland Agr. Quart. J. 1 (4), 18-23 (1941)*; Biol. Abstracts 17, 859, Abs. No. 10,070 (1943).
"From observations and from expts. which are mainly in their initial stages, it is concluded that the tung-oil industry offers

possibilities for many S. African farmers. Yields, and soil and cultural requirements for *Aleurites fordii* are discussed. Selected seedlings of good parentage rather than budded trees are recommended for trial plantings, until variety-rootstock expts. have progressed further." From Biol. Abstracts.

McBride, J. N.
TUNG OIL PRODUCTION. A NEW INDUSTRY FOR THE SOUTH.
Mfrs. Record 87, 74-5 (June 11, 1925).

A brief review touching on the source of the oil, the culture of the tung trees and the prospects for the future of the infant American tung industry.

McGregor, C. J.
III. TUNG OIL IN TANGANYIKA.
E. African Agr. J. 2, 107-8 (1936).

Most of the early plantings of *Aleurites montana* and *A. fordii* in Tanganyika failed but one plantation is in good condition. Further trials are warranted. In Iringa Province results have been poor in all cases except where properly planted and fertilized.

Massa, Luigi
EXPERIMENTS IN THE CULTURE OF *ALEURITES* IN ITALIAN EAST AFRICA.
Agr. coloniale (Italy) 36 (7), 183-7 (1942)*; Biol. Abstracts 18, 376, Abs. No. 3423 (1944); Oleagineux 5, 76 (1950).

"Numerous attempts to introduce *A. montana*, *A. cordata* and *A. triloba* into Somaliland, Eritrea and Ethiopia resulted in a low % of doubtful establishments." From Biol. Abstracts.

Mendes, P. T.
TUNG OIL TREE CULTURE.
Ministerio da Agricultura. Servico de Informacao Agricola, Rio de Janeiro, 41 pp., 1948 (S. I. A. 700)*

Meyer, A. C.
TUNG AND THE TUNG OIL INDUSTRY.
Chacaras e Quintais 66, 217-8 (Aug. 15, 1942)*; Bibliog. of Agr. 3, E, 78 (1943).

Miege, E.
TRIALS WITH *ALEURITES* IN MOROCCO.
Mat. grasses, 20, 57-63 (1936); Brit. Chem. Abstracts 1936, B, 515.

"*A. fordii* reared at Rabat yields fruits comparable with those grown in Florida, the seeds containing as much as 34% (≡ 55.2% on the kernel) of oil (d^{15} 0.9445, n 1.520), which conforms to all the ordinary specifications for tung oil; the cultivation trials are promising. It may be possible to cultivate *A. montana* in some districts. Plants of *A. moluccana* flourished, but the climate (1933) was not hot enough to ensure fruiting." From the Brit. Chem. Abstracts.

Milsum, J. N. and Marsh, T. D.

PRELIMINARY REPORT ON THE CULTIVATION OF _ALEURITES_ _MONTANA_.
Malayan Agr. J. _17_ (2), 47-51 (1929)*; Biol. Abstracts _4_, 1845, Abs. No. 19,530 (1930).

"Seeds of this Chinese wood-oil tree, obtained from China were planted at Serdang, Malay Peninsula. Trees grown from these were erratic in behavior, due probably to the lack of a cold season. Flowering and fruiting occurred throughout the season. A case worm (_Psychid_ sp.) is noted as a destructive pest." From Biol. Abstracts.

Mowry, Harold

TUNG OIL.
Proc. Assoc. Southern Agr. Workers [1931] _32_, 315-9 (1932); C.A. _26_, 2607 (1932).

"A brief discussion is given of some of the problems encountered in the establishment of the tung-oil industry in the South." From C.A.

Nieves, R.

TUNG PROBLEMS IN OUR COUNTRY.
Bolsa de Cereales, Buenos Aires, Rev. _36_ (1891), 1-2; (1892), 3-5, 7, 10, 12, 20-4; (1893), 2, 4-5, 7, 10, 12, 20-2, 24 (Apr. 7-21, 1949)*

Nieves, R.

TUNG PROBLEMS IN OUR COUNTRY.
Argentina Dir. de Inform. Pub. Misc. _304_, 30 pp. (1948)*; Bibliog. of Agr. _13_, 75586 (1949).

Petiaev, S. I.

TUNG OIL FROM _ALEURITES_ _FORDII_ AND _A_. _CORDATA_.
Sovet. Subtropiki _1932_ (3), 27-39 (in Russian)*; Biol. Abstracts _10_, 2306, Abs. No. 21,928 (1936).

"Brief descriptions, geographical distribution, properties and use of the oil extracted from the species, their economic importance; their introduction in the USSR, and a brief progress report in connection with experimental cultivation of _A_. _cordata_ and _A_. _fordii_ in different parts of the Caucasus. The author recommends that experimental and industrial plantations be started in locations protected from the north and where the soil is not calcareous. Late plantings and the use of weak seed should be avoided. _A_. _fordii_ developed more rapidly than _A_. _cordata_; however the latter gave a better yield. In Chakva _A_. _cordata_ has become completely acclimatized and reproduces by self seeding. Oil extracted from _A_. _cordata_ in its technical qualities was almost as good as that from _A_. _fordii_ and in elasticity of the film was superior to it." From Biol. Abstracts.

Petiaev, S. I.

THE TUNG OIL TREE. THE LEADING "INDUSTRIAL" CULTURE IN THE USSR.
Sovet. Subtropiki _1934_ (1/2), 138-84 (in Russian with English summary)*; Biol. Abstracts _10_, 2306, Abs. No. 21,929 (1936).

"A review. The following topics are discussed: (1) properties of tung oil, (2) economic importance of the trees, (3) productive spp. of Aleurites, (4) climatic requirements of the trees, and (5) introduction of Aleurites into the USSR. Descriptions of *Aleurites fordii*, *A. cordata* and *A. montana* are given. Experimental plantings of these spp. in W. Transcaucasia gave satisfactory results." From Biol. Abstracts.

Pires, E. F.
THE CULTURE OF ALEURITES TREES.
Gazeta do Agricultor (Mozambique) 1(7), 151-2 (1949)*; Oléagineux 5, 275 (1950).

Botanical descriptions of *A. fordii* *A. montana* and *A. cordata*. Distribution of these species throughout the world. *A. montana* alone is cultivated in Mozambique. The conditions of sun and climate required by the different species are given as well as tables of rainfall for Mozambique.

Potter, G. F.
A SUMMARY OF THE TUNG INDUSTRY.
Tung World 2 (12), 17, 20-3, 27 (1948).

A letter written in response to a request for a statement on the tung industry in the southern United States.

Rousseau, A.
THE ALEURITES IN MADAGASCAR.
La Potasse No. 165, 87-9 (1949)*; Oléagineux 5, 76 (1950).

A discussion of methods of culture applied to a considerable acreage of *A. fordii* in the region of Lake Itasy in Madagascar. The author concludes that its culture shows promise of success.

Schlippe, P. de
THE *ALEURITES MONTANA* TREE, PRODUCER OF TUNG OIL.
Bull. agr. Congo Belge, Léopoldville Nos. 1-4, 85-95 (1944); Oleagineux 1, 48 (1946).

The introduction of tung into Belgian Congo dates from 1931. Good results have been received from its culture at Kurukwata and Costermansville. The introduction contains generalities regarding *A. fordii*, *A. montana* and *A. moluccana*. The discussion of economic factors covers uses of the oil, producing countries, yields, etc.

Schultz, E. E.
TRIALS WITH THE TUNG TREE (*A. FORDII*) AT THE TUCUMÁN AGRICULTURAL EXPERIMENT STATION.
Rev. ind. y agr. Tucumán 30, (7/9), 195-6 (1940)*; Biol. Abstracts 15, 1806, Abs. No. 19,619 (1941).

Aleurites fordii is satisfactory for growth in Tucumán, Argentina.

Schultz, E. E.
REPORT.
Rev. ind. y agr. Tucumán 36 (1/3), 28-57 (1946)*; Biol. Abstracts 21 972, Abs. No. 9994 (1947).

"Report of work done at the Agric. Expt. Station of the Province of Tucuman (Argentina). Reports of yields (1939-44) of vars. of lemons, mandarins and oranges. Report of work on control of

Piricularia on rice; possibilities of growing tung, *Aleurites fordii*, *A. molucanna*, or *A. montana*; and detailed report on the commercial handling of flax fiber in the Province." From Biol. Abstracts.

Shearon, Will H., Jr.
SURFACE COATINGS AND THE SOUTHWEST.
Chem. Eng. News 25, 3150-1 (1947); C. A. 42, 1065 (1948).
"Reasonable estimates indicate that paint production and demand have increased more sharply in the Southwest than in the rest of the U. S. since the war. Industrial demands are reaching a new peak, chiefly because of phenomenal plant expansion in the Gulf Coast area, coupled with the naturally rigorous exposure conditions in that region. The Southwest is generally dependent on other U.S. regions for pigments other than carbon black. The petrochem. industry is rapidly coming into position as an adequate source of supply for solvents, synthetic resin intermediates such as glycerol, and the resins themselves. Natural drying-oil prospects are good. Examples are tung culture in Louisiana, Texas flaxseed, and stillingia (Chinese tallow) tree cultivation on the Gulf Coast." From C.A.

Smith, W. M., Jr.
TUNG TREES IN THE U. S. PRODUCE TUNG OIL FOR FINISHING MATERIALS.
Ind. Finishing 18, (2) 42-3, 47-8, 52 (1941)*; C.A. 36, 1198 (1942).
"A review of the progress in growing tung trees in the U.S."
From C.A.

Swearingen, Lynn
THE AMERICAN TUNG INDUSTRY COMES OF AGE.
Paint Ind. Mag. 57, 300, 302, 304, 306 (1942)*; C. A. 36, 7332 (1942).
"Historical." From C. A.

Thomas, A. S.
II. TUNG OIL IN UGANDA.
E. African Agr. J. 2, 107 (1936).
Plantings in Uganda of *A. fordii*, *A. montana* and *A. triloba* have not shown satisfactory growth.

Traub, H. P.
TUNG OIL TREE IN TEXAS.
Cotton Seed Oil Mag. 56 (10), 16 (1928).
Research on the culture of the tung tree is under way by the Texas Agricultural Experiment Station Sub-Station No. 2 at Troup, Texas.

Webster, C. C.
NOTES ON THE CULTIVATION OF TUNG OIL TREES. II. TUNG CULTIVATION IN NYASALAND.
Nyasaland Tea Assoc. Quart. J. 5 (1), 5-11 (1940)*; Biol. Abstracts 15, 1806, Abs. No. 19,624 (1941).
"Tung tree acreage has increased from 51 acres in 1932 to 4356 acres in 1939." From Biol. Abstracts (abridged).
Aleurites montana is a more promising species for Nyasaland than is *A. fordii*.

Webster, C. C.
A NOTE ON THE YIELD OF TUNG TREES IN NYASALAND.
E. African Agr. J. *6*, 160-3 (1941)*; Biol. Abstracts *16*, 1888, Abs. No. 18,944 (1942).

"*A. montana* gives every sign of proving profitable while the appearance and the results obtained with *A. fordii* make it doubtful whether it will pay its way." From Biol. Abstracts (abridged).

Webster, C. C.
NYASALAND TUNG OIL.
Paint Manuf. *12*, 223,227 (1942)*; Brit. Chem. Abstracts *1943*, B, II, 321.

"The variety *Aleurites montana* grows better in Nyasaland than does *A. fordii*; a yield of oil estimated at 15 tons is expected from the current crop, and the annual yield is expected to increase rapidly. Data on samples from previous years show the oil to be of good quality for paint making." From Brit. Chem. Abstracts.

Webster, C. C.
THE CULTIVATION OF THE TUNG TREE IN NYASALAND
Empire J. Exptl. Agr. *14*, 18-24 (1946); Oleagineux *2*, 46 (1947); Soils and Fertilizers *9* (2), 149 (1946).

The introduction of *Aleurites fordii* and *A. montana*. Favorable predictions for the *A. montana*. Culture interposed with tobacco, with a corn-bean mixture or better with soybean. Favorable effect of farm manure and composts on the old trees and of N additions, but weak, on the young trees. Translated from Oleagineux.

Webster, C. C.
THE VIPYA TUNG DEVELOPMENT SCHEME. A PROGRESS REPORT.
Nyasaland Agr. Quart. J. *7*, 30-5 (1948)*; Hort. Abstracts *19* (1), 66, Abstract No. 562 (1949)*; Oleagineux *4* (10), 643 (1949).

"500 acres (200 ha) should be planted in the mountains of Vipya to serve for experimentation. If the results are good the plantations will expand rapidly according to a large scale plan. An account submitted reveals the preliminary work." Translated from Oleagineux.

Webster, C. C.
REPORT ON THE PRELIMINARY RECONNAISSANCE OF THE POSSIBILITY OF CULTIVATION OF TUNG OIL TREES IN THE EASTERN DISTRICTS OF SOUTHERN RHODESIA.
Rhodesia Agr. J. *45*, 319-29 (July/Aug., 1948)*.

Webster, C. C.
THE TUNG EXPERIMENTAL STATION.
Nyasaland Agr. Quart. J. *8*, 1-15 (Jan. 1949)*.

When, Wei-Yen
INVESTIGATION OF THE DRYING OF YOUNG WOODY PLANTS AS BASIS FOR THE REFORESTATION OF WASTE LAND IN CHINA.
Z. Weltforstwirtsch. *5* (10), 715-44 (1938)*; Biol. Abstracts *12*, 1273, Abs. No. 13,766 (1938).

"Seedlings of *Picea excelsa*, *Pinus silvestris*, *P. massoniana*, *Alnus incana*, and *Aleurites montana* were tested to ascertain the soil moisture point at which they would wilt and die, their ability to suck up water from the soil, the relation between withering and dying of the plants and the suction power of various kinds of soil, the possibility of increasing drought resistance by reducing the supply of water, and the relation of wilting to light. Soil moisture at the wilting point was 6-7 times greater with loam than with sand, and 4 times greater with humus than with loam. Seedlings utilized water better in full light than in the shade. Reduction of water supply resulted in a slight increase in drought resistance. In regions with low or irregular rainfall like China, sandy soil with low colloidal content is better for forest nurseries than humus soil. Shading of seedbeds tends to reduce drought resistance and should not be practiced unless watering is practicable. A. montana requires more soil moisture the 1st yr. than later. Regular waterings of plants after the 1st yr. decreases their drought resistance." From Biol. Abstracts.

Whitlow, S.
GROWING TUNG NUTS.
Farm & Ranch Rev. 68, 36-7 (Jan., 1949)*.

Wilson, E. H.
A NATURALIST IN WESTERN CHINA. 2 vols.
Methuen & Co., London, 1915 (?).
A description of the tung trees in China and of their culture by Chinese farmers.

Winfield, H. K.
FROM A FEW TUNG TREE NUTS GREW SOUTH'S NEWEST CROP.
South. Florist & Nurseryman 62 (19), 14-5, 56-60 (Aug. 5, 1949)*.

Wooley, Frank
TUNG (ALEURITES FORDII).
Rev. de Agr. (Piracicaba) 17, 435-7 (Dec., 1942)*; Bibliog. of Agr. 3, E, 78 (1943).

Wooster, Julia L.
TUNG GROWING IN LATIN AMERICA.
Agriculture in the Americas 3 (2), 29-33 (1943)*; Biol. Abstracts 17, 1552, Abs. No. 17,179 (1943).
"History and present extent of the industry with some of the problems. Bibliog." From Biol. Abstracts.

III. FRUIT

Bahrt, M., Jones, R., Angelo, E., Freeman, A. F., Pack, F. C., and McKinney, R. S.

THE EFFECTS OF ZINC AND OTHER TRACE ELEMENTS ON OIL CONTENT OF TUNG FRUITS.

Proc. 10th Ann. Convention Am. Tung Oil Assoc. and United Tung Growers' Assoc. 1944, 98-101; C. A. 39, 2611 (1945).

"Soil applications of 100 lb. per acre of $ZnSO_4$ in 2 tung orchards increased the oil content of tung fruit from approx. 19.5 to 20.5% even though there were no typical Zn-deficiency symptoms present. In 2 other orchards no significant increase in oil content was obtained with the $ZnSO_4$ treatment. Fruit from plots treated with salts of Ba, Co, Cu, Mg, B, V, and Mn at different locations showed no significant differences in oil content." From C. A.

Best, A. H., Peterson, A. H., and Sell, H. M.

DETERMINATION OF COPPER REDUCED BY SUGARS.

Ind. and Eng. Chem. Anal. Ed. 14, 145 (1942); C. A. 36, 1869 (1942).

"In detg. reducing sugars in the tung tree * * [one can use a] $Ce(SO_4)_2$ titration in the presence o-phenanthroleneferrous-complex indicator." From C. A. (abridged).

Carratalá, Rogelio E.

COLLECTIVE INTOXICATION BY THE FRUIT OF ALEURITES FORDII.

Dia. Med. 8, 443 (1936)*; Anales asoc. quím. argentina 26, 13B*; C. A. 32, 7134 (1938).

"The gastrointestinal and nervous manifestations were examd. in collective intoxication by ingestion of the fruit of Aleurites fordii. The liquid extd. by incision of the fruit exerts a local irritation on the skin. A substance like a toxalbumin, a natural albuminoid, contained therein, acts like strychnine on the organism. No alkaloids were found. A soln. of the substance, heated to 90° and injected into guinea pigs, gave no toxic effect." From C. A.

Close, J.

EXTRACTION OF ALEURITES OIL.

Courrier Agr. 14 (12), 2-3 (June 8, 1949)*

Francois, M. Th.

ANALYSIS OF TUNG (ALEURITES FORDII) SEEDS GROWN IN MOROCCO (1933 HARVEST).

Agron. colon. 25, 89-91 (1936)*; Chimie & industrie 38, 330*; C. A. 32, 372 (1938).

"Grind the kernels and ext. in a Soxhlet app. with redistd. low-boiling petr. ether; dry the soln. over anhyd. Na_2SO_4; distil off the solvent and remove the last traces by entrainment under reduced pressure with a current of CO_2. The yield of oil is very high, up to 34% on the whole seed; the oil content decreases with time of storage. The chem. characteristics of the oil met the U. S., British, Australian, and Chinese specifications; the d., however, is too high." From C. A.

Francois, M. T.

THE PROPERTIES OF THE OILS OF ALEURITES AND THEIR RELATIONS TO THE PREPARATION METHODS EMPLOYED.

Compt. rend. 206, 1321-3 (1938)*; C. A. 32, 6888 (1938).

"A comparison of the oils of A. *fordii* Hemsley (Tung) and A. *montana* Wilson (Abrasin) extd. by hydraulic pressure (1500 kg.) and by means of petroleum ether shows that all properties of the oils vary according to the extn. method. In oil extd. by pressure, which does not represent the total amount of lipides contained in the seed, the d., n, and refractive dispersion are higher and the length of their heating necessary for gelatination is shorter than in ether-extd. oil." From C.A.

Freeman, A. F. and McKinney, R. S.

TUNG-OIL EXTRACTION BY A SOLVENT PROCESS.

Proc. Am. Tung Oil Assoc. 1941, 38; Oil, Paint Drug Reptr. 140, (5) 5, 38, 45 (1941)*; C. A. 37, 6476 (1943).

"Com. tung oil is now produced entirely by pressing, but higher yields can be secured by solvent extn. Pilot-plant tests (Batch) indicated that oil yields were reduced by channeling when the ground kernel was extd. This could be remedied by using alternate layers of ground kernel and coarse gravel in the extractor, thus securing 98.3% oil removal. Similar efficiency of oil removal was secured with unground press cake, but ground press cake also gave trouble with channeling. The best solvents appeared to be a hexane fraction boiling from 63 to 70° and a petroleum fraction boiling from 54 to 71°. A heptane fraction was satisfactory but difficult to remove. Vacuum removal of solvent appeared to be satisfactory. The solid oil produced by this process can be permanently liquefied by heating at 250° for 30 min." From C. A.

Freeman, A. F.; Pack, F. C.; and McKinney, R. S.

MOISTURE DETERMINATIONS ON TUNG FRUIT AND ITS COMPONENTS FOR CONTROL PURPOSES.

Proc. Am. Tung Oil Assoc. 1942, 25-29*; Oil & Soap 20, 203-4 (1943); C. A. 39, 1551 (1945).

"By means of a special dryer in which the sample is dried for only 5-15 min. in a blast of hot air (at 260° F.), H_2O in tung, fruits, meal, kernels, seeds and hulls could be detd. sufficiently accurately for routine control purposes." From C. A.

Freeman, A. F.; Pack, F. C.; and McKinney, R. S.

SOLVENTS IN EXTRACTION OF TUNG OIL.

Ind. Eng. Chem. 35, 1156-9 (1943); Proc. Am. Tung Oil Assoc. 1943, 57-61; C. A. 37, 6913 (1943).

"Of 33 solvents tried, the following were satisfactory as to b.p. and properties of the extd. oil: hexane, petr. naphthas, cyclohexane, C_6H_6, n-heptane, methylcyclohexane, $CHCl_3$, isopropyl ether and $AcOC_2H_5$. Higher-b. naphthas, $C_6H_5CH_3$ and $C_6H_4(CH_3)_2$ might be used with better solvent-stripping facilities. Halogenated compds. might be used if decompn. of solvent and halogenation of drying oil can be prevented." From C. A.

Freeman, A. F.; Pack, F. C.; and McKinney, R. S.
EFFECT OF MOISTURE ON GRINDING OF TUNG KERNELS AND SOLVENT EXTRACTION OF MEAL.
Oil & Soap 21, 328-30 (1944); Proc. Am. Tung Oil Assoc. 1944, 43-52; C. A. 39, 432 (1945).

"Data are presented to show the effects of moisture on grinding of tung kernels and on solvent extn. of oil from meal. The data indicate that the efficiency of oil extn. can be increased by vacuum drying ground kernels before extn. The state of comminution obtainable on grinding the kernels is dependent on the moisture content; above 9% moisture the efficiency of grinding and extn. decreases progressively with increase of moisture content. The most efficient grinding is obtained with material of 6 to 9% moisture. In general progressively poorer grinding is obtained on tung kernels with moisture ranging downward from 6%. Six tables of results are given." From C. A.

Gardner, H. A.
CRUSHING EXPERIMENTS ON AMERICAN TUNG OIL SEED.
Paint Mfrs. Assoc. U. S., Circ. 205, 12-24 (June, 1924); C. A. 18, 2815 (1924).

"Tung nuts from Fla., Ala., and Cal. were crushed, and the oil was extd. in an Anderson expeller. When the nuts were dried in the sun or in a warm room, the resultant oil was very pale in color, of low acidity, and required only 5 to 6 min. in the Worstall heat test; but when the moisture in the hulls was allowed to remain before pressing, a darker oil of higher acidity, more nearly like the present com. oil from China, resulted. Cold expelling yielded only very slightly less oil than hot, and produced a better oil. Yields were approx. 28% oil, and 72% cake. Analyses of the latter showed N 3.47-3.21%, P_2O_5 0.78-1.19%, K_2O 0.85 to 1.14%, so that it has considerable fertilizer value. Analyses of oils and cakes are tabulated. A Fla. oil stored for 2 yrs. in a partially filled bottle showed an abnormally low I no. and high acid no. and d. Cal. nuts that had been stored for more than 2 yrs. prior to crushing produced a darker colored oil of somewhat abnormal constants compared to oil from Ala. and Fla. nuts. From C. A.

Gardner, H. A.
MACHINERY FOR HULLING AND CRUSHING TUNG SEED WITH NOTES ON CONSTANTS OF ABNORMAL OILS.
Paint Mfrs. Assoc. U. S., Circ. 255, 199-206 (1925); C. A. 20, 1330 (1926).

"Detailed analyses are tabulated of oils made by different methods of hot and cold pressing seeds imported from China, compared with commercial Chinese tung oil and Florida-grown tung oil." From C. A.

Gardner, H. A.
STANDARD CONTROL SAMPLES OF TUNG OIL WITH DATA ON RECENT CRUSHING EXPERIMENTS ON FLORIDA SEED.
Paint Mfrs. Assoc. U. S., Circ. 269, 8-12 (1926); C. A. 20, 2256 (1926).

"Notes on a shipment of pure tung oil, samples of which are available for control testing. American tung oil is extremely pale if pressed from the white seed that has been sepd. from the inner jacket of the hull. Data of crushing expts. on Florida tung nuts are given." From C. A.

Gardner, H. A.

MILL AND LABORATORY EXPERIMENTS ON TUNG OIL PRODUCTION FROM 1927 AMERICAN CROPS.

Am. Paint Varnish Mfrs. Assoc. Circ. No. 328, 318-44 (1928); C. A. 22,2670 (1928).

"Results are tabulated on lab. extns. made on 20 samples of tung-oil seed from trees treated with different types of fertilizer, or from trees which bear either single or cluster type fruit. Oil and moisture contents are given. Various plant size hulling and oil crushing tests on the 1927 tung oil fruit are described." From C. A.

Gilbert, S. G.; Loustalot, A. J.; and Potter, G. F.

STORING HULLED TUNG NUTS SAFELY.

Tung World 1, (10) 8-9, 17, 22 (1947); C. A. 41, 2914 (1947).

"Tung nuts sacked as they came from a portable huller stored satisfactorily for 9 months in a well-ventilated storage. At the end of the storage period the oil had an acid no. of 1.73, n_D^{25}1.5194, and was 67.7% of the kernel in comparison with an original acid no. of 0.04, n_D^{25}1.5174 and 70.0% oil in the kernel. Similar storage of nuts bin-dried immediately after hulling for 8 hrs. at 200° F. was almost as satisfactory. After storage satisfactory oil expression was obtained with the air-dried nuts in an Anderson lab. model expeller press. Nuts with broken shells (6-15% of total) high in moisture content (19-20%) deteriorated rapidly during shipment without ventilation, the acid no. of the oil increasing to 66.4, the n_D^{25} decreasing to 1.5130 and oil content of kernels decreasing to 60.9%. Mold growth on the surface of the exposed kernels appeared to be the main cause of deterioration. Nuts with unbroken shells under similar conditions did not deteriorate during shipment nor did bin-dried nuts with either intact or broken shells." From C. A.

Greenstreet, V. R.

COMMERCIAL PRODUCTION OF TUNG OIL IN NYASALAND. TECHNICAL ASPECTS.

Oil & Colour Trades J. 116 (2671), 1765-7 (1949)*; Oléagineux 5, 275 (1950).

Summary of results in a Nyasaland factory for the production of tung oil (*A. montana*). These concern (1) the optimum conditions for the extraction of the oil, (2) the establishment of an analytical method for the oil and (3) seeing if heating the oil to facilitate decantation from the sediment changes the constants of the oil. (translated from Oleagineux).

Greer, S. R.

TUNG OIL.

Soybean Digest 7 (1) 14-5 (1946); J. Am. Oil Chemists' Soc. 24, 63 (1947) (abstract).

"The article describes the production of tung fruits." From J. Am. Oil Chemists' Soc.

Gurney, E. H. and Patten, G. R.

TUNG OIL FRUIT (ALEURITES FORDII).

Queensland Agr. J. 40, 121-2 (1933); C. A. 27, 5778 (1933).

"Data are given on the compn. of the oil, meal, testa and husks of fruit grown from American and Australian seed on scrub land and from American seed on forest land (all in Queensland)." From C. A.

Hakubun, R.

CHEMICAL COMPOSITION OF THE FRUITS OF ALEURITES PRODUCED IN CHINA.

J. Agr. Chem. Soc. Japan 10, 25-30 (1934)*; C. A. 28, 3258 (1934).

Tung oil is prepd. from the fruits of Aleurites in China. Analysis of the fruits of Aleurites fordii gave: H_2O 3.742, ash 2.606, crude fat 61.500, crude protein 16.569, crude fiber 4.350 and sol. non-nitrogenous compds. 11.233% in air-dry matter. Most of the sugar consisted of nonreducing sugars; 6.68% of pentosans as present." From C. A.

Hamilton, J. and Gilbert, S. G.

RAPID METHOD FOR DETERMINING OIL CONTENT OF TUNG KERNELS.

Anal. Chem. 19, 453-6 (1947); C. A. 41, 6066-7 (1947).

"This method requires much less time and app. than the Goldfisch method. Disperse ground samples of tung kernels in com. hexane with a Waring Blendor for 5 min. Transfer the resulting dispersion to a 250-ml. calibrated volumetric flask and allow to settle. Pipet 50 ml. of supernatant liquid into a 250-ml. beaker; evap. the solvent on a steam bath or hot plate. Weigh the non-volatile oil and calc. the amount of oil in the total sample. The statistical method of reporting indicates good accuracy compared to the Goldfisch method." From C. A.

Ho, K.

PROPOSAL FOR A MODERN TUNG-OIL PLANT, SUBMITTED TO MINISTRY OF INDUSTRY, CHINA.

Industrial Center 3 (10), 309-12 (1934) (in Chinese).

Holmes, R. L., McKinney, R. S., and Minor, J. C.

THE EQUILIBRIUM MOISTURE CONTENT OF TUNG FRUIT AND ITS COMPONENTS AT DIFFERENT RELATIVE HUMIDITIES.

Proc. Am. Tung Oil Assoc. 1950, 24-36.

"The equilibrium moisture contents at 25° C. were determined for the whole tung fruit, the outer hull, the inner hull, shell, kernels, and seed of the fruit, and on the cake from continuous screw presses at 9 different humidities. The relative humidities were maintained by enclosing saturated solutions of different salts in dessicators in a room maintained at constant temperature." Summary by the authors.

Holmes, R. L. and Pack, F. C.
SAMPLING OF TUNG FRUIT AT THE MILL.
Proc. Am. Tung Oil Assoc. 1946, 40-6; C. A. 40, 6269 (1946).

"The purpose of this paper is to emphasize the importance of proper sampling and to indicate requirements of adequate sampling procedures for tung fruit. Data indicate that to obtain values within 0.5% of the true av. oil content of a lot, a 100-fruit sample would be necessary. For values within 0.25%, a 400-fruit sample would be required. In paying for tung fruit, rounding off to the nearest 0.5% for oil would appear as accurate as ordinary sampling would justify. Samples should represent all portions of a load. It seems desirable to take a larger sample and reduce this to the desired size by quartering." From C. A.

Holmes, R. L. and Pack, F. C.
THE APPLICATION OF CONTINUOUS SOLVENT EXTRACTION TO TUNG OIL.
U. S. Dept. Agr., Bur. Agr. Ind. Chem. AIC-116, 16 pp. (1946);
C. A. 41, 2588-9 (1947).

"The present status of solvent extn. and factors to be considered in adopting this method for tung oil production are presented. Certain problems are indicated that will require future study and solution before a complete solvent-extn. process for tung oil can be developed and recommended. The only solvents for tung oil about which enough is known to permit consideration for operation are the straight-chain-hydrocarbon fractions which boil at 140° to 248° F., and the chlorinated hydrocarbons, dichloro- and trichlorethylene." From C. A.

Holmes, R. L. and Pack, F. C.
EFFECT OF SHELL CONTENT AND STORAGE ON EXPELLING OF TUNG NUTS.
Oil & Soap 23, 314-16 (1946); C. A. 41, 299-300 (1947).

"Expeller tests were made on ground tung nuts contg. all of the shell (33%) at the time of hulling and after the nuts had been stored for 1 or 2 months. Comparative tests were also made on material contg. about 24% shell from regular mill operation. One test was made on hand-shelled kernels entirely free from shell. Meal contg. all of the shell not only processed satisfactorily, but the recovery of the oil from such material was somewhat higher than from material contg. about 2/3 of the shell. The amt. of oil expelled per hr. was about the same in both cases. The kernels completely cleaned of shell expelled very inefficiently. In general, with the particular type of expeller used, a considerable amt. of shell in the meal is essential for efficient expelling. Bags of nuts with hulls removed but with shells intact showed no deterioration after 2 months' storage." From C. A.

Holmes, R. L.; Pack, F. C.; and Gilbert, S. G.
EFFECT OF DRYING AND STORING TUNG SEEDS ON QUALITY OF THE OIL AND MILLING CHARACTERISTICS OF THE SEEDS.
J. Am. Oil Chemists' Soc. 24, 311-14 (1947); C. A. 41, 7135-6 (1947).

"Hulled tung seeds were dried at 2 temps. in Dec. and Jan. and put in storage in bags along with similar seeds not artificially dried. Bi-monthly tests were made on a com. screw press. The acid value of oil in the intact seeds put in storage at 10% H_2O in early Dec. and late Jan. had risen from 0.5 to 0.8-1.5 by the following Apr. Intact seeds dried to about 10% H_2O at 158° F. and about 172° F. processed in the screw press as well the following Apr. as they did when put in storage in early Dec., and there was no deterioration in the quality of the oil. Intact seeds which were dried from 26% H_2O to about 10% in late Jan. at 155-212° F. did not process efficiently after 2 months storage, nor did the material stored at the same time without artificial drying." From C. A.

Holmes, R. L. and Pack, F. C.

MOISTURE RELATIONSHIPS IN TUNG FRUIT AND SEEDS.

Proc. Am. Tung Oil Assoc. 1948, 57-65; C. A. 42, 6891 (1948).

"Equil. moisture contents of tung seeds and kernels were established when in contact with air of different relative himidities. As the relative humidity was increased from 45.2 to 100.0%, the moisture in the seeds increased from 7.92 to 11.16% and in the kernels from 4.80 to 11.53%. The effect of temp. on moisture content was slight for a given relative humidity. The acid value of the oil from the seeds and kernels remained low, 0.7 or less at all relative humidities even after 2 months storage at 71.6° F. with the exception of kernels stored at 100% relative humidity. The rate of absorption of moisture by whole tung fruit, seeds, and kernels was also detd. It was found that moisture penetrates to the kernel slowly. After soaking either whole fruit or seeds in water for 24 hrs. the moisture in the kernels increased only up to about 8% from an original 4%. Kernels soaked for 24 hrs. with the shells removed increased to over 33%." From C. A.

Hopper, T. H., et al.

REPORT OF THE SEED AND MEAL ANALYSIS COMMITTEE (1949).

J. Am. Oil Chemists' Soc. 27, 21-4 (1949); C. A. 44, 2262 (1950).

"The specifications of the methods for sampling tung fruit, for analysis of tung fruit, for the phys. analysis of the fruit for components, and for the analysis of tung kernels are described in detail. It is recommended that these methods be continued as tentative." From C. A.

Koo, E. C.

EXPRESSION OF VEGETABLE OILS. III. TUNG OIL.

J. Chem. Eng. (China) 5, 47-52 (1938)*; C. A. 34, 6837 (1940).

"The effect of pressure, temp. and time on the yield of tung oil is given by $W^2 = 0.164P\,3/\theta/-\sqrt[3]{(4/p)}$, where the units are as described formerly (C. A. 31, 4517^9). $d_4^{15.5}$, n25, the acid, sapon. and I values, together with the color compared with that of I soln. (g. of I/l, of KI soln.), are recorded for oil expressed at a series of temps. from 29° to 100°. The quality of oil expressed above 80° does not fulfil the requirements of the specifications." From C. A.

Koo, E. C.

EXPRESSION OF VEGETABLE OILS. VIII. GENERAL EQUATION ON OIL EXPRESSION.

J. Chem. Eng. (China) 8, 5-10 (1941)*; C. A. 36, 5039 (1941).

"Based upon the data on the expression of 7 vegetable oil seeds (i.e., soybean, cottonseed, tung nut, rapeseed, sesame seed, peanut and castor seed), the following general equation is applicable: $W(d.b.) = kW_0 \sqrt{P} \sqrt[6]{\theta} / \sqrt{(\mu/p)^z}$. In this equation, W(d.b.) = the oil yield in wt. % on dry basis, k = a const. for each kind of oil seed, W_0 = the oil content of the seed on dry basis, P = the pressure in lbs./sq. in., θ = the pressing time in hrs., μ/p = kinematic viscosity of the oil in stokes, and z = the exponent in viscosity factor which varies with different kinds of oils. The values of k and z for the various cases are:

Kind of seed expressed	k	z	Optimum % H_2O in meal
soybean	0.00450	1/2	...
cottonseed	0.00535	1/2	5-11
rapeseed	0.00583	1/3	7-11
peanut	0.00751	1/3	6-8.5
sesame	0.00835	1/6	5.7-8.2
tung nuts	0.00907	1/3	7-9
castor seed	0.00927	1/6	...

From C. A.

Koo, E. C.

EXPRESSION OF VEGETABLE OILS. A GENERAL EQUATION ON OIL EXPRESSION.

Ind. End. Chem. 34, 342-5 (1942); C. A. 36, 2172 (1942).

"Exptl. data on the expression of 7 kinds of oil seeds are in accord with the equation $W = CW_0 \sqrt{P} \sqrt[6]{\theta} / \sqrt{v^z}$, where W is the oil yield (% on the dry basis), C is the press const. for the particular kind of oil seed, W_0 is the oil content of the seed (dry basis), P is the pressure (lb. per sq. in.), θ is the pressing time (hrs.), v is the kinematic viscosity of the oil at press temp. (stokes) and z is an exponent dependent upon the type of oil. Values of $C \times 10^3$ and z are: soybean, 4.50, 0.5; cottonseed, 5.35, 0.5; rapeseed, 5.83, 1/3; peanut, 7.51, 1/3; sesame, 8.35, 1/6; tung, 9.07, 1/3; castor bean, 9.21, 1/6. The press efficiency can be calcd. from W/W_0. For each kind of oil seed there is an optimum range of moisture content for max. oil yield; this range varies from 5 to 13% for the oils studied." From C. A.

Lagasse, F. S., Sell, H. M.; Johnston, F. A., and Potter, G. F.

METHODS OF DETERMINING THE OIL CONTENT OF TUNG FRUITS AND FACTORS AFFECTING IT.

U. S. Dept. Agr. Circ. 806, 24 pp. (1949)

"Moisture content of tung fruits can be determined by drying whole fruits, but the most rapid and satisfactory method is to grind a 25-fruit sample, mix thoroughly, and determine moisture in duplicate 5-gm. portions at 100° C. and 4-mm. pressure over phosphorus pentoxide.

Moisture in tung kernels can be determined by grinding or flaking and drying them at 70° to 100° C. and 4-mm. pressure.

Oil in kernels can be determined readily by flaking the kernels to a thickness of about 50 μ with a mechanical flaker and extracting the oil in a Goldfisch unit. More than 99 percent of the total oil can be extracted in 12 hours without regrinding the residue. Tung kernels must be flaked longitudinally because the micropylar end contains less oil than the midsection.

The oil can be determined either by direct weighing after the solvent is driven off or by obtaining the difference in weight of the kernels before and after extraction. Rapid weighing of the residue is essential because of its hygroscopic properties. Determinations by loss in weight of residue are simpler and more expeditious and are adequate for most purposes.

When tung kernels have not more than 5 percent of moisture the oil whether extracted with acetone, ethyl ether, or petroleum ether is practically the same in amount and in quality.

The fruits of some seedling trees are more variable in oil content than those of others. In nearly all instances the degree of precision attained by using a 25-fruit sample is such as to permit distinguishing 2 samples differing in oil content of the whole fruit by not less than 2.00 percent." Excerpt from summary and conclusions of the circular.

Leggett, J. T. and Gilbert, S. G.

DEHYDRATION OF TUNG NUTS.

Florida Eng. Ind. Expt. Sta. Bull. No. 21, 35 pp. (July, 1948).

"It appears quite likely that drying at 150° F. to 175° F. will provide safe economical conditioning of the nuts for storage, both for whole nuts from the Reed huller and for partly shelled nuts from the Bauer huller. Studies on the expelling of nuts that were dried in a large laboratory dryer indicate that drying at temperatures ranging from 150° F. to 175° F. does not significantly decrease the percentage of oil expelled, after as much as three months' storage." From the circular.

Drying of whole tung nuts with infrared energy is not economically feasible. Channeling occurs when air is forced through beds of tung nuts more than 3-4 ft. in depth.

Liu, P. W.

CHEMICAL STUDY OF THE FRUIT OF ALEURITES FORDII.

J. Agr. Chem. Soc. Japan 10, 25-32 (1934) (in Japanese).

Liu, P. W.

CHEMICAL STUDIES ON TUNG-OIL SEEDS. II. PHYSICAL AND CHEMICAL PROPERTIES OF PROTEINS ISOLATED FROM THE SEEDS OF ALEURITES FORDII.

J. Agr. Chem. Soc. Japan 11, 781-8 (1935)*; C. A. 30, 2409 (1936).

"The seeds were extd. successively with H_2O, 10% NaCl and 0.2% NaOH. The water-sol. protein, aleurin, contains much org. P and Mg. Treatment with 0.2% HCl gave no phytin or purine base, but gave a pentose. Hence it may be a phosphoglucoprotein. The portion insol.

in 0.2%, HCl, aleurin, was purified by electrodialysis. It contains 2.73% of ash, which consists of large amts. of P, S and Fe, and a trace of Mg. It may be a phosphoprotein. Analysis gave total N 14.30, amide N 1.33, melanin N 0.73, arginine N 2.64, histidine N 0.85, cystine N 0.07, lysine N 0.41 and monoamino N 8.27%; $(a)^{20}_{D}$ -32.92° (0.1 g. in 10 cc. of 0.2% NaOH); isoelec. point pH 4.24. Aleuritulin, sol. in 10% NaCl soln., was isolated. Analysis gave total N 18.01, amide N 1.85, melanin N 0.19, arganine N 4.09, histidine N 0.37, cystine N 0.116, lysine N 0.95 and monoamino N 10.43% $(a)^{20}_{D}$ - 41.58° (0.1 g. in 10 cc. of 0.2% NaOH); isoelec. point pH 5.47. Aleuritenin, sol. in 0.2% NaOH, contained total N 17.28, amide N 1.66, melanin N 0.16, arginine N 3.71, histidine N 2.17, cystine N 0.10, lysine N 0.10 and monoamino N 9.19%; $(a)^{20}_{D}$ - 39.85° (0.1 g. in 10 cc. of 0.2° NaOH); isoelec, point pH 5.75." From C. A.

McKinney, R. S.
PROBLEMS IN THE FIELD OF TUNG-OIL EXTRACTION.
Oil, Paint Drug Reptr. 140 (4) 5, 33-4 (1941)*; C. A. 37, 6475-6 (1943).

"In the past it has been the practice to allow the tung fruit to dry under the trees before shipping to the mill for dehulling, but widely varying moisture contents result. Various types of dehulling devices for use on the farms have been tested, the best probably being that used in the mills. Drying is a difficult problem, as the method must be cheap and the moisture content must be controlled to give maximum oil yield. Drying in ventilated barns is being tested. Brief reference is made to possibility of solvent extn. of the ground nuts. Many problems remain to be solved." From C. A.

McKinney, R. S.
MOISTURE CONTENT OF TUNG FRUIT FROM ITS ELECTRICAL RESISTANCE.
Oil & Soap 18, 188-9 (1941); C. A. 35, 7735 (1941).

"Two parallel holes are bored in a tung fruit longitudinally 1 in. apart and 1/2 in. deep. The two terminals from the ohmmeter are inserted and, by use of the max. amt. of internal resistance in the ohmmeter, the resistance of the fruit to the passage of the small d.c. is read. The moisture content of the tung fruit is est. from either a table or a curve. A moisture content of 37.2% shows a resistance in ohms of 16,000 while 6.3% moisture gave a reading of infinity in ohms. 21 references." From C. A.

McKinney, R. S.
RELATION BETWEEN OIL CONTENT AND KERNEL CONTENT AND KERNEL CONTENT OF TUNG FRUIT. HULLING TUNG FRUIT ON THE FARM.
Oil, Paint Drug Reptr. 144 (3), 3, 69-70 (1943)*; C. A. 37, 5265 (1943).

"A graph, derived from actual detns., for the % oil content of tung fruit vs. % kernel content of tung fruit, is presented as a means for the rapid detn. of the value of a given lot. A study of sampling directions for peanuts suggested that tung fruit be drawn from 25 bags of a load of fruit or at 25 intervals during the unloading operations. A modified English walnut huller was used for removing hulls. Studies of the rate of drying of the seed indicated that elevated temps. greatly increased the rate." From C. A.

McKinney, R. S.
COLLABORATIVE ANALYSIS OF TUNG FRUIT BY THE WHOLE FRUIT AND COMPONENT PROCEDURES.
Proc. Am. Tung Oil Assoc. 1949 (2), 25-30.

"Collaborative studies on six lots of tung fruit varying widely in content of moisture, hull, and oil have shown good agreement for the oil content when analyzed by either the whole fruit procedure or by the component procedure adopted as a tentative method for the analysis of tung fruit by the American Oil Chemists' Society. Those collaborative analyses have shown that it is unnecessary to make any correction in the oil content of tung fruit analyzed by the whole fruit procedure as no significant difference has been found between the results obtained by this procedure and those obtained by the component procedure. The highly significant differences observed in the results reported for the moisture content have indicated that serious errors may be encountered by calculating the oil content of tung fruit to a moisture-free basis." From the author's summary.

McKinney, R. S. and Freeman, A. F.
ANALYSIS OF TUNG FRUIT.
Oil & Soap 16, 151-2 (1939); C. A. 33, 8046 (1939).

"In tung fruits in a closed container the moisture distributes itself evenly between individual fruits. The oil can be extd. completely from tung kernels if they are reground with sand. The moisture can be removed from ground tung kernels and also the solvent from the extd. tung oil by heating to 100° in a vacuum oven with 28-29 in. of vacuum." From C. A.

McKinney, R. S. and Freeman, A. F.
THE DEHYDRATION OF TUNG FRUIT.
Proc. Am. Tung Oil Assoc. 1941, 13; C. A. 37, 6476; Oil, Paint Drug Reptr. 140 (6), 5, 36 (1941).

"A variety of drying methods were tried on tung fruit. Solar driers were too slow to be practicable, but at higher temps. moisture is removed more rapidly. A flash drier was considered unsuitable owing to the necessity of passing fruit through the drier twice, with resulting injury. Under favorable conditions the fruit can be dried to 30% in the field, and this drying can be completed in ventilated barns. The use of heated air to speed up drying in the barns was tried. Rough moisture content tests could be made on the kernels by an elec. cond. method and on the meal by drawing air at 130° through the meal for 10 min. and noting loss in weight." From C. A.

McKinney, R. S. and Halbrook, N. J.
THE PROCESSING OF TUNG FRUIT FOR OIL.
Oil & Soap 19, 182-5 (1942); C. A. 37, 271 (1943).

"The processing of tung fruit is discussed. Studies made indicate that the loss of oil in processing the fruit can be prevented while the kernels are moist and pliable; but the dehulled tung fruits are then too high in moisture for efficient expression of the oil. Adequate drying equipment for tung meal is the solution. High temps. should be avoided, 205° F. being the max., as beyond this the character of the meal is unfavorable to good oil expression." From C. A.

McKinney, R. S., Halbrook, N. J., and Agee, G. W.
A PROGRESS REPORT ON THE SAMPLING AND ANALYSIS OF TUNG FRUIT.
Proc. Am. Tung Oil Assoc. 1948, 66-71; C. A. 42, 7065 (1948).

"Estn. of oil content of tung fruit by the whole-fruit procedure was not found to be adversely influenced by the use of the forced-draft oven method instead of the Bidwell-Sterling method for detg. the moisture content. Collaborative analyses showed that a correction of 0.30% must be subtracted from the oil content obtained with the Wiley-Bauer ground fruit to agree with analyses by the component procedure. Tests on moist tung fruit and its components indicate that there is no appreciable increase in the amount of extractive material obtained from the hulls and shells of moist fruit in comparison with that obtained from the hulls and shells of air-dry fruit." From C. A.

McKinney, R. S., Halbrook, N. J., and Oglesbee, R. E.
STUDIES IN THE EXPRESSION OF OIL FROM TUNG FRUIT.
Oil & Soap 21, 353-7 (1944); C. A. 39, 822-3 (1945).

"Tests indicate that best results in yield of crude and filtered oil by an expression procedure are obtained with a tung meal contg. 4.2% H_2O and 20% shell. The drying of tung meal with an initial air temp. of 320° F. appears to affect adversely the yield of filtered oil from the expeller process. It was found difficult to obtain efficient oil expression from tung meals cong. filter cake. In one test with this material the resulting press cake was high in oil content, while in another test the crude tung oil contained about twide as much foots as was present in crude tung oil from tung meal contg. no filter cake. The expression of tung oil from a tung meal consisting of ground old tung kernels and tung shell was found difficult. This difficulty appeared to be due partly to the fact that the meal from old kernels will not plasticize under heat and pressure. When these kernels were mixed with new ones no difficulty was experienced. Hulling the moist tung fruit in the grove does not interfere with the expression of the oil if the moist dehulled tung fruits are properly dried before pressing. A process was developed for producing a clear tung oil by treatment of the crude oil with a chem. agent to ppt. certain non-oil constituents in the crude tung oil followed by either pressure filtration or centrifugation. When tung oil filter cake was mixed with an equal amt. of tung press cake, over 98% of the oil could be extd. by petroleum solvents. The amt. of foots in crude tung oil can be detd. by filtering 100 g. of the oil at 80° after stirring for 10 min. at this temp. with 1 g. of diatomaceous filter aid through a steam-jacketed Buchner funnel, taking as the end point the time when the last of the oil is absorbed by the filter paper. The filter cake is weighed and analyzed for oil and moisture. Two tables of results are given." From C. A.

McKinney, R. S., Holmes, R. L., and Minor, J. C.
AN ANALYSIS OF TUNG HULLS AND HULLING.
Proc. Am. Tung Oil Assoc. 1950, 23 (abstract).

"Methods for analyzing commercial tung hulls for oil content have been developed. Samples of tung hulls from mill and grove hulling operations have been collected and analyzed. The recovery of oil in hulling was found to vary from 93% to 98% with an average recovery of

97.5%. With an oil recovery of 97.5% in the hulling operation, an oil recovery of the hulled nuts of 87.7% is required to equal an oil recovery of 85.5% on the whole tung fruit." Abstract by the authors.

McKinney, R. S. and Jamieson, G. S.
A NOTE ON THE ANALYSIS OF TUNG FRUITS.
Oil & Soap 13, 71 (1936); C. A. 30, 3259 (1936).

"The fruits were grown under different conditions in Mississippi. Six samples gave the following av. analysis: wt. of fruit 24.8 g., nuts in fruits 55.8, kernels in nuts 60.7, kernels in fruits 33.9, H_2O in kernels 2.3, oil in kernels 62.7% and I. no. of oil (Wijs) 164.5." From C. A.

McKinney, R. S. and Oglesbee, R. E.
PRELIMINARY STUDIES ON THE STORAGE OF TUNG FRUIT AND SEED.
Proc. Am. Tung Oil Assoc. 1945, 48-51.

"Notable changes have been found to occur in the oil and protein contents of fruit held under common storage during the summer and fall months. Studies on tung fruit have indicated that it may be possible to hold the fruit in cold storage until fall, without appreciable changes in these constituents. These results have indicated that it may be possible to express the oil from tung fruits kept in cold storage at about 42° F. during the summer months; whereas, it has been found difficult, if not impossible to do so with tung fruit kept in normal storage into summer months." From the summary of the paper.

McKinney, R. S. and Oglesbee, R. E.
SOME VARIATIONS IN SOLVENT-EXTRACTED TUNG OILS RESULTING FROM THE SOLVENTS EMPLOYED.
Proc. Am. Tung Oil Assoc. 1945, 43-7; C. A. 39, 4498 (1945).

"Extn. of tung oil with petroleum naphthas on lab. and continuous pilot-plant scales indicates that the source and type of naphtha fraction used may affect the quality of oil recovered. One heptane fraction yielded oil which was solid at room temp., while heptane from another source yielded oil that was almost entirely liquid at ice-box temp. Hexane fractions yield oils liquid at room temp. and solid in the cold. Petroleum-naphtha-extd. tung oils make spar varnishes only slightly inferior to those prepd. from expressed American tung oil. Trichloroethylene as an extractant yields oil of excellent quality." From C. A.

McKinney, R. S. and Oglesbee, R. E.
EVALUATION OF TUNG FRUIT.
Tung World, 1, 14-15 (July, 1946); C. A. 40, 5577 (1946).

"The amt. of foreign matter present, % moisture, and % oil are the 3 main factors in evaluating tung fruit arriving at the mill. Satisfactory methods of detg. the moisture content of tung fruit are given. Results are given of analyses for moisture and oil of 2 uniform samples of tung fruit by 7 collaborators. For sample 1 the standard deviation of the individual analyses was 0.67 for moisture and 0.63%

for oil; for sample 2 the standard deviation was 0.41 for moisture and 0.57% for oil. Also in Proc. Am. Tung Oil Assoc., 1946, Part 1, 1-6". From C. A.

McKinney, R. S., Pack, F. C., and Oglesbee, R. E.
DRYING OF HULLED TUNG NUTS.
Proc. Am. Tung Oil Assoc. 1945, 52-4.

"--certain generalizations can be made concerning the drying of hulled tung nuts for expeller operation:

1. Drying carried out at a temperature in excess of about 210° F. is very questionable. While it is true oil quality is not seriously impaired by temperatures as high as 285° F. and the yield by solvent extraction is not greatly decreased by drying temperatures as high as 230° F., there is evidence that hulled tung nuts heated much above 210° F. will not form a cake in the expeller.

2. The passage of the hulled material through the drier should be at a constant rate so that the discharged product will be uniform with respect to moisture and the drying time can be controlled.

3. Direct contact between the material being dried and the heating elements of the drier should be avoided, as after such contact at high temperatures the dried material had a glazed transparent appearance and a strong cooked odor, indicating that the material had been over-heated. This is of particular importance where a drying oil such as tung is involved." From the summary of the article.

McKinney, R. S. and Rose, W. G.
RAPID METHOD FOR THE DETERMINATION OF OIL IN TUNG FRUIT.
Oil & Soap 18, 25-7 (1941); C. A. 35, 2736 (1941).

"The undried tung kernels are ground twice in a "Russian" food grinder No. 1 (the 16-tooth cutter is used); and 5 g. is then ground in a mortar with 2 g. of fine sea sand. With an accurate pipet 5 ml. of acetylene tetrabromide is added and the mass triturated for 5 min. and then allowed to stand for 10 min. and the trituration repeated. A 65-mm. 60°-angle funnel is fitted by a cork into a 1-in. Pyrex test tube having a side arm for suction. A 25-mm. perforated porcelain filtering disk is placed in the funnel and a 27-mm. filter paper is cut and put on the disk. Suction is applied at the side-arm tube. The tung-kernel solvent mixt. is poured on the filter paper and the soln. filtered, and its d. detd. at room temp. in a 2-ml. Gay-Lussac sp. gr. bottle. The percentage of tung oil in the soln. is obtained from a reference curve at a particular temp. and from this is obtained the percentage in the kernels." From C. A.

McKinney, R. S., Rose, W. G., and Kennedy, A. B.
CONTINUOUS PROCESS FOR SOLVENT EXTRACTION OF TUNG OIL.
Ind. Eng. Chem. 36, 138-44 (1944); C. A. 38, 1652 (1944).

"The Kennedy continuous extractor employed consists of a series of semi-circular sections fitted with perforated paddles to transfer the tung meal being extd. from one section to the next in a direction opposite to the gravity flow of the "miscella." Small pilot plant studies gave extn. efficiencies of 99% or better from tung press cake or from tung kernels or seeds prepd. for extn. by attrition grinding, or preferably by the formation of minute flakes in a roller mill. If proper precautions were taken to prevent free fat acid formation, the oil extd. from tung seeds or kernels was of high quality, judged by its characteristics and by exposure tests made on varnishes prepd. from it with phenolic resins. Oil extd. from tung press cake is of poorer quality but is regarded as acceptable to the paint and varnish industry." From C. A.

Markley, K. S.

INFORMAL REMARKS AT AMERICAN TUNG OIL ASSOCIATION MEETING, OCT.11, 1950, BILOXI, MISS.

Proc. Am. Tung Oil Assoc. 1950, 20-2.

Research on tung fruit and tung oil is being conducted by the Bureau of Agricultural and Industrial Chemistry of the U. S. Department of Agriculture at the U. S. Tung Oil Laboratory at Bogalusa, La., and at the Southern Regional Research Laboratory at New Orleans, La.

Morel, Th.

PRESSING OF ALEURITES MONTANA SEED WITH THE HELP OF A KRUPP EXPELLER.

Verfkroniek 22, 50-1 (1949)*; C. A. 43, 4871 (1949).

"The working method and results of the pressing of these seeds with a Krupp expeller are compared with those with an Anderson expeller. Agreeing results were obtained in the pressing of the unheated material with about 33% shell. At lower shell % the pressing was poor in comparison with the Anderson expeller. At high shell % the machine ran fast. A mixt. of 50 parts shell on 100 core gives 87% pure oil; 11.2% remains in the expressed cake and 1.7% is lost. The difference in the wt. between the material used and the oil and expressed cake obtained is due chiefly to a loss by evapn. of moisture during the pressing caused by the development of friction heat in the expeller. The quality of the oil was good. The av. n_D^{25} (according to Leithe, modified by Frahm and Koolhaas for tung oil, C. A. 32, 5240^3) is 1.5141 and eleostearin 73.6%." From C. A.

Mowry, Harold.

VARIETIES AND PRACTICES IN THE TUNG-OIL GROVE.

Proc. Fla. State Hort. Soc. 1932, 52-5; C. A. 28, 4921 (1934).

"The oil contents of the seed kernels, air-dried seeds and dried whole fruits from trees grown at the Fla. Agr. Expt. Sta. were 53.97-66.31, 28.07-37.31 and 17.63-24.53%, resp." From C. A.

Pack, F. C., Holmes, R. L., and McKinney, R. S.

COMPARISON OF THE WHOLE FRUIT AND COMPONENT METHODS OF ANALYSIS OF TUNG FRUIT.

Proc. Am. Tung Oil Assoc. 15 (2), 31-9 (1949); J. Am. Oil Chemists' Soc. 27, 164-6 (1950); C. A. 44, 6170 (1950).

"The effect of H_2O content and fineness of grinding on the percentages of oil extd. by the whole fruit method were investigated and the results compared with those by the component method. No differences were found in the oil content when samples of fruit were ground with plate spacings from 0.004 to 0.012 in. but the results were lower with plate spacings of 0.020 in.. No difference was found in the percentages of oil by the component and whole fruit methods when the results were calcd. on the basis of the original sample. The av. percentage of H_2O obtained by the 2 methods differ. Analyses of tung fruit by either method give reliable results over a wide range of H_2O content." From C. A.

Pickett, T. A. and Brown, W. L.
OIL VARIATIONS OF TUNG TREES.
Georgia Agr. Expt. Sta., Circ. 115, 1-8 (1938); C. A. 32, 7295 (1938).

"On an air-dry basis the percentage of oil in the fruits over a 4-year study varied from 17.4 to 26.0; and in the oven-dry kernels the variation was 59.0-68.9%. Of the samples of oil taken from 40 trees on which I nos. were run, 31 passed the A.S.T.M. specification, i.e., Wijs 163.0, 3 were marginal, and 6 were below. Fourteen samples taken from tung trees grown at higher altitudes gave oil conforming to the specification in 13 cases. Yearly variations in percentage of oil in the kernels and in the I no. of the oil were small." From C. A.

Potter, G. F.; Angelo, E.; Painter, J. H.; and Brown, R. T.
A STATISTICAL STUDY OF VARIATION IN TUNG FRUITS.
Proc. Am. Soc. Hort. Sci. 37, 515-7 (1939)

The variation in tung fruits was such that a 25-fruit sample would give sufficiently accurate results for most experimental work.

Reed, I. F. and Jezek, R. E.
A PORTABLE TUNG NUT DECORTICATOR.
Agr. Eng. 26 (10), 413-4, 420 (Oct., 1945); Proc. Am. Tung Oil Assoc. 1945, 69-72.

A portable decorticator (huller) has been developed and evaluated. It consists of the following parts: (1) a hopper into which fruit are poured, (2) a cylinder unit (for breaking the fruit) composed of a canvass-covered cylinder 11-1/4 in. in diameter by 14 inches in length rotating in a concave chamber formed of a screen perforated with 7/8 in. square holes, (3) a vibrating screen (for separating fines), (4) an aspirator (for removing hull fragments) and (5) a bagger for the hulled nuts. It operates most satisfactorily on fruit containing 25-35% moisture and will handle 1500-2000 lbs. of whole tung fruit per hr. The hulled material was found to contn. the following pctgs: whole nuts 92.25; cracked nuts 4.83; nuts with inner hull attached 0.65; whole kernels 1.46; cracked kernels 0.12; outer hulls 0.41; inner hulls 0.04; shells 0.08; debris 1.11.

Rose, W.G.; Freeman, A. F.; and McKinney, R. S.
SOLVENT EXTRACTION OF TUNG OIL.
Ind. Eng. Chem. 34, 612-14 (1942); C. A. 36, 3688 (1942).

"Ground tung kernels or tung press cake was extd. in a large lab. extractor (35 lb. capacity). All of the oil (5.36% was extd. from the expeller press cake, but it was necessary to free the marc of solvent, regrind and then re-ext. it to obtain all the oil from the ground tung kernels. The extd. oil isomerized to solid β-eleostearin, but can be rendered permanently liquid by heating at 200° for 30 min.

Heat-treated oil extd. from tung press cake had a viscosity of 6.5 poises, iodine value (Wijs) 145.7, Browne heat test 13 min. and n_D^{25} 1.5097." From C. A.

Sell, H. M. and Best, A. H.
ISOLATION OF SUCROSE FROM TUNG KERNELS.
Oil & Soap 18, 146, (1941); Brit. Chem. Abstracts 1941, B, III, 327.
"A non-reducing disaccharide extracted from the kernels of Aleurites fordii, Hensley (by extraction with EtOH), has been identified as sucrose." From C. A.

Sell, H. M. and Best, A. H.
PHYTOSTEROL FROM BUDS AND FRUIT OF TUNG TREE.
J. Am. Pharm. Assoc. 30, 170-171 (1941); Brit. Chem. Abstracts 1941, A, III, 715.
"A sterol, m.p. 136.7-137.7° $[\alpha]_D^{25}$ in $CHCl_3$ was isolated and identified as physterol by the acetate and benzoate." From C. A.

Sell, H. M.; Johnston, F. A., Jr.; and Lagasse, F. S.
CHANGES IN CHEMICAL COMPOSITION OF TUNG FRUIT AND ITS COMPONENT PARTS.
J. Agr. Res. 73, 319-334 (1946); Brit. Chem. Abstracts 1947, A, III, 283.
"Protein-N is formed gradually in the kernel during the period of oil synthesis; this is probably due to hydrolysis of proteins in hull and shell followed by translocation of the products of the kernel. N, reducing sugars, and starch accumulated in the kernel during late June and early July, indicating that these materials are required for synthesis. Sugars are probably translocated from hull and shell to the kernel and used for production of oil, polysaccharides, proteins, and sucrose in the kernel. The oil content of immature fruits did not increase significantly during storage, nor was the content increased by delaying abscission of the fruits after they had reached maturity." From Brit. Chem. Abstracts.

Stiepel, C.
VEGETABLE OILS.
Farben-Ztg. 18, 2001-3 (1913).
Wood oil is obtained from the seeds of Aleurites cordata which contain up to 55% of a fast-drying yellow oil of disagreeable taste and odor.

Taran, E. N.
OIL FORMATION IN THE LATER STAGES OF RIPENING OF SEEDS OF OLEAGINOUS PLANTS.
Biokhimiya 2, 741-4 (1937)*; C. A. 32, 2171 (1938).
"According to the hypothesis of S. L. Ivanov (1912), satd. acids are transformed into unsatd. ones during the ripening of the seeds. Expts. on the seeds of tung wood (Aleurites fordii Hensl.) show that the degree of unsatn. of the oil at first increases, reaching a max. a month before full ripening, and then decreases, attaining a min.

at the period of complete ripeness." From C. A.

Taran, E. N.
THE CONSTANCY OF CHEMICAL PROPERTIES OF THE TUNG TREE.
Sovet. Subtropiki 1938 (3) , 61-3*; Khim. Referat. Zhur. 2 No. 3, 60 (1939)*; C. A. 34, 1051 (1940).

"Seeds of a tung tree contained oil 63.20, ash 2.57 and crude protein 17.87%. Seeds of a graft of this tree contained, resp., 64.07, 2.73, and 16.46%. The physicochem. consts. of oils obtained from the original trees and from the grafts varied only in limits of exptl. errors. The activities of the catalases of the original tree and of the graft were practically the same." From C. A.

Wessel, C. J.
A STUDY OF THE ESTERASE ACTIVITY OF *ALEURITES FORDII*.
Contr. Biol. Lab. Catholic Univ. Am. 38, 1-72 (1941); Biol. Abstracts 17, 1085, Abs. No. 12,256 (1943).

The esterase activity of defatted tung nuts was investigated using a continuous titration method (glass electrode).

IV. OIL

(a). Analysis and Specifications

Anonymous

CHINA WOOD OIL COMPLICATION.
Oil, Paint Drug Reptr. 81 (12), 35 (1912); C. A. 6, 2330 (1912).

A discussion of the variability of the properties of wood oil and the validity of tests used to detect adulteration. No conclusions. Further information regarding case in 81 (2), 32.

Anonymous

CHINA WOOD OIL QUALITY RULES.
Oil, Paint Drug Rept. 82, 25 (Sept. 23, 1912); C. A. 7, 269 (1913).

"According to the N. Y. Produce Exchange China wood oil must comply with following tests: Worstall's test: 100 g. oil is heated rapidly in open metal pan, 6-inch diam. to 540°F. and kept at that temp. while stirring until solidification begins. The time required after the oil has reached 540°, until it begins to solidify, should not exceed 7-1/2 min. in pure oils. The solid product should be pale and firm; dark, sticky "gels" are to be rejected. Bacon's test: 10 cc. of the unknown oil transferred to test tube, 4 inches X 3/4 inch, submerged into an oil bath which has been previously raised to 288°. The temp. after immersion of tube should be 280-285°. Tube is kept in bath exactly 9 min. withdrawn and stabbed from top to bottom with a bright spatula. Pure oils give a hard, clean cut, and incision resembles straight line. Oils with 5% adulteration give soft "gels" and a "feathery" effect on cutting; 10% adulteration will be soft; 12% adulteration frequently leaves oil liquid. Comparisons should always be made with a sample of high purity, and with sample mixed with 5% and 10% foreign drying oils." From C. A.

Anonymous

CHINA WOOD OIL TESTS.
Oil, Paint Drug Reptr. 83 (1), 18 (Jan. 6, 1913).

Mr. Reihl has proposed for testing the purity of tung oil the following 2 tests: (1) a qualitative test based on the fact that a dried film of pure tung oil is water-resistant and (2) a quantitative test in which the oil is gelled by heating until solid at 280° and extracted with benzine to remove any adulterant.

Anonymous

AUSTRALIAN STANDARD SPECIFICATION FOR CHINA WOOD OIL.
Australian Commonwealth Eng. Standards Assoc. (Sydney) No. K-11, 18 pp. (1929); C.A. 23, 3358 (1929).

"Specifications cover color, sp. gr., n, I value, sapon. value, acid value and standard methods of sampling and testing." From C.A.

American Society for Testing Materials.

REPORT OF COMMITTEE D-1 ON PRESERVATIVE COATINGS FOR STRUCTURAL MATERIALS. REPORT OF SUBCOMMITTEE III ON TESTING OF PAINT VEHICLES.
Proc. Am. Soc. for Testing Materials, Pt. 1, 204-13 (1915); C. A. 10, 974 (1916).

A report of cooperative work on Chinese wood oil is given, showing results obtained by the heating test and the iodine jelly test on pure and adulterated samples. The results obtained by the committee using the "light break" method of Ware and Schumenn were not satisfactory. Oils from American grown nuts were very similar to the pure oil from Chinese nuts. The iodine jelly test is described in detail as well as a study of the effect of the variation of different factors on it. It was found essential that the concentration of iodine solution be exactly correct. With either the iodine jelly test or the Browne heat test 5% of adulterant (soya or linseed oil) was indicated and 10% was positively revealed. The Committee recommended the adoption of the Standard Specifications for the Purity of Chinese Wood Oil printed in the 1915 Yearbook.

American Society for Testing Materials
STANDARD SPECIFICATIONS FOR THE PURITY OF RAW CHINESE WOOD OIL.
Am. Soc. Testing Materials Year Book, 1915, 423-27.

$D^{15.5}_{15.5}$, 0.939-0.943; acid no. (max.), 6.0; sapon. no. 190-195; unsapon. matter (max.), 0.75%; n_{25}, 1.515-1.520; I no. (Hübl, 18 hrs.) (minimum), 165; heating test, Browne's method (cf. C.A. 7, 2315) (max.), 12 min; I jelly test (max.), 4 min. Methods of testing are given. An immersed stem thermometer is recommended for the heating test, and if a long stem thermometer is used the reading must be corrected for emergent stem. The I jelly test is made as follows: In a wide-necked 200-cc. Erlenmeyer flask, place 2.5 g. (wt. correct to 1 mg.) of the oil. Add 10 cc. of $CHCl_3$ from a pipet and stopper the flask immediately. Carefully insert a small glass vial into the flask so that the vial stands upright. Into the vial from a pipet run 10 cc. of a soln. of I in $CHCl_3$, containing 0.035 to 0.036 g. of I per cc. Place the flask in a bath containing water at 25 to 26° and allow it to stand there for a few min. Keep the flask stoppered, except when it is necessary to remove it to insert the vial and to add the I soln. Tilt and rotate the flask so that the vial is upset and the contents of the flask are thoroughly mixed, at the same time starting a stop watch. Keep the flask in the bath at 25 to 26° and at the end of every quarter min. tilt the flask towards a horizontal position. Note the time required for the formation of a jelly that does not flow, but sticks to the bottom of the flask or slides as a mass. Record time in minutes and quarters thereof. Pure Chinese wood oil should require 2-3/4 to 3-1/4 min. for the formation of the jelly. If the temp. of the laboratory is more than 2° or 3° above or below 25°, place the flask containing the I soln. in the bath and allow it to remain there for several minutes before pipetting out the 10 cc. for the test.

American Society for Testing Materials
REVISION OF STANDARD SPECIFICATIONS FOR PURITY OF RAW TUNG OIL (D-12-16)
Am. Soc. Testing Materials Proc. 20, Pt. 1, 819-22 (1920).

Several changes are made including changes in the Heating Test and omission of the Iodine Jelly Test.

American Society for Testing Materials

STANDARD SPECIFICATIONS FOR PURITY OF RAW TUNG OIL.

Am. Soc. Testing Materials Yearbook 1921, 659-62.

Specifications (D-12-16). "Raw tung oil shall conform to the following requirements: Properties

	Maximum	Minimum
Specific gravity	0.943	0.939
Acid number	6	---
Saponification number	195	190
Unsaponifiable Matter, percent	0.75	---
Refractive Index at 25°C.	1.520	1.515
Iodine number (Hübl, 18 hrs.)	---	165
Heating test (Browne's method, min.)	12	---
Iodine jelly test, minutes	4	--- "

Methods of testing are also given.

American Society for Testing Materials

STANDARD SPECIFICATIONS FOR RAW TUNG OIL (D-12-48)

1948 Supplement to Book of A.S.T.M. Standards including tentatives. Part II. Am. Soc. for Testing Materials, Philadelphia, Pa., 66-7 (1948).

A footnote states "Prior to their present adoption as standard, these specifications were adopted in 1915, revised in 1916, but withdrawn and replaced by D-12-23T which was published as tentative from 1922 to 1933, being revised in 1923 and 1925."

Specifications D-12-48 were adopted in 1933 and revised in 1941 and 1948.

Raw tung oil shall conform to the following requirements: Specific gravity, 15.5/15.5°C., 0.940-0.943; acid no. (alcohol/ benzol), max., 8.0; sapon. no., 189-195; unsaponifiable matter, max., 0.75%; iodine no. (Wijs), min., 163; appearance, clear and transparent at 65°C.; color, not darker than a freshly prepared solution of 1.0 g. of $K_2Cr_2O_7$ in 100 ml. of pure H_2SO_4 (sp. gr. 1.84), or its equivalent in iron-cobalt solution or in Lovibond glasses; heating test, max., minutes, 12; refractive index at 25°C., 1.5165 to 1.520. (For American grown oil the minimum specific gravity may be as low as 0.938).

Ammann, P.

OIL OF ALEURITES FORDII FROM MADAGASCAR.

Agron. colon. 22, 97-102 (1933); Chimie & industrie 31, 1406; C. A. 28, 6007 (1934).

"The oil has the following characteristics: D_{15} 0.9448; n_{30} 1.5178; free acidity as oleic 0.296% (pressed oil), 0.556% (oil extd. from the press cake with CS_2), 0.339% (oil extd. with petr. ether); flash pt. 210-15°, burning pt. 225-30°. Detn. of the I no. by the Hübl, Wijs or Hanus methods gives abnormal results; Levy's indirect method gives values of 236.9-240.6." From C. A.

Arnold, W.

TUNG OIL AS FOOD OIL.

Z. Nahr. Genussm. 39, 30-3 (1920); C. A. 14, 1859 (1920).

"During 1919 a large amt. of so-called "Pork-oil" imported from China was found to be Chinese Tung oil. The properties of tung oil and methods for its detection are given." From C. A.

Bacon, C. V.

CHINA WOOD OIL TESTS.

Oil, Paint Drug Reptr. 81, 11 (Apr. 8, 1912).

Corrections of statements in "Practical Standard for China Wood Oil" (ibid. p. 18 (Apr. 1, 1912)) allegedly made by Bacon. Viscosity tests are good for detecting adulteration and the drying test on glass is satisfactory. The heat test, either Worstall or Bacon, is a good practical method for detecting adulteration since all oils which give soft, sticky products have been found to be impure by other tests.

Bacon, C. V.

PROPER SAMPLING OF CHINA WOOD OIL.

Paint, Oil Chem. Rev. 76 (21),10 (1923). Chem. Age (London) 10, 13 (1924); C. A. 18, 759 (1924).

"If the oil is in barrels or drums, the sample must be drawn from at least 10% of the packages by means of a "thief"; or if the oil is solid, by means of a tallow trier. The samples are then composited. Tank steamers or cars are sampled at frequent intervals from bleeders in the discharge line." From C. A.

Barry, T. H.

MALAYAN LUMBANG OIL.

J. Soc. Chem. Ind. 48, 289-90T (1929); C.A. 23,5598 (1929).

"The following consts. were found: sp. gr. 0.9264, I no. 150.8 sapon. no. 192.1, acid no. 0.66, unsapon. 0.41, n_{20} 1.4764. By adulterating China wood oil with lumbang oil and subjecting to the Brown heat test it was found possible to detect 10% or more of lumbang oil. In drying properties this oil compared favorably with linseed oil and is as good for paints on iron surfaces. On glass under lab. conditions this lumbang oil dried in 12 days as against 6 for linseed oil. A paint made up with Fe_2O_3, china clay and barytes when painted over a Pb primer on wood gave the same ratio of drying time as compared with a corresponding linseed oil paint, and the film was very soft after 3 weeks." From C. A.

Benham, G. H. and Klee, Leo

AN IMPROVED METHOD FOR THE DETERMINATION OF IODINE NUMBERS.

J. Am. Oil Chemists' Soc. 27, 127-9 (1950); C. A. 44, 5119 (1950).

"A modified Rosenmund-Kuhnhenn method (C.A. 17, 3172) in which, with one easily prepd. reagent, consistent and repeatable I nos. are obtained in 1 min. with all ordinary unconjugated fats and oils. The method: to a sample of the oil in 5 ml. CCl_4 is added 50 ml. of the Rosenmund-Kuhnhenn reagent. Ten ml. of 2.5% Hg acetate in glacial AcOH is added at once. The bottle is allowed to stand 1 min. at room temp. Twenty ml. of 15% aq. KI and 20 ml. of H_2O are added. After 1 min. the liberated I is titrated with standard 0.1 N $Na_2S_2O_3$ with starch as the indicator." From C.A.

For a tung oil this modified method gave an I no. of 229.4 in comparison with 216.3 (Hanus), 156.7 (Rosenmund-Kuhnhenn) and 162.4 (Wijs).

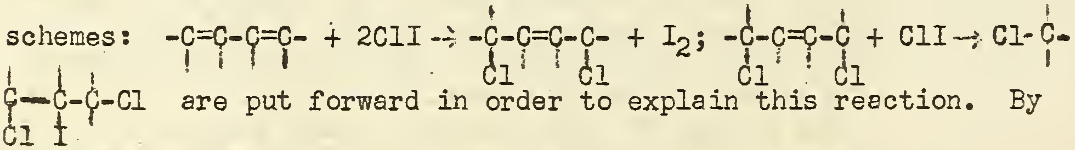
Bickford, W. G., Dollear, F. G., and Markley, K. S.

THE EFFECT OF HYDROXYL GROUP AND ACETYLATION ON THE APPARENT DIENE VALUES OF SOYBEAN AND VEGETABLE OILS.
Oil & Soap <u>15</u>, 256-9 (1938); C. A. <u>33</u>, 421 (1939).

"Diene values (D nos.) of 12 org. compds. and 18 oil samples are tabulated. Some of the av. D nos. by the Ellis 3-hr. reflux toluene method and Kaufmann 20-hr. sealed-tube toluene method, resp., are anthracene 140.3, 140.2 (calcd. 142.5); acetone glycerol 19, 8.6; ethylene glycol 87.5, 57.8; glycerol 79, 53.5; Me ricinoleate 16.6, 3.1; Me acetylricinoleate 2.8, 0.2; α, α'-distearin 0, 0; castor oil (I) 10, 3.2; acetylated I 1.0, 0.2; oiticica oil (II) 56.0, 54.5; acetylated II 51.3, 45.0; tung oil (III) 67, 64.2; acetylated III 62.9, 56.4; extd. soybean oil A (IV) 1.7, 0.7; acetylated IV 16.3, 8.2; edible soybean (V) 0.7, 2.0; and acetylated V 1.8, 6.0."
From C. A.

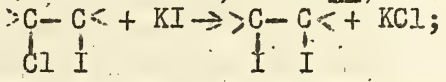
Böeseken, J. and Gelber, E. Th.
DETERMINATION OF THE IODINE NUMBER.
Rec. trav. chim. <u>46</u>, 158-71 (1927); C. A. <u>21</u>, 1628-9 (1927).

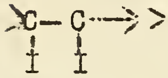
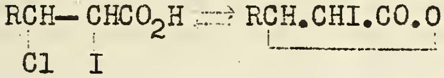
"B. and G. have made an extensive study on the detn. of the I no. with the soln. of Wijs, which often, even with simple org. compds., does not give correct figures, too low I nos. generally being ascribed to an incomplete addn. of the ClI and too high nos. to a substitution, occurring simultaneously with the addn. (cf. Bauer, Ber. <u>37</u>, 3317 (1904); C.A. <u>1</u>, 1407; <u>16</u>, 844). For compds. contg. <u>1</u> double bond they have proved again, that indeed ClI is added (cf. Ingle, J. Soc. Chem. Ind. <u>21</u>, 587 (1902); <u>23</u>, 422 (1904)) and that the correct I no. is found, if only enough time is allowed for the addn. and if the subsequent manipulations, diln. with water, addn. of the KI soln. and titration with $Na_2S_2O_3$ are carried out correctly (see below). Compds. contg. so-called negative groups add ClI slower but after 8 hrs. the addn. always is practically complete. Compds. with 2 or more separate double bonds behave in the same way as compds. with 1 double bond and take up the theoretical amt. of ClI in a very short time, but those with conjugated systems only take up the 1st mol. of the halogen very quickly, but the 2nd mol. very slowly. If not sufficient time is allowed for the complete addn. of the halogen with different amts. of substance different I nos. are found, which always are higher than those calcd., for 1 double bond and thus an easy method is given to discriminate between conjugated and non-conjugated systems. Moreover, with conjugated systems the addn. of the ClI takes place in a different way, free I being formed as soon as the unsatd. substance is dissolved into the soln. of the ClI and the schemes:



$$-\underset{|}{C}=\underset{|}{C}-\underset{|}{C}=\underset{|}{C}- + 2ClI \rightarrow -\overset{|}{\underset{Cl}{C}}-\underset{|}{C}=\underset{|}{C}-\overset{|}{\underset{Cl}{C}}- + I_2;\ -\overset{|}{\underset{Cl}{C}}-\underset{|}{C}=\underset{|}{C}-\overset{|}{\underset{Cl}{C}} + ClI \rightarrow Cl-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{Cl}{C}}-\overset{|}{\underset{I}{C}}-\overset{|}{\underset{|}{C}}-Cl$$

are put forward in order to explain this reaction. By this method the formula, previously given for eleostearic acid, $Me(CH_2)_3\ CH{:}CHCH{:}CHCH{:}CH(CH_2)_7CO_2H$, could be confirmed. (Cf. C.A. <u>19</u>, 2475; Kaufmann, C. A. <u>19</u>, 1565; <u>20</u>, 2989.) B. and G. also have shown that α,β-ClI compds. react with the KI with the formation of free I

and that so-called negative groups, which accelerate the formation of free I from α,β-di-Br compds. and inorg. iodides, accelerate this reaction in the same order (cf. van Duin, C.A. 20, 2441). For this reaction the schemes: 
$>\underset{Cl}{C}-\underset{I}{C}< + KI \rightarrow >\underset{I}{C}-\underset{I}{C}< + KCl$;


$>\underset{I}{C}-\underset{I}{C} \rightarrow >C-C< + I_2$
are given; when the excess of ClI was taken away with mol. Ag. or HgCl, the filtered solns. at once liberated free I after the addn. of KI. It appeared, however, that the I nos., found by titration of the free I, liberated from the solns. of the ClI compds. by the addn. of KI after the excess of the ClI had been taken away with HgCl, are too low and dependent on the time during which the HgCl had acted upon the soln. of the ClI compd. It was then found that the addn. of ClI to unsatd. compds. in dissociating solvents such as acetone, alc., AcOH, pyridine, etc., is a reversible reaction, especially with those compds. which contain a double bond in the α,β-position to a Ph group. In non-dissociating solvents this reaction does not take place and with a soln. of ClI in CCl_4 (cf. Marshall, J. Soc. Chem. Ind. 19, 231 (1900)) the correct I nos. were found for many compds., for which previously far too low I nos. were found (e. g., crotonic acid, cinnamic acid, benzalacetophenone, benzalacetone, etc.). With α,β-unsatd. acids also an equil. exists between the ClI compd. and the α-iodo-β-lactone: 
$\underset{Cl}{RCH}-\underset{I}{CH}CO_2H \rightleftharpoons \text{RCH.CHI.CO.O} + HCl$, which is practically quant. shifted to the left, but on the addn. of water, which takes away the lactone with the formation of an iodohydrin, shifts to the right side. Also for this reason the use of a soln. of ClI in CCl_4 instead of in AcOH is to be recommended. Detailed directions for the detn. of the I no. in different cases are given." From C. A.

Bolton, E. R. and Williams, K. A.
A TEST FOR CHINESE WOOD (TUNG) OIL.
Analyst 51,335-8 (1926); C.A. 21,184 (1927).

(Modified Worstall Test). "Take 150 g. of the oil in a stout Al beaker exactly 3 in. in diam. and approx. 4 in. tall. Heat over a burner so that 285° is reached in about 4 min. As soon as this temp. has been reached in the stirred oil, start a stop watch, keep on stirring and maintain a const. temp. Note the time when polymerization sets in, as is shown by the failure of the oil to drop from the thermometer when it is raised from the bath. If a long-stemmed thermometer is used, a correction must be made for stem exposure. Genuine tung oils reach the described stage in less than 8 min. of heating at 285°. Take out 2 g. from the center of the polymerized mass, weigh into a mortar contg. 3 g. of dry "silver" sand and 2 cc. of petroleum spirit. Triturate until the gasoline has evapd. for the most part. Transfer to an extractor, wash out the mortar with fresh petroleum spirit and ext. in the usual manner. Genuine tung oils give 28% ± 2% of ext." From C. A.

Bolton, E. R. and Williams, K. A.

THE IODINE VALUE OF TUNG OIL.

Oil & Soap 15, 315-16 (1938); C.A. 33, 1522 (1939).

"The 'instantaneous' I no. as developed by B. and W. = I no. 30 min. - 1/5 (I no. 3 hrs. - I no. 30 min.). Irregularities developed when the time of reaction was limited to less than 5 min. and therefore 2 detns., one of 30 min. and the other of 3 hrs., are made and the figure for zero time extrapolated from these. The method used for 8 yrs. is as follows: From 0.08 to 0.10 g. of tung oil is weighed into a 300-ml. flask and 20 ml. of $CHCl_3$ or CCl_4 and 30 ml. of 0.2 N Wijs soln. are added. After 30 min. at lab. temp. 20 ml. of 10% KI soln. and 100 ml. of water are added and the soln. titrated with 0.1 N $Na_2S_2O_3$. The same test is repeated allowing 3 hrs. for absorption." From C. A.

Bolton, E. R. and Williams, K. A.

THE COMPOSITION AND POLYMERIZATION OF CHINESE WOOD (TUNG) OIL.

Analyst 55, 360-7 (1930); C.A. 24, 4173 (1930).

"Chinese wood oil is characterized by contg. a large proportion of glycerides of eleostearic acid to which its power of polymerizing to a solid mass is due. The com. value of the oil can be estd. from the quantity of the above-mentioned acid present. The above-mentioned glyceride can be detd. by the method previously described by B. and W. If the I value of eleostearic acid is defined as the % halogen absorbed by 4 of the unsatd. C atoms (the other 2 being left out of consideration), this value can be detd. by 20 min. of absorption or, if greater accuracy is desired, by a more laborious method, which is described in detail." From C. A.

Boughton, E. W.

EXAMINATION OF CHINESE WOOD OIL.

7th Intern. Cong. Applied Chem. Sect.1,89-96(1909);J.Soc. Chem. Ind. 28, 719 (1909) (Abstract).

"Seven samples of tung oil were examined, six being received directly from China and the seventh pressed from the imported nuts. The constants obtained agreed with those published by other observers, except the I value. This was found to vary greatly, if Hanus or Wijs solution was used, the temp., time of contact, and ratio of I soln. to oil affecting the result. If the Hübl solution be used, however, the variation is small, and the values thus obtained fell with the limits of those published by other observers. The O absorption of Chinese wood oil (Livache test) is much less than that of linseed oil in 48 to 96 hours. On heating tung oil in the steam oven for one hour the gain in weight is greater than for linseed oil. The Liebermann and Storch rosin test gives with Chinese wood oil a claret color. Ten percent of tung oil may be detected in a mixture of tung and linseed oils by either of the following methods: (1) Place 10 cc. of oil in a test tube. Add 10 cc. of a satd. solution of I in chloroform. Heat in steam bath till chloroform is expelled. Then heat one hour in oil bath at 200°. Pure linseed oil remains liquid, while 10% of tung oil will cause solidification. (2) In a glass-stoppered tube place 10 cc. of the oil. Add 10 cc. of strong HNO_3 and shake well. Place in ice water for one hr. If as much as 10% of tung oil be present, the oily layer will be semi-solid." From J. Soc. Chem. Ind.

Boughton, E. W.
THE TESTING OF CHINESE WOOD OIL.
Drugs, Oils & Paints 29, 252-6 (1913).

A comparison is made of a number of analyses and tests with the purpose of selecting those most suitable for detecting adulteration in Chinese wood oil.

"The heat test as given by Browne apparently gives concordant results, and his method of procedure is to be recommended. When many samples of known purity and source have been tested, it will be shown whether Browne's limit of 13 minutes is correct. With conditions better standardized, the Potsdamer test will doubtless be of great value. The iodine "jelly" test will furnish more information than any other, as far as adulteration is concerned, although Browne's limits may be too low for oil generally considered pure." From the author's conclusions.

Bradley, T. F. and Richardson, David
DRYING OILS AND RESINS. ALKALI-INDUCED ISOMERIZATION OF DRYING OILS AND FAT ACIDS.
Ind. Eng. Chem. 34, 237-42 (1942); C. A. 36, 2167 (1942).

"The fat acids of linseed, soy, sardine and dehydrated castor oils were partly isomerized by heating for 2-3.5 hrs. at 225° with 37.5-50% aq. NaOH, KOH or LiOH to more highly conjugated acids. Thus linseed oil acids with NaOH gave 41% of doubly unsatd. and 8.2% of triply unsatd. conjugated acids. Rough fractionation at 1-2 mm. gave a partial sepn. of the more highly conjugated acids. Their quantities were estd. by comparison of the specific extinctions of the characteristic bands of the substance under test and of known, pure conjugated unsatd. acids. With highly conjugated acids such as eleostearic, alkali appeared to isomerize in the opposite direction, reducing the amt. of conjugation. The presence of a small amt. of an acid with 4 conjugated double bonds was indicated, however. "conjugation assays" for 13 raw oils are also given. The oils may be hydrolyzed and isomerized in one operation. A large excess of alkali increased the rate of isomerization only slightly. Isomerization in boiling BuOH, $C_2H_4(OH)_2$, etc., was faster than in H_2O at the same temp. The amt. of conjugation was decreased by long heating. Reësterified isomerized acids showed in part the expected properties, such as frosting, fast drying and H_2O resistance." From C. A.

Brier, J. C.
QUANTITATIVE DETERMINATION OF ADULTERATION IN CHINESE WOOD OIL.
J. Ind. Eng. Chem. 7, 953-7 (1915); C. A. 10, 282 (1916).

"The effect of different oils on the spectrum of Chinese wood oil was detd. and the point at which the spectrum changes is termed the turning point; this requires 14.5-17%. If the adulterating oil is known, very accurate results can be obtained. The addition of 15% of linseed oil is necessary to reach the turning point. To det. the % it is necessary to find out how much adulterant must be added before the turning point is reached, then by subtracting the amt. from 15.5 the amt. present in the oil is obtained." From C. A.

British Engineering Standards Association

BRITISH STANDARD SPECIFICATION FOR TUNG OIL.

British Eng. Standards Assoc. No. 391, 1-9 (1929); C.A. 23, 3586 (1929) (no abstract).

Tung oil must meet the following specifications: (1) description: free from visible impurities after 24 hrs. at 15.6$_{20}$-21.1°C; (2) Color: not darker than a standard;(3) d $\frac{15.5^\circ}{15.5}$: 0.939 - 0.943; (4) n_D^{20}: 1.518 - 1.522; (5) I value: 155 - 167 (Wijs); (6) saponification value: 189-195; (7) acid value: no mineral acid; fatty acid no more than equivalent of 5 mg. KOH per gm. oil; (8) unsaponifiable matter: not over 0.75%; (9) heat test: not over 12 min.; (10) insoluble bromide: none. Procedures are given for tests (5) - (10). Test (9) is essentially the Browne heat test.

Browne, F.

HEAT TEST FOR CHINESE WOOD OIL.

Chem. News 106, 14-5 (1912); C.A. 7, 2315 (1913).

"A tube, 16 cm. x 15 mm. (with a cork so perforated that a glass rod, 3 mm. diam., may move freely therein) containing 5 cc. of the oil to be tested, is immersed in a bath of cottonseed oil previously heated to 293°. The source of heat is removed for 3/4 min. and reapplied when the temp. has fallen to 282°, at which point the tube is kept steadily until the oil just solidifies. (Test is made by raising and lowering glass rod.) The end reaction is fairly sharp. The total time of gelatinization in 7 samples of wood oil varied from 11 to 13 min. Adulteration with 10% soy-bean oil, nut oil, mineral oil, or cottonseed oil caused an increase of 2-3 min. in the time required for gel formation. Cu oil baths, thermometers, etc., are described in detail. The method is recommended for international use." From C. A.

Browne, F.

THE EXAMINATION OF CHINESE WOOD OIL.

Chem. News 114, 123 (1916); C. A. 10, 2808 (1916).

"The following specifications have been drawn up**; total impurities such as H_2O, dirt and foots should not exceed 1%. The refractive index at 15° should not be less than 1.5204, the sp. gr. at 15° not less than 0.9400, and it should satisfy the requirements of Worstall's Bacon's, Browne's or Chapman's heat test." From C. A.

Calef, H. W.

BACON'S TEST OF THE PURITY OF CHINESE WOOD (TUNG) OIL.

Oil, Paint Drug Reptr. 82(2),19 (July 15, 1912); J. Soc. Chem. Ind. 31, 782 (1912).

"About 10 cc of pure tung oil are placed in a test tube, 3/4 inch in diameter and about 4 inches in length, and similar tubes are charged with the same oil adulterated to the extent of 10 percent., and with the sample under examination. The three tubes are immersed for exactly nine minutes in an oil bath maintained at 280° to 285°C. (not more). The contents of each tube are then subjected to a comparative stabbing test with a small bright spatula, which is plunged in from top to bottom and withdrawn. In the case of pure tung oil the cut will be clean and appear as a straight line. In the presence of 5 percent of an adulterant, the oil will be softer, and the edges of the cut will have a feathery appearance, whilst with 10 percent the oil will be soft and paste-like, and with amounts of adulterant in excess of 12 percent will often remain fluid. (See also J. Soc. Chem. Ind. 31, 731 (1912))." From J. Soc. Chem. Ind.

Carrick, L. L.

COMPARATIVE STUDY OF THE METHODS FOR DETERMINING UNSATURATION IN DRYING OILS.

Am. Paint J. 32 (11), 72-6 (1947);* C.A. 43, 7718 (1949).

Numerous methods of measuring unsaturation of drying oils are reviewed. Iodine absorption numbers were measured on tung, linseed, dehydrated castor, safflower, perilla, menhaden, and soybean oils by 4 methods. The values for tung oil were as follows: Wijs, 160.2; Hoffman and Green, 161.1; Kaufman, 170.5; and Woburn, 227.7. For tung oil the difference between the Woburn and Wijs values (67.5) agreed well with the Ellis-Jones maleic-anhydride value (66.4). For castor, soybean and linseed oils, conjugated by processing, the difference values (Woburn - Wijs) were less than the maleic anhydride values.

Chang, Wei-ju

FACTS ON TUNG OIL.

Inspection and Commerce (China) 4 (10), 17-8 (1933).

Exportation statistics for tung oil for the years 1912 - 1931 are listed, together with exportation procedures and a list of purposes for which the oil is used. In accordance with the Chinese Government Regulations promulgated in 1929, all tung oil exports must meet the following specifications: Sp. gr. (15.5°), 0.9400-9430; acidity, 8.0 (max.); refractive index (25°), 1.5165 - 1.5200; iodine number (Wijs), 163 (min.); Heating test (Brown's) 12 min. (max.); Worstall's test 7.5 min. (max.) with the gel crumbly and not sticky under the spatula.

Carriere, M.

ANALYTICAL TESTS ON BLOWN OILS. III.CONJUGATED DOUBLE BONDS.

Ind. corps gras 1, 76-81 (1945); C. A. 40,2323 (1946).

"The diene-value detn. serves to det. amt. of conjugation. The Meinel Br-fixation value permits qual. distinction of thermally polymerized oils from oil bodied by air oxidation. This value for the oxidized oil is lower than for the non-oxidized oil." From C.A. Oils investigated include China-wood, linseed, castor oil, soya, peanut, and neou.

Chapman, A. C.

THE EXAMINATION OF CHINESE AND JAPANESE WOOD OIL.

Analyst, 37, 543-53 (1912); C. A. 7, 2315 (1913).

"The d^{15}_{15} (0.9406-0.9440) of Chinese wood oil is higher than that of any other fatty oil with the exception of castor and possibly tallow seed oils. I value depends so largely upon the precise method adopted that many of the published values cannot be accepted. C. prefers the Wijs method using 0.1 g. oil, 20 cc. CCl_4, 30 cc Wijs soln. and allowing the reaction to proceed for 3 hrs. in the dark. Values should be close to 170. 17 samples gave figures from 166 to 176.2, av. 170.6. n is high, rarely falling below 1.517 at 20°. Viscosity is higher than any other fatty oil likely to be used as an adulterant, but varies considerably. The heat polymerization test is one of the most important. C. considers the hardness of the jelly obtained under standard conditions more important than the time required to form the jelly. About 5 cc. of the oil are introduced into each of 2 test tubes 6 in. by 5/8 in. The tubes are immersed in a paraffin bath at 100° and the temp. of the bath then raised to 250° in about 15 min. At the end of 1/2 hr. one tube is withdrawn, cooled and broken; the other tube withdrawn, cooled and broken at the end of 1 hr. China wood oil of good quality should give on the 1/2 hr. test a fairly firm jelly, and a quite hard jelly on the hr. test. When cut with a knife or broken the cut or fracture should be smooth and free from stickiness, and small portions should break down on rubbing to a soft crumbly mass which should not adhere to the fingers. When spread in a thin film on glass and heated in an air bath for 1 hr. to 105° the genuine oil dries to a crinkly, rubber-like substance which can be removed from the glass without difficulty and is neither soft nor oily. Under these conditions the oil gains 2-3% wt. The solidification resulting from the action of a soln. of I in $CHCl_3$ is a useful qual. test and may be developed into a quant. one. Since Chinese wood oil forms no ether-sol. hexabromide while perilla, candle nut and tallow seed oils all yield more or less hexabromide, this test may serve to detect adulteration. Japanese wood oil is obtained chiefly from the nuts of <u>Paulownia imperialis</u> (Japanese Kirinoki); other seeds may occasionally be employed. The sp. gr. and I values are both lower than for China wood oil, but greater difference is shown in polymerizing properties, the oil remaining liquid under conditions which convert Chinese wood oil into a hard jelly." From C. A.

Cheng, Fa-Wu
A NEW METHOD FOR DETERMINING ADULTERANTS IN TUNG OIL.
Science (China) <u>18</u>, 758-63 (1934);* C. A. <u>29</u>,362 (1935).

"The amount of Chinese vegetable tallow or rosin as adulterant in tung oil can be calcd. by a simple formula, based on the measurement of the refractive const. previously reported." From C. A.

Cheng, Fa-Wu
A NEW METHOD FOR TESTING THE PURITY OF CHINESE WOOD OIL.
Trans. Sci. Soc. China <u>8</u>, 97-101 (1934)*; C.A. <u>29</u>,362 (1935).

"The difference between the <u>ns</u> of the original oil and of the unpolymerizable fraction multiplied by 10^4 is a characteristic const. being 155-158 for genuine tung oil. The figure increases with the amt. of adulterant; 2.5% of rape oil or poppy-seed oil is easily detected by this method." From C. A.

Cheng, Fa-Wu
FURTHER NOTES ON THE PROPOSED METHOD FOR TESTING THE PURITY OF CHINA WOOD OIL.
J. Chinese Chem. Soc. <u>2</u>, 351-3 (1934)*; C. A. <u>29</u>, 3179 (1935).

"Since vegetable oils and rosin produce opposite effects on the refractive const., the acid no. is detd. in cases where both of these adulterants are used." From C. A.

Cincinnati-Dayton-Indianapolis-Columbus Paint & Varnish Production Club

A STUDY OF FLUORESCENCE ANALYSIS AND ITS APPLICATION TO PAINT RAW MATERIALS.

Paint, Oil Chem. Rev. 99, (23), 64-7 (1937)*; Am. Paint J. 22, Convention Daily 15, 16-18 (Oct. 26, 1937)*; C. A. 32, 1491-3 (1938).

"Work of an exploratory, preliminary nature indicates that an experienced observer working with simple equipment can differentiate (1) between most of the resins, (2) bodied from raw oils (3) tung from perilla oil, (4) oleoresinous from alkyd varnishes, and (5) between various white pigments. In general, the application of fluorescence analysis to anything other than raw materials is highly questionable." From C. A.

Cottrell, J. A.

THE CHEMICAL CHARACTERIZATION OF DRYING OILS.

Paint Technol. 9, (100), 73-6,91 (1944); C. A. 38,6112 (1944).

"Methods are given for the detn. of the following: acid value, sapon. value, carbonyl value, hydroxyl value, conjugation and total unsatn. The various procedures are presented and their suitability under different conditions is discussed." From C. A.

To determine conjugation or "diene value" maleic anhydride can be added by the Kaufmann-and-Baltes method or by the Ellis-and-Jones method. Structures are given for compounds formed by maleic anhydride with each of the eleostearic acid isomers.

Dean, H. K.

UNSATURATION OF DRYING OILS.

Paint Manuf. 8, 163 (1938)*; Brit. Chem. Abstracts 1938, B, 1187.

"Polemical against Stitson (ibid. p. 119-23)." From Brit. Chem. Abstracts.

Dvortsak, J.

CHEMICAL EXAMINATION AND DETECTION AND DETERMINATION OF CHINESE WOOD OIL IN LACQUERS, THICK OILS AND VARNISHES.

Vegyi Ipar 28, No. 15-6, 5, No. 17, 4 (1929)*; C.A. 25,3853 (1931).

"The oil had d. 0.936-44, n_D 1.510-20, Köttsdorfer no. 190-7, I no. 160-76. Methods of detn. according to Reibnitz and Marcusson are discussed." From C. A.

Earle, F. R. and Milner, R. T.

STUDY OF THE KAUFMANN METHOD FOR DETERMINING IODINE NUMBERS.

Oil & Soap 16, 69-71 (1939); C. A. 33, 4446 (1939).

"The detn. of the I no. of soybean oil by the Kaufmann method (Studien auf dem Fettgebiet, p. 23, 29, C. A. 29, 6784) is not appreciably affected by moderate changes in temp. and illumination. The excess of reagent is important and a min. of 2 hrs. at room temp. is required. The I nos. found by this method differ but little from those found by Wijs (cf. C.A. 23, 2052) and Hanus except for tung and oiticica oils for which the Hanus method gives values much higher than the Kaufmann and Wijs methods. The Rosenmund and Kuhnhenn (C.A. 18, 477) method gives results lower for all oils studied of I no. above 100. The increased amt. of methoxyl in the brominated oil shows that the acid formed during halogenation is not a measure of substitution by the Kaufmann reagent." From C. A.

Easton, B. J. and Georgi, C. D. V.

CHINESE WOOD OIL AND CANDLENUT OIL.

Malayan Agr. J. 14, 358-60 (1926); C. A. 21, 1195 (1927).

"It is possible to distinguish between Chinese wood oil and candlenut oil by Worstall's test as follows: 100 g. oil is heated in 4-4.5 min. to 282° in a nickel basin 4.5 in. in diameter. When this temp. has been reached, the stop watch is started and the flame adjusted to maintain the oil at 279-285°, the mixt. is stirred constantly. When the oil begins to thicken and a skin forms on the surface the time is noted and the oil stirred vigorously until it becomes solid. Pure Chinese wood oil gives a pale colored cake, firm in texture, and cuts smoothly, not sticking to the knife. The time from the attainment of 282° to the formation of the skin must not be more than 7.5 min. or adulteration can be suspected. As little as 5% of candlenut oil in Chinese wood oil can be detected by this method." From C. A.

Eigenberger, E.

COLOR REACTIONS OF CONJUGATED UNSATURATED OILS.

Fette u. Seifen 47, 577-8 (1940)*; C. A. 36, 919 (1942).

"Investigations were made to det. whether polyene color reactions could be applied to drying oils in an effort to differentiate conjugated unsatd. fat acids from those with isolated double bonds. Color reactions with quinones or polynitrobenzenes characterized the conjugated double bonds of drying oil fat acids. The adducts of the polyene oils were stable only in soln. and could not be isolated. Certain solvents, e. g., aromatic hydrocarbons, inhibited their formation. Color reactions were best made in $CHCl_3$ soln. Polynitrobenzene derivs. gave a yellow to red color with triply conjugated double bonds and no color with doubly conjugated bonds. Di- and trinitrophenol or derivs. of picric acid gave golden-yellow to orange-red colors with wood oils. $CHCl_3$ and tetralin were especially good solvents. Since the intensity of the picric acid reaction was proportional to the wood-oil concn. it was adaptable to colorimetric analysis. 1,3,5-Trinitrobenzene, trinitrochlorobenzene or trinitrobenzoic acid and its esters were better than picric acid. Trinitrotoluene and trinitroxylene were not adaptable. Benzoquinone gave an orange-yellow to red color with conjugated triply double-bonded fat acids in $CHCl_3$ soln. Chloranil (tetrachloro-p-quinone) gave a deep-blue or violet color which slowly became brown. The reaction between chloranil and eleostearic acid consisted of 2 phases: (1) formation of a blue adduct and (2) slow dehydration whereby the chloranil was practically all reduced to tetrachlorohydroquinone. The latter reaction caused the fading of the blue dye. The dehydration proceeded in the absence of H_2O, EtOH and air. This coloration was not adaptable for colorimetric detn. After fading, addn. of more chloranil formed more color. Further, the color depended on the age and type of the eleostearic acid compd. Chloranil gave a stable brown-red color with dehydrated castor oil, linseed stand oil and linseed oil which had been heated awhile. This indicated the formation of conjugated double bonds in the linseed oils. In linseed oil-wood oil mixts. the latter was detected, when as little as 5% was present, by the chloranil, quinone or trinitrobenzene reactions. In contrast wood oil-stand oil gave no or a weak-brown chloranil reaction. While polyene color reactions were not generally adapted for quant. estn. they gave an insight to the various changes in unsatd. systems of drying oils." From C. A.

Ellis, B. A.
CONDENSATION OF MALEIC ANHYDRIDE WITH TUNG OIL. A NEW "CONSTANT" FOR OILS.
Analyst 61, 812-16 (1936); C. A. 31,897 (1937).

"The method described, which is in many respects similar to that of Kaufmann and Baltes, C. A. 30, 7885^2, but was developed independently, consists in refluxing the oil with maleic anhydride dissolved in a solvent immiscible with water; the b.p. of the solvent serves to control the reaction temp. Water is added eventually, the excess maleic acid is removed in a sepg. funnel and titrated with standard alkali hydroxide soln. The term "maleic value," which is indicative of unsatd. linkage, is suggested for 12.69 X ml. of N NaOH/wt. of sample in g." From C. A.

Fasig, Edgar W.
CHINA WOOD OIL. ITS TEST FOR PURITY.
Paint, Oil Chem. Rev. 74 (21), 11-12 (1922); C. A. 16, 2610 (1922) (No abstract).

The standards for China wood oil were in a chaotic condition at the time of writing (1922). The American Society for Testing Materials was the only organization that had attempted to draw up standard methods of testing, and its tests were generally not accepted by importers. Data are included for a comparison of the Browne and the Worstall heat tests on several oils, some of which were probably adulterated. The ASTM specifications for other properties of China wood oil are presented and discussed.

Fitelson, J.
A NEW OXIDATION METHOD FOR THE DETERMINATION OF SATURATED FATTY ACIDS.
J. Am. Oil Chemists'. Soc. 27, 1-8 (1950); C.A. 44, 2259 (1950).

"The method is based upon the nondisruptive oxidation of the unsatd. acids by performic acid, extn. of the oxidized mixts. with petr. ether and, finally, chromatographic purification of the satd. acids. The final residue contains a small amt. of nonacid material, 0.1 to 0.7%, based on the total mixed fatty acids. The unsatn. of these satd. acids is equal to about 0.1% as oleic acid, so that a correction of about 0.4% must be applied. The time required for the method is 6 hrs. for 1 detn. It has been tested with known mixts. of pure satd. and unsatd. acids with results varying up to 0.6% from the calcd. values. Recovery of added satd. acids to olive oil fatty acids was satisfactory. Application of the method to common fats gives results which compare favorably with accepted values. Fats contg. isooleic, eleostearic, chaulmoogric, and ricinoleic acid present no analytical difficulties. Petroselinic acid contains interfering nonfatty material so that the final residue must be further purified. The method can also be used with fats contg. lauric, capric, and small quantities of caprylic acids, but is unsatisfactory when appreciable quantities of water-sol. satd. acids are present. 27 references." From C. A.

Fox, J. J. and Bowles, T. H.
THE ANALYSIS OF PIGMENTS, PAINTS AND VARNISHES.
Ernest Benn, Ltd., London, 1927, p. 168-9.

For the determination of tung oil in paints and varnishes there is described the method of Goldsmith (J. Oil & Colour Chemists' Assoc. 9, 342-51 (1926)) which depends on adding H_2SO_4 and $NaNO_2$ and determining the amount of solid tung oil which is precipitated.

Frahm, E.D.G. and Koolhaas, D.R.
REFRACTOMETRIC DETERMINATION OF OIL IN ALEURITES SEEDS.
Rec. trav. chim. 57,395-8 (1938) (in German); C.A. 32, 5240 (1938).

"Good results were obtained in the refractometric detn. of the oil content of *Aleurites montana* seeds with the use of α-bromonaphthalene solvent, when a sep. n was taken on the oil and used in the calcns. for percentage of oil. With *Aleurites moluccana* seeds 0.0005 should be added to the n of the oil in the calcns. in order that results check those by the extn. method." From C. A.

Francois, M. Th.
THE SPECIFICATIONS OF CHINA WOOD OIL.
Chimie & Industrie Special No., 1051-5 (June 1933)*; C.A. 28,660 (1934).

"Analysis of 4 samples of tung oil (*Aleurites fordii*) of known purity gave the following results: acid no. (as % oleic acid) 0.53-0.84, sapon. no. 192-5, I no. (Hanus) 144-173, I no. (Wijs) 159-179, d_{15}^{15} 0.9422-0.9489, n_D^{21} 1.51875-1.51992; 2 samples of oil of *A. montana* of known purity gave: acid no. 1.3-1.5, sapon. no. 191-192, I no. (Hanus) 137-170, I no. (Wijs) 155-168, d_{15}^{15} 0.9340-0.9399, n_D^{21} 1.51012-1.51194; 1 sample of oil of *A. moluccana* of known purity gave: acid no. 12, sapon. no. 192, I no. (Hanus) 140-159, I no. (Wijs) 150-173, d_{15}^{15} 0.9236, n_D^{21} 1.47449. Some of the values fall appreciably outside the limits set in the generally accepted specifications were in most cases based on the examn. of com. samples which may not have been pure. The I no. is considered to be of little value because of lack of proper duplication of results; 7 days are required to obtain the true value. The most promising single test, from the triple standpoint of rapidity, accuracy and specificity, seems to be the n, or possibly better still the refractive dispersion, which distinguishes between tung oil and oil of *A. montana*." From C. A.

Francois, M. Th.
SPECIFICATIONS FOR CHINA WOOD OIL.
Bull. sci. pharmacol.40, 420-7 (1933); C.A. 27, 5202 (1933).

"A review." From C. A.

Francois, M. Th.
GELATION OF THE ALEURITES OILS, SO-CALLED CHINA-WOOD OILS, BY THE HALOGEN SALTS OF ANTIMONY.
Congr. chim. Ind., 14 me, Paris, 1, 7 pp. (1934).

The aleurites oils called "China wood oils" possess two characteristic properties: (1)they possess a very high refractive index;(2) they are susceptible of being transformed into gels by the action of various agents (heat, various chemical products). The author proposes for this purpose the use of a 10% solution of antimony trichloride in chloroform. That reagent is stable. It causes instantaneous gelation of tung and abrasin oils. Used under precise conditions it permits, in very little time, learning the nature of an oil or the composition of a mixture. It is applied in a similar manner to standoils.

Francois, M. Th.
SOME SPECIFIC CHARACTERISTICS OF CHINA WOOD OILS AND ANALYSIS OF MIXTURES CONTAINING THEM.
Recherches et inventions 16, 330-2 (1935); C. A. 29,5290 (1935).

"A brief discussion of the detn. of d., I no., and jellification by means of $SbCl_3$, from the standpoint of estg. the amt. of China wood oil in a mixt. The first 2 detns. are valueless for this purpose." From C. A.

Francois, M. Th., and Bourgignon, Mme J.
IODINE VALUES OF DRYING OILS.
Bull. mens. ITERG 1948 (8), 33-5*; C. A. 43, 1992 (1949).

"(A) The Wijs method, (B) the Hanus method, (C) the Wijs method modified according to Hoffman-Green employing small quantities of HgOAc (C. A. 34, 901), and (D) the Hanus method modified in analogous manner were comparingly applied to the following oils contg. conjugated double bonds; tung oil (*Aleurites fordii*), abrasin oil (*A. montana*), lumbang oil (*A. moluccana*), ongekea oil (*Ongokea kleinensia*), oiticica oil (*Licania rigida*) and dehydrated castor oil. The results tabulated for reaction times varying between 5 min. and 7 days show striking differences and it is concluded that none of the mentioned methods is reliable for these oil types. For peanut oil and beech-nut oil the agreement is good between (A) and (C), acceptable between (B) and (C)." From C. A.

Fulweiler, W. H., et al.
REPORT OF COMMITTEE D-15 ON THERMOMETERS.
Am. Soc. Testing Materials Proc. 28,592-5 (1928); C.A. 22,2857 (1928).

"Specifications are proposed for thermometers to be used for (a) heat test of raw tung oil, (b) sp. gr. of petroleum products and (c) Engler viscometer (4 ranges)." From C. A.

Gardner, H. A.
STANDARDS FOR TUNG OIL.
Paint Mfrs. Assoc. U. S. Circ. 84, 4 pp. (Feb. 1920).

Detailed procedures are described for testing tung oil by the Browne heat test and the Agnew open pan heat test.

Gardner, Henry A.

DEVELOPMENTS IN THE TUNG OIL HEAT TEST AND EXAMINATION OF NEW SAMPLES OF TUNG OIL.

Paint Mfrs. Assoc. U. S. Circ. 119, 8 pp. (Feb. 1921); C. A. 15,1081 (1921).

"To verify the results obtained by Jameson (C. A. 14, 3804) on the effect of the free fatty acid content of tung oil on the Browne heat test (C. A. 10, 974), G. exptd. with pure oil from China and with commercial oils. Removal of free fatty acids with $Ca(OH)_2$ in each case reduced the time in the heat test by about 1.5 min. Check detns. were more easily obtained on the neutralized than on the original oils. Adding varying amts. of pure tung-oil fatty acids to a neutralized oil, and then plotting % fatty acid against time in min. for the Browne heat test, produces a nearly straight curve. A neutralized oil to which sufficient tung-oil acids have been added to produce the same free acid content as was present in the original raw oil, does not show the same time in the heat test as the latter. The decided drop in the heat test no. of min. when oil is treated with $Ca(OH)_2$ is, therefore, not wholly due to removal of free fatty acids. Jameson's article is reprinted." From C. A.

Gardner, H. A.

TUNG OIL TESTING AND SPECIFICATIONS FOR SOY BEAN AND PERILLA OILS.

Paint Mfrs. Assoc. U. S. Circ. 150, 265-8 (May 1922); C.A. 16, 3216 (1922).

"The proposed tentative specifications of Sub-Com. III on Paint Vehicles, of Com. D-1 on Coatings for Structural Materials, Am. Soc. Testing Materials, for tung oil make the following revisions (cf. C. A. 10, 974): acid no. (alc.-benzene method), 7 (max.); I no. (Wijs), 163 (minimum); heating test (revized method, C. A. 14, 3844), 12 min. Details of the heating test are given. Proposed tentative specifications for soy bean oil: foots, 2.5%; loss on heating at 105°, 0.2% (max.); $d^{15.5}_{15.5}$, 0.924 (min.); acid no., 5.0 (max.); sapon. no., 190 (min.); I no. (Hanus), 128 (min.); unsapon. matter, 1.5% (max.); color, not darker than 1 g. $K_2Cr_2O_7$ in 100 cc. concd. H_2SO_4. Proposed tentative specifications for perilla oil are the same as for soy oil except $d^{15.5}_{15.5}$, 0.932 (min.); and I no. (Hanus), 191 (min.). (Cf. C. A. 16, 841)." From C. A.

Gardner, H. A., Chairman

REPORT OF SUB-COMMITTEE III ON TESTING OF PAINT VEHICLES.

Am. Soc. Testing Materials Proc. 24, Pt. 1, 430-1 (1924).

The committee recommends that the present Tentative Specifications for Raw Tung Oil (D-12-23T) remain tentative and that the present Standard Specifications for Purity of Raw Tung Oil (D-12-16) be withdrawn.

Gardner, H. A.

OITICICA OIL.

Natl. Paint, Varnish Lacquer Assoc. Circ. 470, 213-85 (1934); C. A. 29, 362 (1935).

"A review of the botany and culture of Licania rigida, from the nuts of which oiticica oil is obtained, is given. The oil resembles tung oil in many respects; it thickens more slowly when heated; its varnishes require longer cooking and are somewhat more affected by H_2O than tung oil varnishes. Some consts. of oiticica fatty acids and tung oil fatty acids, resp., are: acid value 185.3, 198.8; m.p. 50-62°, 37-48°; I value (Wijs) 150.6, 172.5. The former are more sol. in turpentine oil, BuOH and EtOAc, but less sol. in EtOH and mineral spirits. Specifications for the raw and partially polymerized (by heat) oils are suggested. Uses of the oil and its fatty acids are suggested. Several short articles and abstracts by various authors are reprinted." From C. A.

Gerard, Andre
IDENTIFICATION AND DETERMINATION OF CHINA WOOD OIL.
Ann. fals. 23, 28-30 (1930); Bull. inst. pin. 1930, 39-40; C. A. 24, 2314 (1930).

"A brief review of the methods of testing and detg. China wood oil." From C. A.

Godbole, N. N. and Amarenda
DETERMINING THE PERCENTAGE OF OLEIC, LINOLEIC AND LINOLENIC ACIDS BY THE KAUFMANN THIOCYANOGEN NUMBER METHOD IN TYPICAL INDIAN OILS THAT CONTAIN LINOLENIC ACID.
Allgem. Oel- u. Fett-Ztg. 33, 7-10 (1936); C. A. 30, 2782 (1936).

"Data on fat acid compn. of some Indian oils are tabulated. These data are calcd. with the use of Kaufmann equations, modified to correct for the unsapond. matter in the oils. The analytical results on the Indian oils are:

	I no. (Hanus)	SCN no.	Percentage of satd. acids (Bertram)	Percentage of Unsaponifiable matter
Linseed oil	178.5	107.6	13.9	0.96
Safflower oil	143.6	80.86	8.4	0.82
Poppy-seed oil	137.25	76.71	11.05	0.46
Walnut oil	151.8	88.11	8.4	0.68
Soybean oil	126.5	99.6	12.7	0.91
Tung oil	210.5	88.52	4.7	0.69

The Kaufmann equations are not applicable to tung oil because of the presence of eleostearic acid." From C. A.

Goldsmith, J. N.
ANALYSIS BY THE REFRACTOMETER.
J. Oil & Colour Chemists' Assoc. 4, 58-82 (1921); C. A. 16, 215 (1922).

"Review, with references, of the historical development of refractometric analysis, with formulas for calcg. n_D of mixts. of 2 liquids, tables and graphs for n and dispersion of various liquid aq. salt solns., linseed and China wood oils after varying heat treatments and storage periods, etc." From C. A.

Goldsmith, J. N.

METHOD OF DETECTING AND ESTIMATING TUNG OIL. I.

J. Oil & Colour Chemists' Assoc. 9,342-51 (1926); C.A. 21,1193 (1927).

"A simple method for the detection of tung oil in varnish or paint medium is as follows: 2 or 3 cc. of the liquid is mixed with petroleum ether. Any ppt. is removed. To the clear liquid is added $NaNO_2$ and then dil. H_2SO_4. If tung oil is present, a yellow solid is pptd., either at once or on standing. If the tung oil is bodied, the test is improved by adding 4% abs. EtOH to the petroleum ether. Further distinguishing tests are obtained by treating the ppt. with a mixt. of equal vols. of petroleum ether and Me_2O or abs. EtOH. The ppts. from tung oil, thin or thickened, do not dissolve. A no. of solvents, such as AmOAc, are given which prevent pptn. This method is then applied to the quant. estn. of tung oil with fairly good agreement. Expts. and results are given for various solvents and variations of the $NaNO_2$-H_2SO_4 method. Substitutes for the latter were: bubbling in N_2O_3 gas; NO_2 gas; Am nitrite alone and with HNO_3; and NO gas. The latter gave no ppt. until air was admixed when a dense, white ppt. formed, a yield of 83.89% of the oil taken. Analysis of the ppt. showed its compn. bears a definite relation to the tung oil. Work on the method is proceeding and will be published later." From C. A.

Harrison, A. W. C.

COMMERCIAL TESTING AND SELECTION OF WOOD OIL AND LINSEED OIL.

Paint Varnish Production Mgr. 34, 8,10,12,14,40 (May 1930).

H. favors more careful determination of the drying properties of linseed and tung oils in conjunction with standard driers. Procedures for determining other constants and the significance of the latter are discussed.

Hehner, O. and Mitchell, C. A.

CONTRIBUTION TO THE CHEMISTRY OF DRYING OILS; WITH A METHOD FOR THE EXAMINATION OF LINSEED OIL.

Analyst 23 (273), 310-18 (1898); J. Soc. Chem. Ind. 18, 77-8 (1899) (abstract).

A method is described which yields hexabromides from fatty acids. Precipitates are obtained from oils containing acids which can form hexabromides.

"A specimen of walnut oil gave, in two determinations, 1.9 and 1.42 percent of bromo-compound. Poppy oil (four specimens) gave no deposit, nor did Brazil nut oil, cotton-seed oil, olive oil, Japanese wood oil, or almond oil. Mixtures of linseed oil and other oils gave percentages of bromine compound in proportion to the percentage of linseed oil." Excerpt from abstract in J. Soc. Chem. Ind.

Henriques, R.

COMMENTS ON A PREVIOUS PAPER.

Chem. Rev. Fett- u. Harz-Ind. 5 (3),43-45 (1898); J. Soc. Chem. Ind. 17, 610 (1898).

"Iodine Number The advantage of the Waller reagent consists in its greater stability, a sample titrated at the end of 24 hours, and again after 12 weeks' standing, giving the values 45.43 and 41.08 respectively, whereas the Hubl reagent under the same conditions decreased in standard from 45.14 to 26.43.

The cause of the lower values given by the Waller method in the case of linseed oil is to be sought in an insufficiency of chloroform in the liquid to retain the addition products in solution, whereby a portion of the oil is apparently carried down and removed from the influence of the iodine.

Wolffbauer and Ulzer's direction with regard to the amount of chloroform should therefore, be amended by the proviso that sufficient chloroform must be present to prevent precipitation during the experiment.

This question of chloroform does not appear to influence the differences noticed in the case of wood oil, the tendency to precipitation being less than with linseed oil. The differences between the values obtained by Holde and the author consequently still remained unexplained.

Saponification Value. In view of the difficulties caused by the presence of alkali carbonates, the author now proposes to employ sodium hydroxide for all ordinary oils, using potash solely for solid fats and waxes forming very hard soda soaps. He regards Holde's proposal to remove the carbon dioxide by boiling, as too troublesome for practical use.

For mixtures of fatty and mineral oils the cold saponification method, performed in the same manner as for waxes, is recommended." From J. Soc. Chem. Ind.

Hertkorn, J.

FLOCK FORMATION IN LINSEED OIL AND LACQUER OIL.
Chem. Ztg. 34, 462-3 (1910); J. Soc. Chem. Ind. 29, 704 (1910).

"The flocculation of linseed oils in the boiling process is not always due to the presence of carbohydrates or proteins from the seed, but is often caused by adulteration with a fatty acid glyceride, which polymerises at a temperature of 240°-260°C., yielding insoluble gelatinous products. When the polymerisation sets in, linseed oil is enclosed in the solidifying jelly, but on further heating and stirring, the jelly suddenly breaks, and spongy, slimy flakes separate. These flakes rapidly harden in the presence of air in the blowing process and frequently ignite spontaneously, causing explosions and fires in the boiler. Chief among the adulterating oils in question, are Chinese wood oil and candlenut oil. Genuine, pure, but "thin" linseed oils show no apparent gelatinisation, but skins and flakes, which lead to explosions, may be formed. The phenomenon in this case differs from that observed with an adulterated oil, in that the oil becomes brown or black and pitchy and yields a useless product. Normal linseed oils containing even a few tenths of a percent of wood oil gelatinise on heating to 240°C., but remain pale in colour, and the odour of the wood oil is pronounced. Certain treated, quick-drying train oils behave in linseed oil in the same manner as wood oil; these also are recognised by their odour on heating. Only the "thin" qualities of linseed oil are liable to this adulteration, since the adulterating oils are far more viscous than normal linseed oil. The phenomena of gelatinisation are not necessarily caused by deliberate adulteration; they are produced, for instance, if a barrel or vessel, having contained wood oil, is subsequently used for linseed oil. In practice the danger of spontaneous ignition in blowing is avoided by heating the oil for a long time at 150°-260°C., allowing the polymerised flakes to settle, and decanting off the clear oil before blowing. The polymerised residues are worked up separately for oil-lacquers, for which they are said to be eminently suitable." From J. Soc. Chem. Ind.

Hilditch, T. P.
CURRENT WORK AT THE UNIVERSITY OF LIVERPOOL ON POTENTIAL SOURCES OF DRYING OILS.
J. Oil & Colour Chemists' Assoc. <u>32</u>, 5-23 (1949); C.A. <u>43</u>, 4025 (1949).

"An address on the low-temp. crystn. of an Argentine linseed oil (I) and investigations of the oils from the seeds of Tetracorpidium conophorum (II) vine, rubber tree, sunflower, safflower, Niger, and Chinese tallow tree, with a report on the culture of II vine from seeds.***** The absorption spectrum of com. Chinese tallow-seed oil indicated the presence of eleostearic acid presumably from the addition of tung oil. It was pointed out that the excellent drying properties of Chinese tallow oil are not compatible with the composition as reported by Jamieson and McKinney." From C. A.

Hilditch, T. P., Morton, R. A., and Riley, J. P.
SPECTROGRAPHIC DETERMINATION OF LINOLEIC, LINOLENIC, AND ELEOSTEARIC ACIDS.
Analyst <u>70</u>, 68-74 (1945); C.A. <u>39</u>, 2269-70 (1945).

"Satd. aliphatic compds. are transparent except in the ultraviolet region and require a vacuum spectrograph. An ethylenic linkage displaces the selective absorption in the direction of longer wave lengths, but the shift of the max. remains below 215 mμ as a rule. Two conjugated double bonds bring about a shift to 230-235 mμ and 3 double bonds to 265-275 mμ. From the value of $E^{1\%}_{1\,\mathrm{ml.}}$ at 268 mμ after isomerizing with KOH in alc. at 170° for 15 min., the linolenic acid can be estd. and from the value of $E^{1\%}_{1\,\mathrm{ml.}}$ at 180° after isomerizing for 60 min., the value of linolenic acid can be estd. When both acids are present, the increment of $E^{1\%}_{1\,\mathrm{ml.}}$ at 234 mμ due to conjugated dienes produced from linolenic acid must be taken into consideration; pure linolenic acid isomerized at 180° for 60 min. shows a value of $E^{1\%}_{1\,\mathrm{ml.}}$ at 234 mμ of 569. Mixts. of linoleic acid and linolenic acids behave additively as far as isomerization data are concerned and are not affected by the presence of eleostearic acid; the technique can be applied to the analysis of sunflower-seed oil, niger-seed oil, linseed oil, tung oil and a mixt. of the last two. Bibliography and considerable analytical data." From C. A.

Ho, K., Wan, C.S., and Wen, S.S.
THE DETERMINATION OF THE IODINE NUMBER OF TUNG OIL. I. EFFECT OF TIME, CONCENTRATION AND TEMPERATURE.
Chem. Ind. (China) 8, 128-44 (1933)*; C.A. 28,4253 (1934).

"I no. by the Wijs method increased with time and did not become const. even after 12 days; it also varied inversely as the amt. of oil sample. The amt. of Wijs soln. should not be more than 39% in excess." From C. A.

Ho, K., Wan, C.S., and Wen, S.S.
IODINE VALUE OF TUNG OIL. EFFECT OF TIME, EXCESS OF WIJS' REAGENT, AND TEMPERATURE.
Ind. Eng. Chem., Anal. Ed. 7,96-101 (1935); Brit. Chem. Abstracts B, 508 (1935).

"The I val. (I) of tung oil varies (166.8-199.6) when halogenation (II) proceeds for 0.5 hr.-12 days at room temp. (I) varies directly as the amount of available I per g. of oil and not as the % excess of Wijs' solution. (I) increases with rise in temp.; a rise of 10% nearly doubles the rate of (II). An empirical formula is deduced which expresses these relations." From Brit. Chem. Abstracts.

Hoepfner, W., and Burmeister, H.
METHODS OF EXAMINING CHINA WOOD OIL.
Chem. Ztg., 37, 18,39 (1913); C. A. 7, 1424 (1913).

"In 24 samples of oil the I no. (Hübl) varied between 156 and 71 and n_D^{20} averaged 1.5175 (cf. Wise, C. A. 6, 2544). These are the most significant consts. and when coupled with Bacon's method for standardizing the gelatinization test (C.A. 7, 269) give a fair estimate of the purity of the oil. Drying tests, densities and sapon. nos. are of minor importance. H. and B. modify Bacon's test by heating the oil for 12 min. at 310° (instead of 9 min. at 280°)." From C. A.

Holde, D.
UNIFORM METHODS IN TESTING FATTY OILS.
Chem. Rev. Fett- u. Harz-Ind. 5 (3), 41-3 (1898).

Discussion of method for determining I no. and sapon no.

Holde, D., Bleyberg, W., and Aziz, M. A.
TUNG OIL.
Farben-Ztg. 33, 2480-4 (1928); C.A. 23, 1761 (1929).

"The I value (Hanus) of tung oil has been found to rise markedly with increasing time of reaction from 1/4 hr. to 2 hrs., and afterwards to remain steady at 230-240, corresponding to satn. of the 3 double linkings of the eleostearic acid present. A 0.2 N soln. of I bromide in CCl_4 gave a similar result in 3 hrs. Since with other vegetable oils a constant I value is obtained after 1/4 hr., it is suggested that the presence of tung oil in linseed oil might be recognized quantitatively by observation of an I value increasing with the time of reaction and vice versa. In the case of β-eleostearic acid, the I value rose from 176 to 279 during

1/2-2 hrs' treatment (45% excess of I bromide); 60% excess of the reagent gave I values up to 300, and, in a few cases, values up to 350 (equiv. to 4 double linkings) were attained, resulting possibly from the occurrence of substitution or of traces of water in the glacial acetic acid, etc. Solns. of I or Br alone were less reactive than was I bromide." From C. A.

Holde, D., Bleyberg, W., and Aziz, M. A.
TUNG OIL. II.
Farben-Ztg. 33, 3141-4 (1928); C. A. 23, 2049 (1929).

"The I value (Hanus) obtained for eleostearic acid is influenced by the time of reaction (loc. cit.), the presence of light, and the mode of prepn. of the I-Br. reagent. Attempts were made to det. the extent of halogen substitution or secondary dehalogenation by detg. the halogen acids in the reaction mixt. after titration with thiosulfate. Only one-fourth to one-fifth of the I apparently absorbed could be accounted for by the halogen retained by eleostearic acid; the remainder was recoverable from the aq. soln. and appeared to be due, at least in part, to a secondary elimination of halogen acid. It could not be ascertained at what stage in the Hanus test this sepn. occurred, but it is suggested that there is a tendency for the 6-membered chain constituting the triple conjugated linkings to close, by the addn. of halogen to the terminal C atoms and subsequent elimination of halogen hydride, leaving hydroaromatic or aromatic derivs." From C. A.

Holley, C. D.
FURTHER INVESTIGATION OF THE ANOMALOUS DISPERSION OF CHINA WOOD OIL.
Drugs, Oils & Paints 31, 361 (1916); C. A. 10, 1601 (1916).

"Turpentine gives a 'turning point' when 15% by vol. is added to tung oil. Rosin oils are not as sensitive as vegetable oils in influencing the 'turning point', and their acid no. has little effect. Damars and ester gums of rosin act similarly to rosin oils. Detailed results are tabulated." From C. A.

Hulst, I.L.J.N. van der
APPLICATION OF ABSORPTION SPECTRA IN FATTY OIL RESEARCH. I. & II.
Rec. trav. chim. 54, 639-50 (1935); C. A. 29,6782 (1935).

"Curves are shown for acetic, elaidinic, linoleic, eleostearic and stearoleic acids, Me acetate, Et oleate, Et and Me linolate. Differences between curves of impure and purified materials indicate that the absorption spectrum might be used for detection of such compds. II. Ibid. 644-50. -- At least an approx. estn. of the amt. present of strongly absorbing compds. is possible. If the log Km of a binary mixt. is obtained, and those of the components (A and B) are known, then at the same wave length the concn. x of A follows from the equation, $Km = xK_A + (1 - x)K_B$. For more than 2 components other equations may be derived at different wave lengths." From C. A.

Jenkins, J.H.B.

HEHNER'S BROMINE TESTS OF OILS.

J. Soc. Chem. Ind. 16, 193-5 (1897).

A number of oils were tested for unsaturation by both the Hübl iodine method and the Hehner bromo-thermal and bromogravimetric methods (Analyst, Mar. and July, 1895). Agreement was good for neatsfoot, castor, olive and rape but poor for blown rape oil, blown cotton oil and Japanese wood oil. The origin and composition of the latter was not well understood but the author considered it to be "practically the same as Chinese oil."

Jordan, L.A.

TUNG OIL. CHEMICAL STUDIES AND SPECIFICATIONS.

J. Soc. Chem. Ind. 53, 1-11T(1934); C. A. 28,1877 (1934).

"A lecture covering the detn. of complete and partial satn., gelation by heat and polymerization. The heat test is reviewed and a new method of test which has been in use for some time described. The complete compn. of 11 Empire tung oils is given." From C. A.

Jordan, L.A.

TUNG OIL FROM ALEURITES MONTANA AND SPECIFICATION TESTS.

J. Soc. Chem. Ind. 53, 21-2T(1934); C.A. 28,2201 (1934).

"Examn. of Aleurites montana oil shows in comparison with Aleurites fordii oil a lower content of eleostearic glyceride, which is the chief polymerizing component of both types of tung oil. As the former will be available as a trade material the following specifications are suggested: I no. 155 (Wijs), n_{20} 1.5130, $d_{15.5}$ 0.934; the heat test should not exceed 12 min. and 30% extractive by the Paint Research Sta. method." From C. A.

Kaufmann, H. P.

THE THIOCYANATE NUMBER OF FATS AND ITS APPLICATION.

Seifensieder-Ztg. 55, 297-300 (1928); C. A. 22, 4845 (1928).

"A reply to Dittmer's criticism (C. A. 22, 2476), with an historical review of the method and some new data and details. A large excess of thiocyanate (up to 500%) does not influence the accuracy of the results, as is the case with a large excess of I in the detn.of the I. no. To obtain anhyd. glacial AcOH, the 99-100% variety is treated with 10% acetic anhydride and warmed under reflux. The anhyd. Pb thiocyanate (5 g.) is placed in 200-cc. glass-stoppered bottles and the latter filled with above prepd. AcOH and allowed to stand until used, when 0.6 cc. Br is flowed into the bottle, and shaken until colorless; the soln. is then filtered and ready for use. Oleic, petroselinic, erucic, ricinolic and elaidinic acids add only 1 mol. thiocyanate, thereby making the thiocyanate no. equal to the I no.; linolic acid adds thiocyanate to only 1 of its 2 double bonds and eleostearic acid to only 1 of its 3 double bonds. K. gives numerous examples to show the accuracy of the new method, comparing results obtained by other methods." From C. A.

Kaufmann, H. P.

DETERMINATION OF THE SATURATED CONSTITUENTS OF FATS BY THE THIOCYANATE NUMBER.

Z. angew. Chem. 41, 1046-8 (1928); C. A. 23, 293 (1929).

"The thiocyanate no. for triolein is 86.06 and for trilinolin 86.65, mean 86.36; then the satd. constituents X = 100/86.36 (86.36 — thiocyanate no. found) or: 100 — 1.158 X thiocyanate no. found. For the free acids (oleic and linolic) the equation becomes X = 100 — 1.108 X thiocyanate no. The following values were calcd. In the first formula the figures representing the thiocyanate no. and the % satd. glycerides are, resp.: coconut oil 8.24, 90.5; palm kernel 12.97, 85.0; babassu fat 15.17, 82.4; milk fat 21.7, 74.9; cacao butter 34.5, 60.1; mutton tallow 38.5, 55.4; beef tallow 39.4, 54.4; lard 44.21, 48.8; peanut 72.38, 16.2; sesame 75.7, 12.0; olive 76.5, 11.4; corn 77.10, 10.7; wood oil 78.0, 9.7; poppyseed 78.7, 8.9; sunflower 79.50, 7.9; almond 81.66, 5.4. A graph is shown which eliminates calcn." From C. A.

Kaufmann, H. P. and Baltes, J.

DIENE SYNTHESIS IN THE FIELD OF FATS. I. THE DIENE NUMBER OF FATS.

Fette u. Seifen 43, 93-7 (1936); C. A. 30, 7885 (1936).

"Conjugated double bonds present in fats or fat acids can be detected and detd. by reaction with an excess of maleic anhydride (I), sepn. of the reaction product and titration of the unreacted I. Weigh out a 0.1-0.15-g. sample (a larger sample with substances having a lower diene no.) into a small glass sample tube and place the latter in a small Jena glass bomb of 20-cc. capacity. Add 10 cc. of a soln. of 10 g. of resublimed I in 1 l. very pure Me_2CO. After sealing the bomb, heat 20 hrs. to 100° in a paraffin bath. After cooling and opening the bomb, rinse the contents with 80 cc. CO_2-free water into a 250-cc. Erlenmeyer flask, using a small amt. of NaCl to hasten sepn. of the fat material in filterable form. After allowing to stand 6-8 hrs., filter and titrate the filtrate with 0.1 N NaOH, using a 1% soln. of phenolphthalein in alc. as an indicator. Run a blank at the same time and det. by difference the amt. of I reacted. Since one mol. of I reacts with one double bond (forming part of a conjugated system) it is possible to express the extent of the reaction of the double bonds with I in terms of I-no. equivs. This value (the diene no.) is equal to (1.269 X a)/sample wt., where a is the no. of cc. of 0.1 N NaOH which would be required to neutralize the amt. of I that has reacted with the sample. Expts. with β-eleostearin showed that one mol. of I was added quantitatively per acid radical when the time of reaction was 10-15 hrs., depending on the size of the sample. Anthracene reacted quantitatively with I within 26 hrs., while 9,11-octadecadienecarboxylic acid (II) reacted with one mol. of I after 18 hrs. Two samples of tung oil had diene nos. of 68 and 70, corresponding to a β-eleostearin content of 78 and 80%, resp. The β-eleostearin content of mixts. of varying proportions of tung oil and olive oil was detd. readily by the diene no. method. The reaction of II with I in a closed tube at 90-100° for 5 hrs. with benzene as solvent yielded 6-hexyl-3-(ω-carboxyoctyl)-1,2,3,6-tetrahydrophthalic anhydride (III), m. 94.5°, dissolving readily in hot Et_2O or benzene but only slightly in hot petr. ether and forming water-sol. Na and NH_4 salts and an insol. Ag salt (cf. C. A. 25, 913). On boiling III with excess aq. KOH, acidifying and extg. with Et_2O, and evapg. the solvent, a bright yellow, uncrystallizable oil was obtained. β-Eleostearic acid with I yielded 3-butyl-6-(ω-carboxy-α-nonenyl)-1,2,3,6-tetrahydrophthalic anhydride, m. 67-8° after repeated recrystn. from MeOH (cf. C. A. 26, 5545)." From C. A.

Kaufmann, H. P., and Baltes, J.
TUNG OIL AND OITICICA OIL. A CHEMICAL STUDY BY THE DIENE SYNTHESIS METHOD.
Paint Varnish Production Mgr. 16, 32,34 (April 1937); C. A. 31, 5603 (1937).

This is a shortened report in English of the work previously presented by the same authors in "The field of fats. XXX. Diene synthesis in the field of fats. 2. Composition of Chinese wood oil." Ber. 69B, 2676-9 (1936) and XXXI. Oiticica Oil. Ibid. 2679-83. See C.A. 31, 2032-3 (1937).

Kaufmann, H. P., Baltes, J., and Büter, H.
THE FIELD OF THE FATS. XXXV. DIENE SYNTHESES IN THE FIELD OF THE FATS. 4. IODIMETRIC DETERMINATION OF THE DIENE NUMBER. DIENE NUMBERS OF VARIOUS FATS AND THEIR UTILIZATION.
Ber. 70B, 903-11 (1937); C. A. 31, 4837-9 (1937).

"The alkalimetric detn. of diene nos. (C. A. 30, 7885^2) requires a sepn. of the water-insol. addn. product (I) with maleic anhydride (II) from the nonreacting fat components, and as the I forms an emulsion when pptd. from the acetone solution with water it can be filtered off only after having been allowed to stand for some time. At the same time there is a possibility of reaction with atm. O. These disadvantages could be avoided if the excess of II (or the acid formed from it) could be detd., as soon as the reaction is completed, in the presence of the I and accompanying substances. It has been found that, in the absence of the lower fat acids, the excess of II can be detd. iodimetrically in aq. mediums. II in contact with water gives the free maleic acid which reacts with $KI-KIO_3$ according to the equation $3(:CHCO_2H)_2 + 5KI + KIO_3 = 3(:CHCO_2K)_2 + 3I_2 + 3H_2O$; if an excess of $Na_2S_2O_3$ is added the reaction is quant. Thus, 10 cc. of 0.1 N II in acetone treated in a pressure flask with 50 cc. water, 15 cc. each of 4% KIO_3 and 24% KI and 25 cc. 0.1 N $Na_2S_2O_3$, allowed to stand 2 hrs., then treated with 25 cc. 0.1 N I and titrated back with $Na_2S_2O_3$, gave results which agreed excellently with those obtained by the alkalimetric method. Moreover, this method permits of carrying out the diene synthesis in solvents which are immiscible with water but may accelerate the synthesis; the titration is carried out in the same way except that the mixt. is shaken frequently and vigorously during the period of standing. To det. the diene no. of a fat 0.1-0.15 g. of the sample in a Jena glass capsule is sealed with 10 cc. of a standardized soln. of II (9.8016 g. per l.) in benzene, toluene or xylene in a 20-cc. Jena glass ampule and heated 20 hrs. at 100°, and the contents are then washed with 20 cc. benzene and 20-30 cc. water into a 250-cc. flask with ground-glass stopper and titrated as above. Or the sample is refluxed 15 hrs. in a 250-cc. flask with 10 cc. of the soln. of II in toluene, the condenser is washed down with 20 cc. each of toluene and water, and the excess of II is titrated. The latter method always gives somewhat low diene nos., probably because of the action of atm. O on the sensitive diene fat acids. Acetone can be used as solvent with pure glycerides, but not always with the free fat acids. It had already been observed (C. A. 30, 7885^2) that linseed oil has a diene no. It has since been found that many other fats also have diene nos. while, on the other hand, there are some oils with diene nos. practically zero, as shown by the following list: Merck triolein 0, palm-kernel oil 0, cacao butter 0, peanut oil 4.8-5.3, crude rapeseed oil 11.8-12.3, poppyseed oil 13.0-3.3, almond oil 8.0-8.4, cherry-kernel oil, crude cottonseed oil 4.7-5.0, freshly extd. soja oil 9.9-10.3, crude soja oil 8.5-8.9, freshly extd. linseed oil 8.1-8.2, crude linseed oil 7.4-7.7, D.A.B. VI linseed oil 7.7-8.04, wood oil I 67.3-7.8, wood oil II 69.1-9.8. Hence fats which, as far as is known, contain no conjugated unsatd. acids have diene nos. Side reactions of II, such as esterifications, are excluded in the absence of water. It must be concluded, therefore, that fats which have diene nos. contain double bonds which can react with II. The free acids of fats which have diene nos. but contain no known acids with conjugated systems show no diene nos. when isolated from the fats; either the unsaponifiable portion is responsible for the diene nos. or in the sapon. process (which was effected in the cold) the diene fat acids are altered. This question is to be investigated further. Unsaponifiables isolated under the mildest possible conditions gave diene nos. of an order of magnitude which could not explain the diene nos. of the fats themselves. In the partial sapon. with cold alc. KOH of a linseed oil of diene no. 7.9, the diene no. of the half-sapond. product was only 1.3-1.7. It may be concluded, therefore, that many fats contain unsatd., very labile substances which are as yet unknown." From C. A.

Kaufmann, H. P., and Kirsch, P.
ADSORPTION SEPARATION IN THE FIELD OF FATS. V. THE INCREASE IN THE MOLECULAR SIZE OF UNSATURATED ACIDS AND OF THEIR ESTERS AS THE BASIS FOR THE DRYING PROCESS AND THE MANUFACTURE OF SURFACE-COATING MATERIALS. III. THE FRACTIONATION OF GLYCERIDES.
Fette u. Seifen 49, 841-54 (1942); C. A. 37, 6481 (1943).

"The methods for the sepn. of glycerides are reviewed based on phys. or chem. methods or on the use of surface-active materials. Among the phys. methods discussed are crystn. and fractionation by the use of solvents. The chem. methods include reësterification, elaidin formation, oxidation, hydrogenation and bromination. Sepn. by adsorption method with Al_2O_3 and silica gel are reported for blown and oxidized linseed, rapeseed and China wood oils. In general, Al_2O_3 adsorbs the constituents of high mol. wt. while the reverse is true of silica gel. A blown linseed oil with a viscosity of 113 centipoises was sepd. with Al_2O_3 into a filtrate of 62 centipoises and an adsorbed portion of 928 centipoises. With silica gel as the adsorbent the corresponding viscosities were 154 and 106." From C. A.

Kaufmann, H. P. and Kirsch, P.
CONJUGATED UNSATURATED COMPOUNDS IN THE CHEMISTRY OF FATS. I. THE DETECTION OF CONJUGATED UNSATURATED FAT ACIDS BY MEANS OF THE TETRANITROMETHANE REACTION.
Fette u.Seifen 50, 314-16 (1943); C. A. 39, 205 (1945).

"Fats and fat acids contg. conjugated double bonds give intense red colors with $C(NO_2)_4$; nonconjugated unsatd. compds. give yellow colors. The intensity of the red color is much greater with 3 than with 2 conjugated double bonds. Tung oil, oiticica oil, parinarium and trichosanthes oil give a reddish yellow color in a diln. of 1:1000. The test can be carried out by adding 0.2 cc $C(NO_2)_4$ to 0.5 g. oil or fat acid in 0.5 g. $CHCl_3$, and further dilg. with $CHCl_3$ if the color is too dark." From C. A.

Kaufmann, H. P. and Hartweg, L.
THE FIELD OF FATS. XLVIII. MESO- AND MICROANALYTICAL METHODS IN THE FIELD OF FATS. 1. IODINE NUMBER AND DIENE NUMBER.
Ber. 70B, 2554-9 (1937); C. A. 32, 1961 (1938).

(In accordance with a suggestion by Wieland in the introduction to the 1937 edition of Gattermann's Die Praxis des organischen Chemie, meso is used instead of semimicro.) The purpose for which this systematic investigation was undertaken was not so much a reduction in the amts. of materials used as a shortening of the time required for the detns. In the present paper are described methods for the detn. of I and diene nos. I no.--The reagents are 0.1 N Br in MeOH satd. with dry NaBr, 10% KI, 0.05 N $Na_2S_3O_3$and alc.-free $CHCl_3$. The fat (0.01-0.015 g.) in a weighing tube is dissolved with 2 cc. $CHCl_3$ in a 150-cc. I-no. flask, exactly 5 cc. of the Br soln. is run in from a Derona microburet, the mixt. is shaken until the Br addn. is complete (generally 1 min. suffices for fats having I nos. up to 110, 5-10 min. for fats with higher I nos.), 3 cc. of KI is added, and the liberated I is titrated with the $Na_2S_2O_3$. In expts. of such short duration, diffuse daylight has no influence. Results obtained with elaidic acid, coconut, castor, beet, beechnut, soy and linseed oils, linseed oil fat acids and cholesterol are given. Diene no.--The technic is the same as in the previously described macromethod (C. A. 31, 4837^7), but only 0.01-0.02 g. of sample is used in ampoules of 10-cc. capacity, with 0.2 N maleic anhydride soln., and the ampoules are heated only 2 hrs. at 130°. The results obtained on wood and oiticica oils after heating for varying lengths of time (1-12 hrs.) at 100° and 130° are given.

Kaufmann, H. P. with Lutenberg, Ch.
THE FIELD OF FATS. XIII. PARTIAL HALOGEN ADDITION TO MULTIPLY UNSATURATED FATTY ACIDS. BETA-ELEOSTEARIC ACID GLYCERIDES AND WOOD OIL.
Ber. 62B, 392-401 (1929); C. A. 23, 3360-1 (1929).

"Eleostearic acid (I) and its glyceride, (II), which are readily available and can be prepd. in pure form, afforded welcome exptl. material in K's search for a method of partial halogen addn., which could be detd. quantitatively by titration. It had already been shown that in the action of Br in MeOH (satd. with NaBR) on II there is a distinct halt in the addn., corresponding to the consumption of 2 mols. Br; on continuing the action for several days, I nos. approaching that corresponding to 3 double bonds are obtained; the latter is reached quickly with Br in CCl_4 in the light of a uviol lamp. Hitherto, however, it had not been possible to obtain titrimetrically with halogen a definite halting point corresponding to 1 double bond, such as can be secured with $(SCN)_2$. The object of the present work was to obtain a sharper endpoint in the addn. of Br to 2 double bonds and to establish, if possible, the conditions for adding halogen, in a titrimetrically controllable manner, to 1 double bond. By using Br in CCl_4 in the dark on pure II and Chinese wood oils, the values obtained for 2 double bonds are so const., as compared with the results of other methods hitherto known, that the process is recommended for the detn. of the I no. of the wood oils. Addn. of KIO_3, at the end of the detn., and titration of the I liberated by the acid present, shows that only a very slight amount of acid is formed in the process and that therefore, no appreciable substitution has occurred. If, however, the I no. detn. is made with Br in MeOH satd. with NaBr instead of in CCl_4, and KIO_2 is added at the end of the expt., almost all of the halogen is recovered. Substitution of alc. NaI for the aq. KI had no detectable influence on the results. To effect with halogens what had already been accomplished with $(SCN)_2$, i.e., addn. to only 1 double bond, it was necessary to diminish greatly the reactivity of the halogen. Numerous attempts were made to secure the result by using substances holding Br in loose combination, such as org. perbromides (azo-benzene perbromide), but none of these solns., fulfilled the condition of titrimetric constancy. The desired object was finally attained by combining the Br in MeOH not only with NaBr but also with I, numerous trials showed that the best results were obtained by using equiv. amounts of Br and I in NaBr-MeOH and by dissolving the fat in equal vols. of $CHCl_3$ and CCl_4." From C. A.

Klatt, R.
STUDIES OF THE IODINE NUMBER OF DRYING OILS WITH REFERENCE TO MARGOSCHES' RAPID METHOD.
Chem. Umschau Fette, Oele, Wachse Harze 39, 225-6 (1932); C. A. 27, 617 (1933).

"The difficulty in obtaining consistent results with Margosches' rapid I no. method (cf. 'Chemische Analyse' 1927, p. 121 by Margosches and C. A. 18, 2436), especially for wood or fish oils, is overcome by substituting for the 10-15 cc. alc. a mixt. of 10 cc. ether-acetone (1:2) or a mixt. of 10 cc. amyl alc.-abs. alc. (1:4); in the latter case add the 2 cc. amyl alc. first, then weigh in the oil and add 8 cc. abs. alc." From C. A.

Klee, Leo and Benham, G. H.
THE DETERMINATION OF THE TRUE IODINE NUMBERS OF OILS CONTAINING CONJUGATED DOUBLE BOND SYSTEMS.
J. Am. Oil Chemists' Soc. 27, 130-3 (1950); C. A 44, 5119 (1950).

"The modified Rosenmund-Kuhnhenn procedure (C. A. 17, 3172) has been applied to conjugated systems. The only difference is that the 1 min. reaction time is extended to 30-120 min. depending upon sample wt. and excess reagent. This procedure gives true I nos. and has been investigated for various tung oils, oiticica oil, isomerized fatty acids, and dehydrated castor oil." From C. A.

Kok, W.J.C. de, Waterman, H.I., and Westen, H.A. van
THE HYDROGEN VALUE AS A MEANS FOR MEASURING UNSATURATION.
J. Soc. Chem. Ind. <u>55</u>, 225-8T (1936); C. A. <u>30</u>, 7929-30 (1936).

"Detn. of the H value, rather than halogen values, is preferable for many unsatd. org. compds. By using Pd and Pt on active C as catalysts, olefinic and aromatic unsatn. can be separately detd. The app., prepn. of the catalysts, and methods for volatile and nonvolatile compds. are described in detail. The results given for 17 compds. and for tung oil show low Br and I but theoretical H values for di- and triolefins." From C. A.

Ku, P. S.
DIRECT DETERMINATION OF ELEOSTEARIC ACID IN TUNG OIL.
Ind. Eng. Chem., Anal. Ed. <u>9</u>, 103-6 (1937); C. A. <u>31</u>, 3715 (1937).

"The method is based on the different solubilities of the fat acids of tung oil in 76% EtOH at 0°, these are (in g. per 100 g. satd. soln.) for eleostearic acid (I) 0.614, stearic 0.22, palmitic 0.105 and oleic 28.0. The tung-oil sample is sapond., acidified at 41° for 10 min., the fat acids are dissolved in 76% EtOH, cooled to, and filtered at 0°, and washed once with 60% EtOH at 0°. The crystals of I are dissolved in EtOH and titrated. The error of this method was estd. and the necessary correction ascertained. The method has been found satisfactory with commercial and also with pure samples. For the former the values of I obtained are 75.5-7.5%, for the latter 75.8-7.0%. The method is applicable to adulterated tung oil and may be used to detect 2% or more of common adulterants." From C. A.

Ku, P. S.
DIRECT DETERMINATION OF ELEOSTEARIC ACID IN TUNG OIL. CORRECTION.
Ind. Eng. Chem., Anal. Ed. <u>9</u>, 588 (1937); C. A. <u>32</u>, 884 (1938).

"Comments on the precision of the measurements and the use of significant figures." cf. C. A. <u>31</u>, 3715. From C. A.

Leppert, Z., and Majewska, Z.
DETECTION OF WOOD OIL.
Przemysł Chem. <u>18</u>, 471-3 (1934)*; C. A. <u>29</u>, 6080 (1935).

"A drop of 90% H_2SO_4 is placed on a drop of oil; when this contains not less than 10% of wood oil, the drop of acid does not spread, but rapidly darkens and assumes a polygonal contour. The reaction serves for mixts. with raw, boiled and aërated linseed oils." From C. A.

Liao, Cheng-chung
THE IODINE VALUES OF CHINESE TUNG OIL.
Chemistry (China) <u>3</u>, 538-49 (1936)*; C.A. <u>31</u>, 891 (1937).

"A review of the method and theory of I value detn., with a table of I values of tung oils from various sources (both Chinese and foreign) appended." From C. A.

Ling, Thomas T. G.

TUNG OIL TESTING DEPARTMENT.

China. Ministry of Industries. Hankow. Bur. of Inspection and Testing of Commercial Commodities. Bull. 1, 10 pp., 14 diagrs.

"During 1930 there were 774 analyses made in the Tung Oil Testing Department on a total quantity of 937,707.11 piculs (1 picul = 133 1/3 lbs.) of tung oil exported to foreign countries from Hankow. Most of the oil came from Szechuan, Hunan, Hupeh and Anhui provinces. It was shipped to many foreign countries, including the United States of America, Great Britain, Germany, France, Holland, Denmark, Italy, Belgium, Sweden, Austria, Norway, Hungary, Spain, Finland, Japan, New Zealand, Australia and India. The United States of America consumed almost 80% of the total quantity exported.

"The limits of the average results of the analyses on tung oil during 1930 were found to be as follows: Specific gravity (15.5°), 9410-0.9418; Acid Number (Alcohol/Benzol), 2.2-6.5; Refractive Index (25°C.), 1.5164-1.5170; Saponification Number, 191-192.6; Iodine number (Wijs), 166.2-166.9; Heating test (Browne), 10-10.5 min.; Worstall's test, 6 min. 26 sec.-7 min. 20 sec.

"The acid number of tung oil is not a constant but a variable. It started to rise in June, as shown on Curve II. High temperature in the summer months had a great effect upon the acid number. The enzyme action or the hydrolysis of the oil is probably accelerated by heat. The high acidity usually causes long Heating Test and Worstall Test. However, it is not the only factor which determines the time of the Heating Test and the Worstall Test.

"Five times during the year tung oil intended for export to foreign countries, by four different firms, was found by our laboratory to be adulterated with mineral oil. The quantity of this adulterated oil amounted to 1647.33 piculs. The firms were notified and prevented from shipping this oil. These firms were probably not to blame in this matter, for they bought the oil after it had passed the Refractive Index and the Worstall Tests. However, we have found that these two tests alone are not sufficient to show the adulteration." From Summary of the Testing of Tung Oil during 1930.

Loon, J. van

THE APPARENT IODINE NUMBER OF CHINESE WOOD OIL.

Chem. Umschau Fette, Oele, Wachse Harze 37, 175-7 (1930); C. A. 24, 4413-4 (1930).

"Analytical work is reported which shows that the detn. of the I no. as usually carried out gives varying results, depending upon (1) the type of halogen soln., (2) the duration of reaction, (3) the excess of halogen. The true I no. can be detd. only with a great excess of halogen soln. and a sufficiently long reaction time (7 days for ICI and Br soln.)." From C. A.

Loon, J. van

THE APPARENT IODINE NUMBER OF CHINA WOOD OIL AS A CRITERION FOR ITS PURITY.

Chem. Umschau Fette, Oele, Wachse Harze 37, 229-32 (1930); C. A. 24, 5515 (1930).

"Duration of I absorption and excess of I are the factors that influence Hübl no. Detn. These conditions were standardized by using

25 cc. Wijs I soln. and absorbing I for 2-1/2 hours. L. then varied the amt. of oil used for analysis from 20.8 to 557.1 mg., thereby varying the excess of I present. Using pure China wood oil, a curve was drawn for the 'apparent I no.,' the wts. of oil forming the abscissas. The formula

$$X = \frac{(5 X A)}{(B X t)}$$

(A = wt. of oil in mg., B = cc. thiosulfate used for blank, t = 0.1, the titer of thiosulfate) expresses the wt. of pure China oil which would correspond to the I no. found by analysis of the sample in hand. The reading for the I no. on the standard curve for this calcd. wt. of oil should agree with the I no. detd. if the sample has been pure." From C. A.

Loon, J. van
THE IODINE NUMBER OF FATS AND FATTY ACIDS.
Verfkroniek 4 (6), 18-20 (1931); C. A. 26, 1814 (1932).

"The detn. of the Wijs I no. is discussed. For various oils the value increases with the time of reaction after the normal period of 1.5-2 hrs. has elapsed; for their fatty acids the value is more const. Exceptions are: (1) hydroxy acids and oils contg. them the I no. of which increases after 12 hrs., (2) wood oil, which is satd. very slowly, taking perhaps a week to come to a const. value; the same is true for oiticica oil (couepic acid) and po-yoak oil, both contg. stereoisomers of eleostearic acid; (3) oils with considerable unsaponifiable matter, on which ordinary I no. detns. cannot be made; the I nos. of their acids can, however, be detd.; (4) polymerized oils or acids, which can only be dealt with by hydrogenation, as their I nos. are too high; (5) the 6,7-stearolic acid with acetylene bond from seeds of Picramniaceae, which is only half satd. by by I." From C. A.

McIlhiney, P. C.
A METHOD OF EXAMINING CHINA WOOD OIL.
J. Ind. Eng. Chem. 4, 496-7 (1912); C. A. 6, 2544 (1912).

"The oil, dissolved in glacial AcOH, is treated with an AcOH solution of I (15 g. per l). Solid product seps. which is repeatedly washed with petroleum (b.p. 80°) to ext. liquid portions of oil. Water is added, the petroleum layer sepd., washed, evapd. Residue represents proportion of constituents not solidified by I. No figures given owing to difficulty in obtaining authentic samples. Method valuable in detg. grade of oil." From C. A.

McKinney, R. S., Halbrook, N. J., and Rose, W. G.
A STUDY OF THE ELLIS-JONES MALEIC ANHYDRIDE METHOD AND ITS USE IN TESTING TUNG OIL.
Oil & Soap 19, 141-3 (1942); C. A. 36, 6360 (1942).

"Four tables of results are given. The maleic anhydride value obtained for a mixt. divided by the maleic anhydride value of the tung oil (70.6) gives a fair approximation of the percentage of tung oil in the various mixed samples of tung with linseed or perilla oil. On calcg. from the values obtained, it appears that the presence of

10% of linseed oil in tung oil will lower the maleic anhydride values to 63.8. This value is lower than that of any authentic sample of tung oil. The detn. of maleic anhydride may serve as a means for detecting and roughly estg. adulteration of tung oil." From C. A.

Marcille, R.

DETERMINATION OF THE BROMO-DERIVATIVE NUMBER OF OILS.

Ann. fals. 26, 393-8 (1933); C. A. 27,5999 (1933).

"The method recommended for the detn. consists essentially in weighing exactly about 1 g. of oil in a tared centrifuge tube (provided with a screwed-in glass stopper), adding 30 cc. Et_2O, letting stand 10 min. in ice water, adding 0.5-1.5 cc. Br. (according to the nature of the oil) in 0.2-0.25-cc. portions with gentle shaking after each addn., letting stand at least 3 hrs. in ice water, centrifuging, decanting, washing twice with Et_2O (preferably cooled in ice water) by centrifuging and decanting, evapg. the Et_2O and drying at 90-100°. Use of AcOH is unnecessary (Lombard, C. A. 27, 437) and gives low results. When fish oil is dild. with an oil giving no ppt. with Br, the bromo-deriv. no. of the mixt. is not proportional to the fish-oil content; e.g., a fish oil having a no. of 85 gave the following bromo-deriv. nos. (based on the actual wt. of fish oil in the mixt.) when mixed in the following proportions: 5% 60, 10% 63, 20% 68, 40% 77, 60% 80.5, 100% 85. The nature of the dilg. oil apparently is without influence, provided its bromo-deriv. no. is zero. The following values are reported for the various oils: soy-bean oil (fresh) 1.1, soy-bean oil (3 yrs. old) 0.3, China-wood oil trace Bombay linseed oil 44.7-48.1, purified linseed oil (for oil painting) 47.0." From C. A.

Marcusson, J.

DETERMINATION OF TUNG OIL.

Farben-Ztg. 35, 1203 (1930); C. A. 24, 2901 (1930).

"The unfavorable results of Wolff, Zeidler and Rabinowicz (C.A. 24, 1752) were probably due to failure to follow directions or to the presence of less than 15% tung oil in samples. Reply.. H. Wolff and J. Rabinowicz. Ibid. M.'s method sometimes fails to detect as much as 50% tung oil. For quant. results, it must be supplemented by other methods such as n." From C. A.

Margosches, B. M. and Fuchs, K.

CHEMICAL NATURE OF FATS. III. DETERMINATION OF THE DIFFERENCE BETWEEN THE PERIODINE NUMBER AND THE IODINE NUMBER OF A FAT: THE DIFFERENTIAL IODINE NUMBER.

Ber. 59, 375-6 (1926)*; Chem. Zentr. 1926, I, 2751; C. A. 20, 2083 (1926).

Values are reported for 18 oils. Wood oil gave the following values: I no., 171.7-178.8; periodine no. 224.9-231.1; differential iodine no. 52.3-53.2.

Marks, S. and Morrell, R. S.

DETERMINATION OF ORGANIC PEROXIDES.

Analyst 54, 503-8 (1929); C. A. 23, 5439 (1929).

"The object of this investigation was to discover a reliable method for detg. the peroxide-oxygen of oxidized linseed oil and of certain oxidation products of the glyceride of β-eleostearic acid. The following modification of Fahrion's method gave good results; Dissolve 0.2 g. of material in 25 cc. of glacial AcOH, add 2 cc of cold, concd. KI soln. and allow the mixt. to stand a few min. Dil. with 100 cc. of water and titrate with 0.1 N $Na_2S_2O_3$." From C. A.

Mazume, T.

A NEW COLOR REACTION FOR WOOD OIL.

Bull. Inst. Phys. Chem. Research (Tokyo) 9, No. 6, 451 (1930); C. A. 24, 6038 (1930).

"Maleic acid anhydride, likewise phthalic anhydride, reacts with wood oil in $CHCl_3$ soln. to give a characteristic yellow color." From C. A.

Meister

THE IODINE NUMBER OF LINOXYN.

Chem. Rev. Fett.- u. Harz-Ind.17,260-2(1910);C.A. 5, 384 (1911).

"In order to observe the progressive stages of the drying process of linseed oil two samples of good oil, treated at 150° with 3% fused resinate of Pb-Mn and drying in 6 hrs., were spread upon glass in thin layers, 0.6-0.7 mg. per sq. cm., and the I no. detd. every 2 hrs.; separate smaller plates were used to det. the gain in wt. The Hübl method was used for the I nos. but for the samples at 6 hrs. and after, it was necessary to use glacial AcOH as a solvent in place of $CHCl_3$. * * * The linoxyn became less sol. in AcOH with increasing oxidation. The oils tested were 2 months old. A parallel test carried out on wood oil produced an eleostearin which could not be brought into soln. by any of the ordinary solvents; a gain in wt. and a decrease in I no. was found after 2 hrs., though theoretically neither should occur when oleomargarin passes over into the isomeric eleostearin.

	Wood oil	original	2 hrs.	4 hrs.
I	Iodine no.	148.8	143.1	---
	Gain in wt., %	---	0.9	4.2
II	Iodine no.	144.9	138.9	---
	Gain in wt., %	---	0.6	5.0 "

From C. A.

Mikusch, J. D. von

THE IODINE VALUE OF TUNG OIL.

Oil & Soap 15, 186-8 (1938); C. A. 32, 6888 (1938).

"Tung oil has 2 true partial I nos. one around 90 and one around 160 corresponding to the points where 1 and 2 of the 3 double bonds of the eleostearate has added I, besides the true total I no. of 230. It has been detd. by expt. that the following method gives const. values for the partial I no. of tung oil with varying excess of Wijs soln.,time and temp. Weigh 0.12 to 0.15 g. of $CHCl_3$ and place the flask in a large beaker half-filled with cracked ice and H_2O and swirl gently for 1 min. Add 25 ml. of Wijs soln. prepd. according to the Am. Oil Chemists Society specifications. Continue swirling in the ice bath during and after addn. of the reagent. After 2 min. add 10 ml. of 15% KI soln. and 40 ml. of distd. H_2O. Titrate with 0.1 N $Na_2S_2O_3$ soln. using 1% starch soln. as indicator." From C. A.

Mikusch, J. D. von and Frazier, Charles
WOBURN IODINE ABSORPTION METHOD.
Ind. Eng. Chem., Anal. Ed. <u>15</u>, 109-13 (1943); C. A. <u>37</u>,1885 (1943).

"The quant. relationship, total I value — partial I value = diene value, can form the basis for detg. the diene value of fat acids and oils. The Woburn I method which makes use of IBr solns. 1.6 to 2 times the concn. of Hanus' soln. may serve to det. total I values. The partial I values can be detd. with Wijs soln. by limiting the contact to 2 min. at ice-bath temp. The modified Wijs method can be used to det. total unsatn. in nonconjugated fat acids by using the correct excess of reagent. The diene values by differential I absorption for tung and oiticica oil compare well with maleic anhydride diene values. With pure conjugated fat acids and esters the differential diene values are in good agreement with calcd. values. The new method does not work in the presence of polymerized oil and certain types of unsatn. which may cause differential I absorption due to steric hindrance. Certain com. fat acids and oils of the conjugated type have differential diene values much higher than their maleic anhydride addn. values detd. by standard methods." From C. A.

Morrell, R. S.
THE THEORY OF POLYMERISATION IN FATTY OILS. II.
J. Oil & Colour Chemists' Assoc. <u>7</u>, 153-64 (1924); C. A. <u>18</u>, 3117 (1924).

"The results of a large no. of detns. of the I No. of thickened oils by the Wijs method show that there is an apparent depolymerization tendency of the components of the Wijs reagent. With ordinary oils the I Nos. remained fairly const. whether the Wijs soln. remained in contact for 1 hr. or much longer - up to 384 hrs.; but with heat-thickened oils much higher I Nos. were obtained by prolonged contact with the Wijs reagent. Depolymerization by the CCl_4 in which the thickened oil was dissolved for various lengths of time prior to addn. of the Wijs soln. was also shown in some cases. Therefore, if the fall in I No. on heating an oil is to be used as a measure of the degree of polymerization special precautions must be taken in the Wijs detns. as to temp. and time of interaction. Detns. of mol. wts. by the cryoscopic method to indicate the degree of polymerization are often subject to error. A review of earlier work shows that detns. with C_6H_6 as solvent are unreliable, since association of the fatty acids, and combination of the esters with the solvent will occur. AcOH or stearic acid gives better results (cf. C. A. <u>10</u>, 1938). According to present knowledge the polymerization of linseed oil may be extra-molecular as well as intramolecular. That the former may take place is indicated by the behavior of thickened glyceryl α-eleostearate (tung oil) with an observed mol. wt. of 1431, which yields on treatment with MeONa at ordinary temp., methyl α-eleosterate, mol. wt. 300. Staudinger's condensed polymerization (C. A. 14, 3423) is contrasted with true polymerization, and a chem. representation of the polymerization of tung oil is given. A graph of the gain in wt. of the ethyl esters of linseed oil and tung oil compared with the oils themselves shows that at the end of 7 days the gain in wt. of the oils and their esters were nearly the same. The films of the oils were solid but of the esters, fluid. In the glyceryl esters, polymerization followed by gelation has taken place. Salway's hypothesis (C. A. 15, 770) may explain the preliminary stages, but fails to explain the process of gelation. Tung oil offers greater promise in the study of polymerization of drying oils because the glycerides are simpler and the viscosity changes more rapid." From C. A.

Neto, A. S.
SPECIFICATIONS FOR CRUDE BRAZILIAN TUNG OIL.
Anais assoc. quím. Brasil 7, 89-91 (1948); C. A. 43, 3212 (1949).

"Based on the analysis of 32 Brazilian tung-oil samples, the following specifications have been established for this country: d^{20}_{20} 0.939-0.943, acid no. (max.) 5, sapon. no. 191-195, I no. (Wijs) 163, n_{25} 1.517-1.520, mucilage by vol. (max.) 1.5%, gelatinization time (max.) 12 min." From C. A.

Norris, F. A., Kass, J. P., and Burr, G. O.
A STUDY OF DIENOMETRY.
Oil & Soap 18, 29-30 (1941); C. A. 35, 2351 (1941).

"By use of the Kaufmann alkalimetric and iodometrics method (C. A. 31, 4837) for the detn. of conjugation, theoretical values for α- and β-eleostearic acids could not be obtained although the values found for tung oil agreed with those generally accepted. The alkalimetric method gave less consistent results than the iodometric method owing to the persistent emulsion formed at one stage in the former method, making filtration difficult. The use of a pad of filter paper pulp resting upon No. 42 Whatman paper gave clear filtrates of higher diene no. Further work is necessary to det. the empirical values that should be used in the calcn. of the no. of conjugated double bonds present in fat acids or glycerides." From C. A.

O'Connor, R. T., Heinzelman, D. C., Freeman, A. F., and Pack, F. C.
SPECTROPHOTOMETRIC DETERMINATION OF ALPHA-ELEOSTEARIC ACID IN FRESHLY EXTRACTED TUNG OIL. DETERMINATION OF EXTINCTION COEFFICIENTS IN OIL SOLVENTS.
Ind. Eng. Chem., Anal. Ed. 17, 467-70 (1945); C. A. 39, 4498 (1945).

"The characteristic absorption in the ultraviolet of the triene conjugation of α-eleostearic acid provides a rapid means for its detn. in freshly extd. tung oil. The optical d., E, of a soln. of approx. 0.005 g. per l. of tung oil is detd. with the Beckmann spectrophotometer at the point of max. absorption, 271 mμ in cyclohexane and 270 mμ in isoöctane. Percentage of α-eleostearic acid = (E/α) $(100/cl)$ where α is the extinction coeff. (av. 168.6 in cyclohexane and 169.8 in isoöctane), c is the concn. of tung oil in g. per l, and l is the length of the cell in cm. About 4% adulterant in tung oil can be detected by this method. Extinction coeffs. of pure α-eleostearic acid were measured in EtOH, cyclohexane, isoöctane, and heptane. Previous discrepancies in the value of the extinction coeff. are explained by changes which take place in the acid on storage." From C. A.

O'Connor, R.T., Heinzelmann, D.C., McKinney, R.S., and Pack, F.C.
THE SPECTROPHOTOMETRIC DETERMINATION OF THE ALPHA AND BETA-ISOMERS OF ELEOSTEARIC ACID IN TUNG OIL.
J. Am. Oil Chemists' Soc. 24, 212-16 (1947); C.A. 41, 4931 (1947).
"The presence of β-eleostearin in tung oil interferes with the spectrophotometric detn. of α-eleostearic acid. Cyclohexane was used as the solvent for the detn. of extinction coeffs. for the α and β isomers obtained from tung oil. Absorption measurements were made with a Beckman quartz spectrophotometer with 1-cm. cells contg. portions of the freshly prepd. acids dissolved in the solvent and dild. to approx. 0.005 g. per l. Optical ds. were measured every 0.5 mμ from 265 to 280 mμ and the corresponding extinction coeffs. calcd. from the Bouger-Beer law equation. Absorption curves of the 2 pure isomers and fresh and irradiated tung oil show the differences between the isomers are not great. The method of binary analysis by spectrophotometric measurement consists simply of making measurements at 2 different wave-length positions and solving 2 Bouger-Beer law equations simultaneously. The percentage of the distribution of the α and β-eleostearic acids of tung oil and the complete absorption curves of each being available, an absorption curve based on the analytically detd. percentage compn. and the value of the extinction coeffs. of the pure components at each wave length throughout the spectrum can be calcd. If against such a curve the actual curve of the tung oil is plotted, the 2 curves will be identical, provided the percentage compns. have been correctly distributed between the 2 absorbing components. Repeated detns. of α and β-eleostearic acids in tung oil show that a reproducibility of within about 1% is attainable. Sample 1: α 47 to 48%, β 24 to 25.5%. Sample 2: α 49.1 to 50.3%, β 24.8 to 25.9%." From C.A.

Ogura, Masateru
AN IMPROVED METHOD OF HEATING TEST FOR A SPECIFICATION OF CHINESE WOOD OIL.
J. Soc. Chem. Ind. Japan 36, Suppl. binding 180-1 (1933); C. A. 27, 3625 (1933).
"A new heating test has the following features: (1) a metal bath instead of a glass beaker, (2) a Cu-constantan pyrometer,

(3) a stirrer within the bath, and (4) an elec. heater. The bath is maintained at 280° during the test. The effects of heating temp., of free fatty acids in the oil, and of adulterants upon the setting time of Chinese wood oil are tabulated." From C.A.

Paquot, Ch.

APPLICATIONS OF THE INDEX OF REFRACTION TO THE STUDY OF FATS.

Ind. corps gras. 2, 272-4 (1946)*; C.A. 41, 297 (1947).

"P. reviews the use of n for the detn. of oil in seeds, glycerol in aq. solns., I no., and structure of acids, such as eleostearic." From C. A.

Pearce, W. T.

A STUDY OF THE FATTY ACIDS OBTAINED FROM VARNISH OILS AND FROM VARNISHES.

J. Ind. Eng. Chem. 11, 121 (1919); C.A. 13, 664 (1919).

"P. found that as little as 5% tung oil present in linseed oil raises n of the mixed fatty acids derived from the oils directly; but the values obtained from the fatty acids derived from varnishes were not in good agreement (cf. C.A. 11, 1315). Changes in n mixts. of other oils with linseed were not appreciable. I-jelly tests (Boughton, C.A. 4, 2049) made on the mixed fatty acids detected 10% tung oil in linseed, 20% in soy-bean and in menhaden oil mixts., and 25% in varnishes. Results are tabulated." From C.A.

Potsdamer, L. S.

A METHOD FOR THE DETECTION OF ADULTERATION OF CHINA-WOOD OILS.

Orig. Com. 8th Intern. Congr. Appl. Chem. (Appendix) 25, 791-3 (1913); C.A. 7, 2482 (1913).

"Test tubes containing the oil are suspended in larger test tubes which serve as air baths; these latter are placed in an oil bath. Thermometers in the oil samples in the test tubes. Heat to polymerization. The addition of non-drying oils, vegetable or mineral, lowers the polymerization temp." From C. A.

Preise, O.

APPLICATION OF MEINEL'S METHOD FOR DETECTION OF CONJUGATED CARBON DOUBLE LINKINGS.

Farbe u. Lack 1938, 161-2, 173-4; Brit. Chem. Abstracts, B, 681 (1938).

"A series of drying oils was treated with sufficient Br dissolved in MeOH to react with one double linking and the Et_2O extracts of the products were mixed with a suspension of AgCNS in MeOH to react with one double linking and the Et_2O extracts of the products were mixed with a suspension of AgCNS in MeOH containing Fe...; the colorations produced at intervals are expressed in terms of Congo-red aq. solutions of varying concns. Raw tung, heat-treated linseed, and esterified tall oils and "synourin" gave positive reactions; raw linseed and castor oils, and "firnagral" gave negative reactions. The coloration can be used to detect the presence of tung in admixture with linseed oil. It is rendered more rapid by adding sufficient Br to produce saturation in accordance with the Wijs I val. and is also affected by the method of prep. of the AgCNS reagent." From Brit. Chem. Abstracts.

Reibnitz, von
DETERMINATION OF WOOD OIL IN OIL PAINTS.
Farben-Ztg. 34, 266-8 (1928); C. A. 23, 2307 (1929).

"Marcusson's method for the detn. of wood oil, depending on its polymerization with I to a solid mass, gives results about 10% low. In paints (without thinners) the extn. of linseed oil with chloroform is difficult and results are frequently high. A better approximation to the truth is obtained if the ascertained value is multiplied by the I value of the oil under test, and the product divided by the average of the I values of the boiled and unboiled oils. Small quantities of turpentine oil greatly hinder the polymerization of wood oil and should be removed by shaking with 96% alc. Marcusson's method is indirect since the wood oil is detd. as the difference between the original oil and the extd. linseed oil. The polymerized wood oil can, however, be saponified with 0.5 N alc. potash, the fatty acid pptd. with $BaCl_2$ and the excess alkali titrated with HCl. This method is described. Comparative tests between it and gravimetric analysis of pure wood oil and mixts. with linseed oil show good agreement." From C. A.

Reibnitz, von
DETERMINATION OF THE IODINE NUMBER IN FATTY DRYING OILS.
Farben-Ztg. 34, 1782-4 (1929); C. A. 23, 3358 (1929).

"The Hanus, Hübl-Waller, and Wijs iodine numbers of raw and bodied linseed and tung oils were found to increase with increase of temp. and length of the reaction period. The Wijs method is recommended for speed, reliability and reproducibility." From C. A.

Reutenauer, G. and Regent, Mlle.
ESTIMATION OF IODINE VALUES WITH CHLORINE SOLUTIONS.
Bull. mens. ITERG (Inst. tech. études et recherches corps gras) 1948 (4), 35;* C. A. 42, 6139 (1948).

"Prep. the following solns.: A: 1 l. HOAc, 10 g. chlorine, 20 g. Hg acetate; B: 250 ml $CHCl_3$, 200 ml. HOAc, 50 ml. EtOH. Weigh 0.1-0.3 g. of the fat into a 250-ml. flask, add 20 ml. of soln. B and 2 drops concd. HCl, heat 2 min. at 75-80°, add 5-6 drops concd. alc. soln. of helianthin. Pour soln. A slowly from a buret to decolorization. Make sure that the rosy color does not reappear on heating a few instants on the water bath (the soln. sometimes has a light yellow color which resists the chlorine but must not be taken into account). The titer of soln. A is detd., and the computation of the I value made in the usual manner. Out of 20 samples of different fats examd. only castor oil and China wood oil gave noticeable deviations from the corresponding Wijs nos. whereas the others differed only by 1 to 3 units." From C. A.

Savary, Pierre and Ferrari, Colette

DETERMINATION OF IODINE NUMBER OF CHINA WOOD OIL BY THE KAUFMANN METHOD.

Oléagineux 3, 134-5 (1948); C. A. 42, 6142 (1948).

"The Kaufmann method (C. A. 33, 4446[5]) gives low values for fats contg. conjugated double bonds; for the I no. detn. Hanus' soln. is recommended instead." From C. A.

Scheiber, Hans

THE DETECTION OF CONJUGATED DOUBLE BONDS.

Farbe u. Lack 1937, 149;* C. A. 31, 5606-7 (1937).

"Meinel's method (cf. C. A. 31, 3865[7]) for detecting double bonds appears capable of application in fat chemistry. A strong pos. reaction was obtained immediately with tung oil (I) but not with linseed oil (II). With heat-treated II or linolenic acid prepd. by debrominating its hexabromide, the reaction was weaker than with I but stronger than with II." From C. A.

Scheiber, Johannes

THE DETERMINATION OF WOOD OIL.

Farbe u.Lack 1928, 274, 286-7; C. A. 22, 3541 (1928).

"To 5 g. of the sample mixed with 5 g. of sand add with const. stirring 5-10 cc. ether contg. 2-10% $SnCl_4$. Place the mixt. in a desiccator until solid (1-30 hrs.) then ext. with dry ether. The wt. of the unextd. matter represents the wood oil. Samples of less than 6% oil do not solidify but an increase in viscosity may be noted. $SnCl_4$ will effect solidification of wood oil in the presence of substances which inhibit the solidification with iodine. The max. error in 58 detns. was 20.4, the min. 0.0 and the av. 3.8%." From C. A.

Scheiber, Johannes

FLOW METHOD FOR DIFFERENTIATING OILS.

Chem. Umschau Fette, Oele, Wachse u. Harze 35, 123-5 (1928); C. A. 22, 3793 (1928).

"Jaeger's method of differentiating wood oil from linseed oil is restricted to crude oil and is based on the formation of air bubbles along the fibers of the carton paper; wood oil dries with a wrinkled surface while linseed oil will fill the capillaries of the paper fibers and subsequent wetting of the spots brings out the difference in appearance. Only 3 types of patterns can form in Jaeger's method; the long time required for a test (7 days and more) will make its general adoption doubtful." From C. A.

Scheiber, Johannes

DETERMINATION OF TUNG OIL IN VARNISH PRODUCTS.

Farbe u. Lack 1930, 513-4, 524-5; C. A. 25, 608 (1931).

"When linseed oil is heat treated, the double bonds of the linolic and linolenic acid constituents rearrange to form conjugated systems similar to those in tung oil. This fact increases the difficulty of detg. tung oil by methods involving the formation of insol. gels. To det. tung oil in the presence of such products, S. proceeds as follows: A 5 g. sample is mixed with 10 g. sand. To this mix there is added, with const. stirring, 10 cc. of a 5% soln. of $SnCl_4$ in $CHCl_3$, which converts the tung oil to a gel. The gel is stored in a desiccator for 24 hrs. and then extd. with ether. The wt. of the residue represents tung oil. In the presence of highly thickened linseed oil or rosin, the above method is modified by the addn. of EtOAc before the $SnCl_4$ soln. and also by the use of EtOAc as the extn. liquid. In case of small quantities of tung oil or of non-gelling products, tung oil of known gelling properties is added and the proper correction made. EtOAc may be added in amts. sufficient to produce reasonably rapid gelling. Wolff's refractive index method (C. A. 24, 1752) is not suitable because duration and temp. of heating oils have a varying effect on the refractive index, that for tung oil sometimes passing through a min." From C. A.

Scheiber, Johannes
DETERMINATION OF TUNG OIL-LIKE COMPOUNDS IN VARNISH PRODUCTS.
Paint Varnish Production Mgr. 35, 10, 12, 14, 16 (July 1931).

A review of methods for determining tung oil by coagulation together with experimental data on determinations carried out with $SnCl_4$ on several stand oils.

Scheiber, Johannes
PRINCIPLES OF OIL-VARNISH ANALYSIS.
Farbe u. Lack 1933, 353-4, 365-7 (1933); C. A. 27, 4696 (1933).

"The complex nature of varnishes precludes a complete sepn. of the ingredients, but approximations are possible and useful. The limitations of the Wolff-Scholze method for resins and oils and the sepn. of tung oils from other oils with $SnCl_4$ are described." From C. A.

Steele, L. L., and Sward, G. G.
DETERMINATION OF THE ACID VALUE OF TUNG AND OTHER VEGETABLE OILS.
Ind. Eng. Chem., 14, 57-58 (1922); J. Soc. Chem. Ind. 41, 260A (1922).

"When alcohol alone is used as the solvent in the determination of the acid value of vegetable oils the results obtained are too low, particularly in the case of tung oils having a small acid value; a mixture of equal parts of alcohol and benzene, however, gives trustworthy results. The titration should be made with alcoholic potassium hydroxide or sodium hydroxide solution." From J. Soc. Chem. Ind.

Stitson, W. H.
THE UNSATURATION OF DRYING OILS.
Paint Manuf. 8, 119-23 (1938); C. A. 32, 5235 (1938).

"The chem. compns. of linseed, tung and other drying oils are discussed. Hydrogenation is the most satisfactory method of measuring unsatn. The detn. is so cumbersome in carrying out that methods based on halogenation are widely used. The effect of polymerization by heat is invariably to lower the I value, so that I-value detns. are of more value with raw oils than with bodied oils. Much recent work on induced and permanent dipole moments leads to the conviction that these measurements will soon assume much importance in drying-oil technology." From C. A.

Stock, E.

DETECTING ADULTERATION OF WOOD OIL FROM INDO-CHINA (ABRASIN OIL) WITH CASTOR OIL AND PEANUT OIL.

Farben-Ztg. 36, 173 (1930); C. A. 25, 423 (1931).

"A wood oil from Indo-China with the following consts.: sp. gr. 0.935, acid no. 8, n_{19} 1.512, and sapon. no. 193 was mixed with varying proportions of castor oil, peanut oil and both. From the detn. of the above consts., definite conclusions regarding the compn. of the mixts. could not be drawn." From C.A.

Suen, T. J., and Wang, M. C.

ESTIMATION OF TUNG OIL AS AN ADULTERANT.

Ind. Eng. Chem., Anal. Ed. 16, 511-13 (1944); C. A. 38, 5996 (1944).

"Because tung oil is cheap in China, it is used to adulterate edible oils. It may be roughly detd. by shaking 2 ml. of oil with 2 ml. of 65% HNO_3, letting stand 30 min. at 0°, filtering the voluminous ppt. on asbestos, washing with 50-150° naphtha, drying at 100°, and weighing. Graphs, which vary for different oils, give percentages of tung oil corresponding to the wts. of ppt. per ml. of oil." From C. A.

Thomas, A. W. and Yu, C. L.

NEW QUALITATIVE TESTS FOR RAPE AND TUNG OILS.

J. Am. Chem. Soc. 45, 129-39 (1923); C. A. 17, 645 (1923).

"The Mg soaps from all oils examd. (preceding abstr.) are entirely or almost entirely sol. in boiling alc. with the exception of tung oil which yields an abundance of a white elastic Mg soap insol. in 90% alc. even on prolonged refluxing; the acid liberated from this insol. Mg salt has the strong odor characteristic of tung oil, is sol. in cold 90% alc., m. about 44°, absorbs O from the air and changes to a dark brown resinous mass in 1-2 days. It is believed to be eleomargaric acid. The yield from one sample of tung oil tested was about 20%." From C. A.

Thymian, E. V.

SIMPLE METHOD OF IDENTIFICATION OF CHINA WOOD OR TUNG OIL.

Pharmazie 4 (3), 140 (1949)*; Chimie & Industrie 62, 585 (1949) (abstract)*; Oleagineux 5, 275 (1950)(abstract).

In times of scarcity edible oils are often adulterated with substances more or less toxic. One of the latter is China wood oil. The latter can be revealed by conc. H_2SO_4, which gives a black coloration followed by the precipitation of a black mass. (translated from Oleagineux).

Tilleard, D. L.

COLOR SCALES FOR OILS AND VARNISHES.

J. Oil & Colour Chemists' Assoc. C. A. 31, 7269 (1937).

"A wide range of linseed, tung, soybean, cottonseed, peanut, sardine and shark oils of refined and deodorized qualities and some 40 samples of oil varnishes of all types were analyzed by means of a Guild trichromatic colorimeter (cf. C. A. 20, 3591) both with respect to content of the 3 primary colors and with respect to brightness. From the data so obtained, two 10-point color scales were set up for oils and for varnishes, resp. The points on these scales correspond to various combinations of Lovibond tintometer glasses to be used to match closely and to designate the color and brightness of oil and varnish samples. Possibilities of errors, e. g., those due to improper light sources, are discussed." From C. A.

Toch, M.

CHINA WOOD OIL.
Drugs, Oils & Paints 40, 414-6; 41, 14-9 (1925)
Paint, Oil Chem. Rev. 79 (16), 10-1; (17), 10-1; (18), 10-2; (19), 14-5; (20), 11, 25 (1925); C.A. 19, 2277 (1925).

"A lecture. The quickest infallable tests for purity of tung oil are d., n, and dispersion factor. If these 3 consts. agree with the established standards for pure oil, it is absolutely positive that the other consts. will be in harmony. Lab. expts. on the refining of crude tung oil, given in detail, show that the best results are obtained by bleaching with 5% of fuller's earth, or of a mixt. with bone black. The effects of the addn. of 5, 10 and 15% of paraffin, soy, linseed, perilla, corn, menhaden, Stillingia, and peanut oils on the phys. consts. and on the heat tests are shown in tabular form. The construction and use of the Abbe refractometer are described and ns of the commoner oils tabulated." From C. A.

Toch, M.

CHINA WOOD OIL.
J. Soc. Chem. Ind. 44, 511-2T, 517-8T, 527-8T (1925); C.A. 20, 671 (1926).

An abridgment of "China Wood Oil" (Paint, Oil Chem. Rev. 79, (16), 10-1; (17), 10-1; (18), 10-2; (19), 14-5; (20), 11, 25 (1925).) by M. Toch.

Toms, H.

OIL BROMIDE FILMS AND THEIR USE IN DETERMINING THE HALOGEN ABSORPTION OF OILS.
Analyst, 53, 69-77 (1928); Brit. Chem. Abstracts 1928, B, 236.

"The 'insoluble bromide' obtained from most drying oils has been debrominated with difficulty and the presence of hexabromostearic acid confirmed, whilst the presence of tetrabromostearic acid has been rendered more probable by the isolation of a thick oil, apparently a liquid form of this acid. A satisfactory micro-method for determining the unsaturation value of non-volatile oils consists in spreading a thin film of the oil in a single drop, about 0.2 mm. thick, on a weighed microscope slide, and placing the slide in a wide tube closed at each end with a waxed cork and containing a boat with a few drops of bromine. After 20-30 min. the slide is withdrawn, excess of bromine removed, and the slide again weighed; the bromine value is calculated from the increase in weight. This value multiplied by the at. wt. of iodine and divided by the at. wt. of bromine gives the ordinary iodine value, and agrees well with theory except in the peculiar case of tung oil, the appearance of the brominated films of which is characteristic. A method is given for calculating the percentage of α-elaeostearic triglyceride in tung oil assuming the presence in the oil of two types of substances, viz., (a) those containing non-conjugated systems of double linkings and giving the same iodine value regardless of the method used, and (b) the glyceride of α-elaeostearic acid which gives only two thirds its theoretical value with Wijs' solution in 2 hrs. but its full value by the bromide vapour method." From Brit. Chem. Abstracts.

Ueno, S. I., and Kuzei, Nobuo

ACETYL VALUE OF UNSATURATED FATTY OILS.

J. Soc. Chem. Ind., Japan 33, Suppl. binding 234-6 B (1930); C. A. 24, 4410 (1930).

"The acetyl values of old and refined unsatd. fatty oils were detd. by Lewkowitsch's and Andre's methods (cf. C. A. 15, 2556) including the following: linseed, sardine, wood, soy-bean, herring, rape, olive, semi-hardened sardine, hardened sardine, beef tallow and coconut. With the exception of beef tallow, the acetyl value detd. by the filtration process is higher than that of the distn. process. Although the acetyl values of oils of high I no. show great differences in the filtration and distn. processes, the differences in the case of oils of low I no. are smaller. The acetyl value by the distn. process, even with old samples, approximates to the true acetyl value. Most of the acetyl values of fresh unsatd. fatty oils contg. no hydroxyl group are shown to be less than 10. The acetyl value of hardened fish oils is less than that of the original oils." From C. A.

Uhrig, Karl, and Levin, Harry

DETERMINATION OF BROMINE ADDITION NUMBER.

Ind. Eng. Chem., Anal. Ed. 13, 90-2 (1941); C. A. 35, 2089 (1941).

"Add 5 ml. of $CHCl_3$ to 0.1-1.0 g. of the hydrocarbon sample and titrate the mixt. with Br reagent (2% Br in glacial AcOH) until a distinct orange-yellow color persists for about 15 sec. With dark-colored samples the end point is detd. by adding a drop of the titrated mixt. to 1 cc. of KI-starch soln. on a spot plate, a blue color indicating excess Br. The titer of the Br reagent is detd. by titrating a mixt. of 5 ml. Br reagent, 25 ml. 10% KI soln. and 5 ml. $CHCl_3$ with 0.1 N $Na_2S_2O_3$ soln., using starch as indicator. The method gives nearly theoretical results with cyclohexene, di-isobutene, tri-isobutene or their mixts., styrene, oleic acid and tetraisobutene. The Br reagent has little or no effect on C_6H_6, toluene, xylenes, triisopropylbenzene, cyclohexane, and isopentane. The results by this method agree with those by the Wijs method for tallow, castor oil and blown rapeseed oil, but are lower for cottonseed oil, lard oil and linseed oil. The Br no. obtained for tung oil represents satn. of only one of the three double bonds present; the Br no. found for linseed oil checks the H no. for this substance." From C. A.

Vaubel, W.

PRIMARY AND SECONDARY BROMINE VALUES OF OILS.

Z. angew. Chem. 23, 2077-8 (1910); J. Soc. Chem. Ind. 29, 1395 (1910).

"In determining the bromine value of oils by dissolving them in a suitable solvent, adding potassium bromide solution and hydrochloric acid, and titrating the solution with an excess of potassium bromate, it was found that in the case of certain oils, e. g., olive oil, hardly any bromine was absorbed directly, but that it was necessary to add an excess of potassium bromate and to titrate this excess in order to obtain serviceable results. Drying and semi-drying oils, however, behaved differently in this respect, for a point could be found at which the direct absorption of bromine was perceptibly slower. It was thus possible in the case of these oils to determine two kinds of bromine values -- the primary value calculated from the amount of bromine directly absorbed, and the secondary value, obtained by the use of an excess of bromine. In determining the primary value a very small quantity of potassium bromate solution is added and the flask shaken until the liquid is colourless, when more is added, and so on until a faint yellow colour persists and no further absorption of bromine takes place until a large excess of bromate is added. The end-point of the first absorption may be more accurately found by introducing into the liquid a crystal of potassium iodide the disappearance of the violet colour of the iodine liberated therefrom showing that free bromine is present. In determining the secondary bromine value about 5 grms. of the oil are dissolved in 50 to 100 cc. of chloroform, carbon tetrachloride, or petroleum spirit, and the solution treated with a corresponding amount of potassium bromide solution and sufficient water to make up the aqueous layer to 300 to 500 cc., after which 10 cc. of concentrated hydrochloric acid and a crystal of potassium iodide are added, followed by a suitable excess of potassium bromate solution. The stoppered flask is now vigorously shaken for about one minute, and the excess of bromine titrated with standard sodium thiosulphate solution, the end-point of the reaction being shown by the appearance of the iodide coloration. The results thus obtained are in close agreement with the iodine values of the oils. The following results illustrate the differences between oils with regard to their primary and secondary bromine values:

Oil	Primary bromine value	Secondary bromine value	Iodine value calculated from secondary value
Linseed	75.2-80	107.7:107.7	170.7
Tung	56.0-57.9	94.6	150
Arachis	50.2-52.8	52.6	91.3 "

From J. Soc. Chem. Ind.

Vaubel, W.

THE COMPOSITION OF DRYING OILS AND THEIR RELATIONS TO THE PRIMARY AND SECONDARY BROMINE (IODINE) NUMBER.

Farben-Ztg. 31, 2771-5 (1926); C. A. 20, 3828-9 (1926).

"The primary Br. number is calcd. from the amt. of Br. directly absorbed by the oil. It corresponds to the content of linoleic and linolenic acid and their isomers. The linoleic acid can be detd. by means of the hexabromine number. The secondary Br number is calcd. from the quantity of Br absorbed when used in excess. The difference between primary and secondary Br (I) numbers corresponds to the amt. of oleic acid present in the oil. The iso- or β-linoleic acid reacts like oleic acid after the addition of 2 Br. mols. The drying oils constantly change their constitution, whereby the Br (I) no. diminishes. Therefore the highest Br (I) no. ever found corresponds to the original character of the oil. V. reviews the composition and the I numbers of the following oils and compares his own figures with the figures found by others; sunflower, soy bean, poppy, rape, hemp, peanut, walnut, linseed, wood, whale and sardine oil." From C. A.

Wan, C. S. and Ho, K.
NOMOGRAPH FOR IODINE VALUE OF TUNG OIL.
Ind. Eng. Chem., Anal. Ed. 8, 282-3 (1936); Brit. Chem. Abstracts 1936, B, 893.

"The nomograph gives the corrections to be applied for various excesses of Wijs reagent and working temp. from 16° to 40°." From Brit. Chem. Abstracts.

Wan, S. W. and Hu, D. B.
REACTION OF WIJS SOLUTION WITH TUNG OIL.
J. Am. Chem. Soc. 61, 2277-83 (1939); C. A. 33, 9015 (1939).

"The behavior of Wijs soln. (I) toward α-eleostearic acid (II), oleic acid (III) and a mixt. of the 2 acids was studied by varying the proportion of I to acid and the time of contact. The 2-stage halogen absorption from I by II, forming a tetrachloro addn. product in the 1st stage and the addn. of ICl to III were qualitatively established. The difference in halogen absorption between II and III was applied to the analysis of a mixt. of the 2 acids and to the analysis of II glyceride in tung oil, further work being carried on for developing the latter analysis into a reliable method. Böeseken's assumption (C. A. 21, 1628; 22, 219) of a bimol. reaction for the 2nd-stage halogen absorption by II from I was found incorrect. A combination of 2 simultaneous bimol. reactions has been suggested: $\mathrm{Me(CH_2)_3CHClCHClCH{:}CHCHClCHCl(CH_2)_7CO_2H + ICl \rightarrow Me(CH_2)_3CHClCHClCHICHCl\text{-}CHClCHCl(CH_2)_7CO_2H}$ and $\mathrm{+ I_2 \rightarrow Me(CH_2)_3CHClCHClCHICHICHClCHCl(CH_2)_7CO_2H}$. The variation of the I value of tung oil with temp., excess of reagent and time of contact has been explained." From C. A.

Ware, E. E.
OPTICAL DISPERSION OF CHINESE WOOD OIL AS AN INDEX OF PURITY.
J. Ind. Eng. Chem. 8, 126-8 (1916); C. A. 10, 827 (1916).

"A new method based on the observations of Brier (C. A. 9, 2459) is proposed, the necessary app. being the ordinary spectrometer with an autocollimating eyepiece. A cut of app. is given. A brass electrode arc lamp was used as the source of light. Compared to other fatty oils Chinese wood oil has an abnormally wide dispersion. The angle through which the table of the spectrometer must be rotated to focus properly the slit image upon the slit itself is the angle from which, knowing the angle of the prism, the n for any particular wave length may be calcd. By using a source emitting light of different wave lengths the relative dispersion for any two can be calcd.

From this value, expressed in angular degrees or in vernier units, adulteration in Chinese wood oil can be estd. with remarkable accuracy. In W.'s results the greatest error was 0.5%, the oil containing 5% of adulterant. Expressed in vernier units, pure Chinese wood oil gave values of 267-269, while other oils, such as soy-bean, linseed and rape, gave values of 127-143. Tables, curves and formulas containing the necessary data are given." From C. A.

Ware, E. E. and Schumann, C. L.
EXAMINATION OF CHINESE WOOD OIL.
Drugs, Oils & Paints, 30, 52-4 (1914); C. A. 8, 3244 (1914).

"Two new methods are given. The first is based on the acceleration of the "light break" by a small amt. of I. Five g. of oil are weighed into a small beaker and thinned with 25 cc. of petrolic ether (60° b.p.) and the soln. cooled to 0°. Five cc. of ice cold satd. soln. of I in petrolic ether are added with stirring. Pptn. starts within a few min. After 1 hr. more petrolic ether is added and the mass stirred. The first filtration should take place after 3 hrs.; the filtrate is cooled and again exposed to light. A few mg. of I in soln. may be added. Three pptns. with corresponding filtrations are generally sufficient to give total yield. Pptn. should always be made cold. The amt. of pptd. material in the oils varied from 91.8 to 94.1%. The amt. of adulterant is found by weighing the residue after evapn. of the petrolic ether from the last filtration, allowing 7% residue for pure oil. Results with mixts. of known comp. were very good. The second method is based on the insolubility of the K soap. Three g. of the sample are saponified with 100 cc. of 0.25 N absolute alc. potash for 1/2 hr., using a reflux condenser. Cool the mixt. to 0° and hold for 10 min. at that temp.; filter through a Gooch crucible using a filter paper disk instead of asbestos. Wash with abs. alc. at 0°; remove ppt. to a watch glass and dry at 75-80° under partial vacuum in a stream of of dry H or CO_2. The wt. of the K soap is equal to the wt. of the wood oil taken. The abs. alc. used for the prep. of the alc.-potash and for washing must be satd. with some of the K soap. The amt. of adulterant is found by subtracting the % of K soap obtained from 100%. Results on mixtures of known comp. were very good. W. and S. state that some of their results on Chinese wood oil-rosin varnish indicate that the polymerization of the oil in the presence of rosin is practically as complete as in the oil subject to the same heat treatment in the absence of rosin. The fatty acid in each case shows a mol. wt. double that of the fatty acid in raw Chinese wood oil. A comparison of the mol. wts. of the fatty acids from raw wood oil and from the light break seems to show that this light break is an isomer rather than a polymer, and that there is practically no difference between the light break formed slowly by light alone and that catalyzed by I." From C. A.

Waterman, H. I., Kok, W.J.C. de, and Vlodrop, C. van
HYDROGEN-IODINE NUMBER OF CHINA WOOD (TUNG) OIL AND ITS HYDROGENATION PRODUCTS.
Chimie & industrie Special No., 899-901 (April, 1934); C.A. 28, 5998-9 (1934).

"The I no. (Wijs) cannot be used to follow the progress of hydrogenation as there are considerable differences between the true H-I no. (i.e., the I equiv. of H absorption) and the Wijs I no., even when the latter is carried out by prolonging the time of reaction to 7 days and using 500-1200% excess of I. The differences decrease as the oils become satd. with H." From C.A.

Wolff, H.

A CONTRIBUTION TO THE ANALYSIS OF OIL VARNISHES.

Farben-Ztg. 21, 1302-4 (1916); C. A. 11, 1315 (1917).

"In attempts to detect tung oil in varnishes in the presence of resins and linseed oil, W. found that McIlheney's method (C. A. 6, 2544), extn. with EtOH, or saponification and subsequent esterification and examn. of the esters of the fatty acids, gave no promise of a suitable method. Expts. were made to det. the effect of heating and polymerization of the oils, on certain constants of the fatty acids obtained from them. Tung acids from untreated oil were found to be practically completely esterified by the Wolff method (C. A. 8, 2495); volumetric detns. after single esterification showed 4.5 to 6% of unesterified fatty acids, while gravimetric detns. showed 2.8 to 4.1%, indicating that acids of higher mol. wt. are more easily esterified than those of lower mol. wt. Double esterification, one hot and one cold, showed a max. of 0.2% unesterified acids detd. gravimetrically on 8 samples of oil. Complete esterification also took place with the acids from polymerized oils. On heating to 200° for various lengths of time, the n of the tung oils, except in 2 cases, increased. There was practically no change, however, in the n of the fatty acids from these oils. Esterification of the acids and their subsequent recovery, produced only a slight depression of their n, and gave an av. of 1.4912 or 103° Zeiss-butyrorefractometer for the acids from 8 oils. Linseed oils were similarly heated, and it was found that the n of the fatty acids obtained direct or recovered after esterification, increased regularly for the first 2 hrs. of heating, but then became more nearly constant. The reason for this, in contrast to the behavior of the tung acids, appears to be in the formation of volatile acids which escape after longer heating. The av. n of linseed acids from 5 samples of oil that had been heated for more than 2 hrs. was 1.474 or 73° Zeiss-butyrorefractometer. To test McIlheney's method on the acids from polymerized linseed and tung oils, it was modified as follows: 2 g. of the oils or the fatty acids were heated with an equal vol. of glacial AcOH, and 10 cc. of 5% soln. of I in AcOH added and the mixt. boiled for 5 min.; then cooled and shaken out with petroleum ether. The petroleum ether soln. was treated with a 3% soln. of Na_2SO_3 to absorb excess I, then washed with H_2O evapd. to dryness and the residue weighed. The amts. of residue thus obtained from linseed oils that had been heated for various lengths of time at 200°, varied from 101.5 to 100%; from the fatty acids of these oils, from 100 to 79%. The residues from tung oils similarly treated, varied from 0.2 to 5.8%; from the fatty acids of these oils, from 40 to 40.4% depending on time of heating. The differences in the amts. of petroleum ether residues obtained from the fatty acids of polymerized linseed and tung oils, were not only greater than in those obtained from the original oils but the individual results obtained on the acids varied widely. These results indicate that McIlheney's method cannot be used for the detn. of tung oil in mixts. that have been heated. For detg. the oils in varnishes by means of the n of the fatty acids, the non-volatile portion of a 10 g. sample is saponified, the acids separated and then esterified. The esters are separated from the resin acids, treated with KOH, then acidified and the liberated fatty acids recovered from the Et_2O soln. by distilling and drying in CO_2. Det. n at 20 to 70° and use the correction factor 0.6° Zeiss-butyrorefractomer for each 1° in temp. to calculate n to standard temp. (presumably 15.5°). Results on varnishes of known composition are:

Resin detd. gravimetrically	Resin present	Fatty acids found	Zeiss readings
30.5%	30.0%	64.0%	83.5%
24.8	25.0	69.2	91.0

Assuming the refractometer readings for linseed and tung acids as 73 and 103°, resp., the tung acids in these varnishes would calculate to 35 and 60% of the fatty acid mixts. corresponding to approx. 25 and 40% of wood oil in the original varnishes, whereas 25 and 50% were actually present." From C. A.

Wolff, H., and Rabinowitz, J.
DETERMINATION OF TUNG OIL.
Farben-Ztg. 35, 1203 (1930)*; Brit. Chem. Abstracts 1930 B, 467.
"Polemical against Marcusson. The authors reiterate that the method is unreliable." From Brit. Chem. Abstracts.

Wolff, H. and Rabinowicz, J.
COAGULATION AND ANALYSIS OF BOILED OILS CONTAINING WOOD OIL.
Chem. Umschau Fette, Oele, Wachse u. Harze 38, 213-6 (1931); C. A. 25, 5582 (1931).
"The amt. of wood oil in a mixt. with boiled oil is usually detd. by coagulation with I. J. Scheiber (C. A. 22, 3541) uses $SnCl_4$ in place of I, thereby coagulating wood oil and substances, all contg. conjugated double C bonds, the coagulate representing the "technically valuable constituents." W. and R. object to the last statement because analysis usually dets. "wood oil" and not "valuable constituents," and they present exptl. evidence that the coagulate obtained by S's method contains a mixt. of various fatty acids and in most cases does not represent the correct % of wood oil and still less so in the analysis of oil varnishes." From C. A.

Wolff, H., and Zeidler, G.
APPLICATION OF THE SAPONIFICATION-SPEED FACTOR IN THE ANALYSIS OF VARNISHES.
Paint Varnish Production Mgr. 15, 7-8, 11-12, 13 (Nov. 1936)*; C. A. 31, 559 (1937).
"The sources of error in utilizing the various speeds of sapon. of oils and resins in the chem. analysis of varnishes are: the presence of phthalate resin, the concn. of the nonvolatile

constituents in solvents, compn. of the solvent mixts., excess of KOH, influence of the acid resins and oily constituents on the results of the analyses. Each of these sources is discussed. In studying the rate of sapon. the sapon. process is considered a bimol. reaction a = the quantity of KOH soln. consumed at the beginning, b = the quantity of KOH consumed after complete sapon. and c = the quantity of KOH consumed at a time t: then (1/b.t) log c(a-b)/a(c-b) = const., b = the value of complete sapon. and K is given for linseed oil varnish, linseed oil-stand oil and wood stand-oil. These values show that the rates of sapon. of the various oils are almost identical. The const. of reaction for the rate of sapon. of the fatty oils in EtOH solns. can be considered 0.03. Working on resin esters and alkyd. resins gave k of very low value for resin esters." From C. A.

Wolff, H., Zeidler, G., and Rabinowicz, J.
DETERMINATION OF TUNG OIL IN STAND OILS.
Farben-Ztg. 35, 896-7 (1930);* C. A. 24, 1752 (1930).

"The amt. of tung oil in stand oil is equal to $(\eta^{40} - 1.4714)/0.672$. In 63 dtns. on samples of known tung oil content, no tung oil was found in 3 cases, 5% error in 8, 5-10% error in 28, 10-15% in 17 and 15-25% in 7 cases. Oils mixed before thickening give low values while those thickened separately and subsequently mixed give high values." From C. A.

Yamaguchi, E., Matsumura, T., and Takaji, T.
BROMINE VALUE OF SOME FATTY OILS.
Waseda Applied Chem. Soc. Bull. 13 No. 4 (29), 7-11 (Abstracts in English .61) (1936)*; C. A. 31, 2459 (1937).

"In detn. of Br. value by the method of P. Becker (C.A. 18, 1211) a ground-glass dish with rounded and turned-up edges was substituted for the glass plate in order to effect an even coating of oil film. Br values of olive, Tsubaki, peanut, rapeseed, Shoshi, tallow, lard, whale, sardine, and liver oils agreed well with Wijs I values. Sesame, soy, linseed, whale, blubber and hydrogenated soy oils varied 2 to 6 units from the Wijs value, castor oil 7 to 8, polymerized sardine oil, 20, and Japanese and Chinese wood oils more than 40 to 70 units." From C. A.

Zeidler, G.
THE DETECTION OF WOOD OIL.
Farben-Ztg. 47, 294-6 (1942)*; Chem. Zentr. 1944, II, 378-9;
C. A. 40, 6841-2 (1946).

"The purity of crude wood oil can be judged by the gelatinization test or from the following limits for certain indexes: d_{20} 0.936-0.944, acid no. less than 8, sapon. no. 190-5, n_{20} 1.518-1.522, I no. (Wijs) more than 190. Directions are given for carrying out the gelatinization test of Tatimori (cf. C. A. 32, 5645) at 282°. The wood oil content of mixtures can be estd. from n. For mixts. with fat acids it is given by (n - 1.475)(1000/0.3) and in stand oil it is given by (n - 1.4714)(1000/0.162). Extn. of the nongelatinized oil from gels of mixts. of wood oil and other oils does not give satisfactory results. Direct detn. of the eleostearic acid (m. about 47°) with 76% alc, is of interest. According to the tetranitromethane test of Kaufmann (cf. C. A. 39, 205) the presence of wood oil or oiticica oil is indicated by the immediate development of a red color when 2 drops of the oil in 2-3 cc. of ether is treated with 10 drops of $C(NO_2)_4$. However, the results are difficult to judge with wood oil-stand oils and mixts. of wood oil with linseed oil, since red-brown to brown colors difficult to read are obtained. When H_2SO_4 is dropped onto wood oil or wood-oil mixts. brown polyhedral figures appear on the surface (cf. Leppert and Majewska, C. A. 29, 608). This reaction gives useful results. The concd. H_2SO_4 (d. 1.84) is dild. 7:1 with water. As little as 10% of wood oil can be detected in mixts. of stand oils and lacquers by this reaction; oiticica and Trienol (cf. C.A. 34, 3514) also give pos. reactions. With other acids (H_3PO_4, HCO_2H) the reaction is neg." From C. A.

Ziegelmann, G. C.

CONSTANTS OF CHINA WOOD OIL.

Paint, Oil Chem. Rev. 73 (12), 10-11, 25 (1922); C. A. 16, 1671 (1922).

The constants are variable because of variations in the trees, climatic conditions while the fruit was growing, and processing procedures. Earlier reported values were often in error due to undetected adulteration. Tests for adulteration and for quality are reviewed. The Worstall heat test is described in detail and compared with the Browne test adopted by the American Society for Testing Materials. The Schumann tests which utilize (1) the insolubility of the sodium soap of elaeomargaric acid in absolute alcohol, and (2) the insolubility of light-converted eleostearin in petroleum ether produce accurate results but are not suited for factory control testing. Optical dispersion tests are mentioned. The Wijs method for iodine number is quicker than the Hübl and more accurate than the Hanus method. Commercial china wood oil consists of about 10% olein, 2-3% oxy- or saturated fatty acids, and the balance of elaeomargaric acid-tri-glyceride. The author divides the drying process into (1) polymerization, (2) oxidation, and (3) gelatination.

(b) Composition

Bilger, L. N., and Westgate, M.
STEROLS OF TROPICAL OILS.
Hawaii Agr. Expt.Sta. Ann. Rept.1937 54-5 (1938); C.A. 35 2022 (1941)

Sterols obtained from China-wood oil have been compared with sterols from other tropical oil and found to possess the following properties: unsaponifiable (%), 0.59; ppt. by digitonin (%), 37.30; sterol in oil (%), 0.22; Molecular weight .365. The presence of two components is indicated since solvent fractionation gives two fractions (m.p., 132.1-134.3; $[\alpha]_D^{25}$, - 19.17, and m.p., 130'-136'; $[\alpha]_D^{25}$, -22.71.

Davis, S. B., Conroy, E. A., Shakespeare, N. E.
ISOLATION AND STRUCTURE OF A DIHYDROXYOCTADECADIENOIC ACID FROM TUNG OIL.
J. Am. Chem. Soc. 72, 124-8 (1950); J.Am. Oil Chemists' Soc:27,·147 (1950)(Abstract)

"Tung oil was mixed with an anion-active ion exchange resin and a small fraction was recovered by elution of the resin with alkali and extraction of the acidified eluate with carbon tetrachloride. Storage of this product at 5° resulted in the separation of an oil and a crystalline product. The latter was identified as 9,14-dihydroxy-10,12-octadecadieonic acid." From J. Am. Oil Chemists' Soc.

Eibner, A. and Groth, A.
THE PRESENCE OF DISPERSED PHASES IN FATTY DRYING OILS.
Chem. Umschau 35, 97-100 (1928); C. A. 22, 2281 (1928)

"Auer's hypothesis (C.A. 22,1695) that fatty drying oils in their original state contain two phases which can be sept. by shaking with formic acid, is disproved by expts. with 12 samples of linseed, wood and perilla oil that were treated with 45%, 90% and abs. formic acid. In no case of fresh oil could any dispersed phase be sept.; but from wood oil and from oxidized linseed oils a sepn. of the dispersed phase could readily be obtained with formic acid, the dispersed phase showing an I no. of 131.7 and the dispersing medium 134.2." From C.A.

Eibner, A., and Groth, A.
THE QUESTION AS TO THE OCCURRENCE OF DISPERSE PHASES IN THE FATTY DRYING OILS
Paint Varnish Production Mgr. 4,6,8 (Nov., 1929)

This article is similar in content to "The Presence of Dispersed Phases in Fatty Drying Oils" by the same authors (Chem. Umschau 35, 97-100 (1928)

Erastova, R.
STUDIES OF WOOD AND PERILLA OILS.
Lakokrasochnuyu Ind. Za. 1934 (5-6), 41-4*; C.A. 29, 6443 (1935)

"Comparison of the oil from *Aleurites cordata* from the Caucasus with that from an American *A. fordii* shows that the former apparently contain an isomer of α-eleostearic acid which renders it less easy to oxidize. Perilla oil from the Caucasus does not differ essentially from that of other regions." From C. A.

Fahrion, W.
WOOD OIL AND ITS POLYMERIZATION
Farben-Ztg., 18, 2418-20 (1913); C.A. 7, 4081 (1913)

"Largely a resume of S. von Schapringer's dissertation, Karlsruhe, 1912, von S. has recorded some results differing from F.'s (C.A. 7,269) and the article is partly polemical. F. adheres to former statements, i.e., that oleic acid, and not an isomer is present with elaeostearic acid in the oil. The formula for elaeostearic acid (as shown by v.S.) is $Me(CH_2)_3CH:CH(CH_2)_2CH:CH(CH_2)_7CO_2H$ and agrees with that proposed by Majima (cf. Ber., 42, 674), although vS. presents no proof that the acid is isomeric with linoleic acid. On heating elaeostearic acid at 200-50° in the atmosphere of N, v.S. obtained a mixt. of products having lower acid and I nos. (which disproves the work of Cloez, who claimed the production of an isomeric acid, elaeoleic acid under similar experimental conditions). F. claims that "memomorphous isomerism" does not take place, and defends his work, showing that the polymerization of wood oil is largely analogous to that of linseed. With the exception that the n_D of heated linseed oil increases from 1.47 to 1.49 on heating to 300° while the nD of wood oil decreases from 1.519 to 1.509 on heating to 250° (for 18 minutes in N) this anomaly is not explained." From C. A.

Fokin, S.
TUNG OIL
J. Russ. Phys Chem. Soc., 45, 283-5 (in Russian);* C.A. 7, 2315 (1913)

"The polymerization of tung oil by heat, its increased refraction and the conversion of the linoleic acid (a) found in this oil by exposure to the light seem to indicate that (a) contains 2 conjugated double unions. Its most probable formula is $Me(CH_2)_3CH:CHCH:CH(CH_2)_9CO_2H$. Oxidation with $KMnO_4$ in alk. soln. did not give tetrahydroxystearic acid, but a sirupy liquid $C_{18}H_{32}O_5$ which is decompd. by hot alk. with formation of HCO_2H and a black substance. Fractional crystn. of the Ba salts gave only HCO_2H and valeric acid. The sol. acids were dibasic and contained another O at. in the mol. Fractional pptn. of the Cu salts showed only the acids $C_{10}H_{18}O_5$ and $C_{11}H_{20}O_5$. The complete conversion of (a) into stearic acid makes it difficult to explain the formation of acids with $_5$O ats., unless it be assumed that the double anions are displaced towards the nearest neighboring position." From C. A.

Grollman, A.
PREPARATION OF EXTRACTS FROM OXIDIZED MARINE AND OTHER OILS FOR REDUCING THE BLOOD PRESSURE IN EXPERIMENTAL AND HUMAN CHRONIC HYPERTENSION.
J. Pharmacol. 84, 128-35 (1945); C. A. 39, 4686 (1945)

"A no. of refined oils derived from marine fishes when administered orally are effective in reducing the blood pressure in experimentally induced hypertension in rats and dogs. Comparable effects were elicited in 3 human patients suffering from hypertension. Active prepns. were obtained from residues of cod, dogfish, hake, basking shark, and skate liver oils. Sardine and menhaden body oils were slightly effective. A sample of fresh-water fish (burbot) liver oil was entirely inactive. Among oils of vegetable and animal origin other than fish, only tung oil has any hypertension-reducing activity in animals. Oxidation enhances the activity of certain oils; sapon. prior to oxidation in some cases further increases their effectiveness. The activity of the oils is independent of their original vitamin A content, and is retained after destruction of this vitamin by oxidation. Fractional sepn. of the oil by distn. in vacuo, freezing, or distribution between 80% aq. EtOH and a hydrocarbon solvent partially effects a concn. of the active agent. By adsorption on a synthetic ion-exchanger resin (Amberlite IR 100) and desorption with 2% aq. NaOH after washing the resin free from oil with petr. ether it is possible to obtain the active principle in aq. soln." From C. A.

Hilditch, T. P. and Riley, J. P.
THE USE OF LOW-TEMPERATURE CRYSTALLIZATION IN THE DETERMINATION OF COMPONENT ACIDS OF LIQUID FATS. III. FATS WHICH CONTAIN ELEOSTEARIC AS WELL AS LINOLEIC AND OLEIC ACIDS.
J. Soc. Chem. Ind. 65, 74-81 (1946); C. A. 40 4535-6 (1946)

"The general principles of analysis were previously described by Hilditch, et al. (C.A. 39, 5513 ; 40, 3007). Each fraction of acids was analyzed spectrographically before and after isomerization with alkali, to det. the proportions of alpha-eleostearic and linoleic (and, if present, linolenic) acids. The characteristics of American tung, Chinese tung, essang (*Ricinodendron africanum*), neou (*Parinarium macrophyllum*), and krobanko (*Telfairia occidentalis*) oils, resp., were: sapon. equiv. 286.7, 288.7, 291.2, 299.3, 277.7; I No. (Wijs) 163.0, 162.6, 150.8, 108.2, 109.0; n_{40} 1.5133, 1.5120, 1.5010, 1,4848, 1.4772; and the compns. of their resp. fat acids were: palmitic 5.5, 4, 9.5, 12, and 15%; stearic --, --, 1,2, and 9%; oleic 4,9,9.5, 40, and 27%; linoleic 8.5, 10, 26, 15, and 29%; alpha-eleostearic 82, 77, 54, 31, and 20%. Two points of interest emerged: (1) None of the 4 eleostearic-contg. fats contained the nonconjugated triene linolenic acid; this suggests the possibility that the 2 triene acids do not accur together in the same vegetable fat. (2) The diminution in eleostearic acid content is most clearly paralleled by increase in the satd. acids. In regard to the possible economic value of the last 3 oils: they are freely produced in Nigeria; neou and essang nuts have the disadvantage of high shell content, although the kernels are rich in fat and readily extractable once they are decorticated. Krobanko oil appears to have little tech. outlet." From C. A.

Hildith, T. P. and Sleightholme, J. J.
NATURE OF ANTIOXYGENS PRESENT IN NATURAL FATS. I. SEPARATION OF FATTY DERIVATIVES FROM ANTIOXYGENS BY DISTILLATION.
J. Soc. Chem. Ind. 51, 39-44T (1932); C.A. 26, 2881 (1932).

"Lab. expts. with olive, tung, linseed and codling-liver oil on the absorption of O at 100° (70° for linseed oil) show a distinct "induction period" at the start, great for olive oil, small for tung oil. The fatty acids prepd. from the oils had a shorter induction period, and a still further decline was noted when the acids were distd. but the induction period was partly restored when the acids were esterified. The shortest induction period was shown by synthetic glycerides prepd. from the distd. acids of olive and linseed oil. The max. rates of O absorption after the induction period were of much the same order for any particular oil and its corresponding mixed acids or esters, distd. or undistd. Mild NaOH treatment of the oil or boiling with dil. HCl almost eliminates the induction period, while agitation with a small quantity of concd. H_2SO_4 increases the original induction period greatly. The results confirm the view that there are natural antioxygenic compds. present in oil which cause the induction period and the chem. compn. of which probably varies with different oils." From C. A.

Holde, D., Bleyberg, W., Aziz, M. A.
TUNG OIL. III
Farben-Ztg. 34, 1725-6 (1929); C.A. 23, 3358 (1929)

"To ascertain if the hydroaromatic derivs. were present, as previously suggested, the dehalogenated products were oxidized with $KMnO_4$ or chromic acid and tested for the presence of phthalic acid. The resorcinal -H_2SO_4 fluorescence test was modified by heating the sample with addn. of H_2SO_4 to 205-10°. No evidence of phthalic acid was found." From C. A.

Holley, C. D., and Roberts, J. P.
COMPOSITION OF CHINESE WOOD OIL.
Drugs, Oils & Paints 32, 8-9 (1916); C.A. 10 2155 (1916)

"China wood oil is composed of the glycerides of oleomargaric and oleic acids, and since the latter exhibits normal dispersion, the "turning point" of a pure oil depends on the amt. of olein present. An oil with a standard turning point of 15.5 has been reported to contain 10% olein (C.A. 8,3244). Shipment of oil during 1913 to 1915 have uniformly given this standard turning point probably due to similar climatic conditions or to the aging and settling together of the various lots in large tanks. Out of 8 recent shipments, 3 showed turning points of 12 to 15, high acid values of 6 to 7, and their action in the varnish kettle was decidedly unsatisfactory. H. and R. believe that the difficulty in obtaining the desired "body" with these oils was partially due to the 0.5 to 3.0% adulteration considered to be present, and partially to the high acid values. The 5 remaining shipments gave turning points between 19 and 21, acid values of 1.5 to 2.1, and were far superior in the kettle to any oil received in recent years. Expts. with Brown's test show that high acid values have a strong influence on the heat treatment of an oil, and that an oil with acid value above 4 and turning point below 15.5 will be found very slow and unsatisfactory in the kettle. Oleic and olein acid affect the turning point to a greater extent than the vegetable oils. Low acid oils giving a turning point of 21 must contain approx. 5% less olein than a "standard" oil. Such oils permit extensive adulteration without detection by the usual heat tests; 15% linseed or soybean oil can be added and the "gel point" by Brown's method still be within the time limit of the Am. Soc. for Test Mat. specification for purity of raw Chinese Wood oil (C.A.10,974) Results are tabulated." From C. A.

Karnovsky, M. L., Rapson, W. S., and Black M.
SOUTH AFRICAN FISH PRODUCTS. XXIV. THE OCCURRENCE OF ALPHA-GLYCERYL ETHERS IN THE UNSAPONIFIABLE FRACTIONS OF NATURAL FATS.
J. Soc. Chem. Ind. 65, 425-8 (1946); C.A. 41, 3308 (1947)

"The analyses of several marine substances for the presence of a-glyceryl ethers in the unsaponifiable fractions indicate that the presence of vitamin A interferes with the detn. The amts. of HCHO liberated when the unsapond. fraction of vegetable fats is oxidized with periodic acid are negligible; therefore this type of linkage is characteristic of animal fats. The only vegetable fat showing any quantity of a-glyceryl ethers is tung oil." From C. A.

Kaufmann, H. P.
DETERMINATION OF THE COMPOSITION OF WOOD (TUNG) OILS WITH HELP OF THE THIOCYANOGEN VALUE.
Ber. 59 1390-1397 (1926); Brit. Chem. Abstracts 1926, B, 758.

"Addition of thiocyanogen to compounds containing ethylenic linkings is even more markedly selective than that of bromine. In glacial acetic acid-carbon tetrachloride in the dark, addition takes place with ethylene, butylene, phenylacetylene, tolane, anethole, safrole, allyl alcohol, oleic, elaidic, erucic, brassidic, ricinoleic and ricinelaidic acids, ethyl acetoacetate, acetyldibenzoylmethane, ethyl diacetylsuccinate (α, β, form), ethyl formylphenylacetate (γ form), antipyrine, and pinene, but not with acetylene, styrene, stilbene, crotonic, fumaric, maleic, and cinnamic acids (or their esters), cinnamaldehyde, ethyl diacetylsuccinate (α_2, β and α forms) stearolic and behenolic acids. Since linoleic acid, its methyl ester and glyceride add 2 mols. of bromine but only 1 mol. of thiocyanogen, the proportion of linolein in glycerides of fatty acids which add thiocyanogen quantitatively (e.g. oleic acid), and indifferent substances in an oil can be deduced from the thiocyanogen and bromine values. Elaeostearic acid, which polymerises much more readily than has been suspected previously, absorbed only 1 mol. of thiocyanogen whereas 2 mols. of bromine are added from solution in methyl alcohol saturated with sodium bromide and 3 mols. from solutions in carbon tetrachloride exposed to light (thus confirming the constitution $CH_3(CH_2)_3\ (CH{:}CH)_3\ .\ (CH_2)_7\ .\ CO_2H$ for the acid). The composition of various samples of tung oil deduced from the iodine and thiocyanogen values, is elaeostearin 78.5-87.1%, olein 8.5-22.8%, and in some cases, glycerides of saturated acids and unsaponifiable matter." From British Chem. Abstracts.

Kaufmann, H.P., and Baltes, J.
THE FIELD OF FATS. XXX. DIENE SYNTHESES IN THE FIELD OF THE FATS. 2. COMPOSITION OF CHINESE WOOD OIL.
Ber. 69B, 2676-9 (1936); C.A. 31, 2032 (1937)

"The diene no. of fats (C.A. 30, 7885), in connection with the I. and SCN nos., makes it possible to det. the compn. of oils which, in addn. to satd. and unsatd. acids, also contain acids with conjugated double bonds. The eleostearic acid (I) in Chinese wood oil has 3 double bonds which are conjugated and therefore show diminished reactivity. Their power to add Br decreases with increasing satn.; as a rule only 2 of the double bonds react, unless the soln. is exposed to ultraviolet light. The I no. of the acid can therefore be correctly detd. only under special conditions. With $(SCN)_2$ only 1 double bond reacts. Hence, in the presence of other polyunsatd. fat acids, detn. of the individual constituents is very difficult. Two Chinese Wood oils (II and III) gave the following I, SCN and diene nos., resp.; II, 160.8, 84.0, 68.0; III, 163.2, 84.7, 70.0. The diene nos. indicated that II and III contained 74.5 and 76.7% resp. of I, while the I and SCN nos. alone would point to about 9.5% more of I. The above described behavior of I in I and SCN no. detns. led to the suspicion that the oils contained another doubly unsatd. acid with the same I and SCN nos. as I, and linolic acid was, as a matter of fact, detected in the form of the tetrabromide. After detg. the unsaponifiable material, the compn. of the oils could not be detd. from the diene. I and SCN nos. II contained 74.5%, I,9.7% linolic, 8.0% oleic, 3.3% satd. acids, 0.1% unsaponifiable, 4.5% glycerol residue; the corresponding values for III were 76.7, 9.3, 6.9, 2.6, 0.05, 4.5. The satd. acids, as detd. by the Bertram method as a check, were 3.7 and 3.4% resp." From C. A.

Leon, J. van
THIOCYANOMETRY OF TUNG OIL.
Z. Untersuch. Lebensm. 60, 320-7 (1930)*; Brit. Chem. Abstracts 1931A, 602; C.A. 25, 4727 (1931).

"When sufficient excess of reagent was used β-eleostearic acid gave a thiocyanogen-I value of 91.7 or 1/3 the normal. Upon storage in CO_2 for several days the acid gave low values unless a large excess of reagent was present. This action is attributed to polmyerization. α-Eleostearic acid had a thiocyanogen-I value slightly above that of the β-isomeride. Possibly an unknown acid is present in the product. The thiocyanogen-I value of the α-acid is also lowered by polymerization and oxidation Δ^{ck}-octadienoic acid, which has 2 double linkages similarly situated to 2 of those in eleostearic acid, gave the theoretical I value of 181 with Wijs' I or Kaufmann's Br method. When an excess of 200-300% of halogen was present; the thiocyanogen-I value was 107.0-108.4. Conclusion: --Two isomerides are present which behave differently toward the thiocyanogen reagent. The thiocyanogen-I value of various tung oils unaltered by storage varied from 90.9 to 94.8, being much higher than the highest value, 81, which corresponds to a mixt. of glycerides of oleic and α- or β-eleostearic acids with 5% of satd. acids. A hitherto unknown acid, $C_{18}H_{30}O_2$, γ-eleostearic acid, is present which adds thiocyanogen corresponding with 2 double linkings. Tung oil must contain about 15.5% of this acid. This conclusion is confirmed by the thiocyanogen-I values found for the free fatty acids." From C. A.

Leon, J. van
COMPOSITION OF WOOD OIL AND THE CHANGES OF ITS COMPOSITION DURING POLYMERIZATION.
Verfkroniek 6, 184-7 (1933); C.A. 27, 5557 (1933)

"A lecture, reviewing properties of China wood oil and difficulties in its assay." From C. A.

McKinney, R. S. and Jamieson, G. S.
THE COMPOSITION OF AMERICAN TUNG OIL.
Oil & Soap 12, 92-3 (1935); C.A. 29, 4190, 5290 (1935)

"The consts. found on a sample of Florida tung oil were: n_{25} 1.5165, sapon. no. 193.6, I no. (Rosenmund-Kuhnhenn) 162.0, I no. (Hanus) corrected 246.9, thiocyanogen no. 82.75, percentage of insol. fat acids 95.4, satd. acids 4.40, unsatd. acids 90.6, unsaponifiable matter 0.47%, I no. of unsaponifiable matter 74.0. The compn. of the oil was: eleostearic acid 72.8, oleic acid 13.6, satd. acids 4.9, volatile substances 3.4, glyceryl radical 4.7 and unsaponifiable matter 0.5%." From C.A. 4190

"In C.A. 29, 4190 , the compn. of the oil as given is for the figures of van Leon. The percentage in terms of glycerides as found by the authors was: eleostearic acid 94.1, oleic acid 0.8, satd. acids 4.6 and unsaponifiable matter 0.47." From C.A. 5290

McKINNEY, R. S., and Jamieson, G. S.
A FURTHER STUDY ON THE COMPOSITION OF AMERICAN TUNG OIL WITH SPECIAL REFERENCE TO THE LINOLEIC ACID CONTENT.
Oil & Soap 15, 30-2 (1938); C. A. 32, 3173 (1938).

"The complete sepn. of eleostearic acid from linoleic acid by the irradiation and crystn. of tung oil fat acids was found almost impossible. The application of several cold alk. permanganate oxidation procedures to samples of tung oil fat acids indicated the presence of less than 1% of linoleic acid. A study of the reaction of maleic anhydride with α-and β-eleostearic acids and with the α-eleostearic acid glyceride present in tung oil showed that this reagent does not react with them quantitatively but only to 86.6% of the theoretical amt. The eleostearic acid content of a tung oil can be calcd. by dividing its diene value by 78.4, the detd. diene value of pure eleostearic acid. By this method 2 samples of American tung oil were found to contain 85.5 and 89.4% of eleostearic acid. α-Eleostearic acid and the mixed fat acids from tung oil when exposed to the air quickly undergo a change to form an extremely sticky material whose use as an adhesive for insecticides will soon be detd." From C. A.

Phillips, E. P.
TUNG OIL.
Farming S. Africa 6, 507 (1932); C.A. 26, 4967 (1932)

"The oil content of tung nuts grown in S. Africa amounted to 21.8% of the whole fruit or 60.25% of the kernel. The oil contained glycerides of eleostearic acid 80.95, oleic acid 16.4 and satd. acids and unsaponifiable matter 2.65%; n^{25} 1.5189, acid value 2.32, heat test 10.5, I value 173.2, hydrogenation value 225.9 and partial I value 84.7." From C.A.

Piskur, M. M.
ANNUAL REVIEW OF LITERATURE ON FATS, OILS, AND SOAPS. II. REPORT OF THE LITERATURE REVIEW COMMITTEE.
J. Am. Oil Chemists' Soc. 26, 216-35 (1949); C.A. 43, 5205 (1949).

Vaccenic acid, thought to be a growth-promoting factor in butter, has been isolated from tung and proved to have no nutritive effect. Refractive index and dispersion measurements have been recommended for detection of adulteration of tung oil.

Rathje, A.
NEWER INVESTIGATIONS OF THE FATS OF LYCOPODIUM, ERGOT, ARECA NUTS, AND SEEDS OF *ALEURITIS CORDATA*.
Arch. Pharm. 246, 692-709 (1909) ; C.A. 3, 961 (1909)

"*Aleuritis cordata* or Chinese Tung Oil: sp. gr. 0.9383, n. 1.503, sapon. No. 191.5, acid no. 10.4, ester no. 181.1, I no. 156.2, Reichert-Meissel no. 1.04, Hehner no. 96.05, acetyl no. 14.05 (true 10.5), glycerol (direct) 10.45%, (indirect) 8.5, unsapon. matter 0.45, inorg. matter 0.0016. Fatty acids, immediately after isolation m. 39-40°, neutraliz. no. 189.4, calc. mol. wt. 296.5, I no. 163.4. Composition, oleomargarinic acid 75%, oleic acid 25%." From C.A.

Steger, A. and Loon, J. Van

COMPOSITION OF CHINESE WOOD OIL (TUNG OIL).

J. Soc. Chem. Ind. 47, 361-3T (1928); C.A. 23 5050 (1929)

"The authors give an account of the preliminary analysis of a typical wood oil, which they believe to consist principally of the glyceride of an isomeride of linolenic acid. Practically only fatty acids with an 18-C straight chain are present; the satd. fatty acids appear to consist of a mixt. of 75% of palmitic and 25% of stearic acids." From C. A.

Wehmer, C.

DIE PFLANZENSTOFFE, Bd. 2.

Verlag von Gustav Fischer, Jena, Germany, Ed. 2, Vol. 2, pp. 683-5, 1931.

A review of the composition of tung fruit and tung oil, with numerous references.

Yakubovich, S. (or Jakubowitsch, S.) and Terekhov, K (or Terechow, K.)

THE INFLUENCE OF THE COMPONENTS OF A LACQUER UPON ITS RESISTANCE TO THE ACTION OF AIR.

Malyarnoe Delo 1932 (7), 24-9; Chem. Zentr. 1933, I, 3009; C.A. 28, 6000 (1934).

Of the lacquers investigated, which were prepd. with a base of linseed or wood oil, those without the addn. of resins proved most satisfactory. Indeed, resin esters, as Ca resinates, impair the properties of the lacquer. Linseed-oil lacquers were less resistant than those prepd. from wood oil.

(C) Properties

Anonymous

SEEDS OF ALEURITES FORDII AND ALEURITES TRILOBA FROM HONG KONG.

Bull. Imp. Inst. 5, 134-6 (1907); J. Soc. Chem. Ind. 26, 976 (1907).

"This species of *Aleurites* is grown in the Fokien province of China, and the tung oil of commerce appears to be obtained from its seeds as well as from those of *A. cordata*, formerly regarded as the sole source of the oil. The kernels extracted with petroleum spirit yielded 58.3 per cent of oil (36.4 per cent on the whole nuts) of a light colour and with good drying properties. Analytical values: - Sp. gr. at 15° C., 0.9404; acid value, 2.89; saponification value, 191.8; Hehner value, 94.6; iodine value, 166.7 and titer test, 42°-42.5° C. The oil was lighter in colour and had a higher titer than has the tung oil of commerce (37.1° to 37.2° C.)." From J. Soc. Chem. Ind.

Anonymous

WOOD OIL FOR TINS CONTAINING FOOD PRODUCTS.

Farben-Ztg., 18, p. 2754 (1913).

Wood oil-rosin varnishes have been used for years in food containers (e.g., fish cans and mustard covers) with no indication of toxicity. Editor's note: Crude wood oil causes skin sores but dried wood oil varnish is probably harmless.

Anonymous

NEW OILS FOR THE PAINT AND VARNISH INDUSTRY OF THE U. S.

Farben-Ztg., 24, 620 (1919); C.A. 13, 2289 (1919).

"The author tabulates some of the usual "constants" and gives production data on sunflower-seed, lumbang, perilla, tung, and soy-bean oils." From C. A.

Anonymous

TUNG SEED AND OIL FROM EMPIRE SOURCES.

Bull. Imp. Inst. 30, 271-82 (1932); C. A. 27, 432 (1933).

"Samples of fruit, seeds or oil produced in the course of expts. on the cultivation of tung trees in various parts of the British Empire (Assam, India, New South Wales, Natal, Nyasaland, Ceylon) were examd. The compn. and quality of the oils obtained from Aleurites fordii were similar to those of American oils of the same species. Oil obtained from A. montana grown in Ceylon was similar to the com. Chinese oils." From C. A.

Anonymous

TUNG SEED AND OIL FROM EMPIRE SOURCES. II.

Bull. Imp. Inst. 31, 327-34 (1933); C. A. 28, 1553 (1934).

"A sample of Aleurites fordii fruits from Bihar and Orissa, India, were of satisfactory compn., and contained a normal percentage of oil, which was apparently of good quality. A sample of A. fordii oil from Bihar and Orissa had the following characteristics: $d_{15.5}^{15.5}$ 0.9391, acid no. 0.2-0.3, sapon. no. 192.3, n_{25} 1.514, I no. (Wijs) 175.5, heat test (A.S.T.M.) 10.25 min., color pale yellow. Oil extd. in a lab. press from A. fordii grown in Nairobi, Kenya, in 1931 and 1932, resp., had the following characteristics: color (Lovibond, 1-cm. cell) red 0.30, 0.36; yellow 1.0, 1.4; n_D^{25} 1.5181, 1.5181; d_{25} 0.9361, 0.9358; heat test 12.25 min.; acid value 0.6, 0.4; I value 167.7, 168.0; sapon. value 192.6, 194.4. Oil cold-pressed in the lab. from A. fordii grown at Misiones, Argentina, had the following characteristics: color (Lovibond, 1-cm. cell) red 0.24, yellow 1.2, acid value 0.37, I value 167.0, heat test 11.5 min., n_D^{25} 1,5178, d_4^{25} 0.9334. Comparative tests on the natural and artificial weathering of varnishes prepd. with oils of A. montana and A. fordii showed little difference between the 2 varnishes, but reliable conclusions can be drawn only from experience of some hundreds of prepns." From C. A.

Adriaens, L.

THE DRYING OILS OF ALEURITES.

Congo 1, 499-519 (1938)*; Chem. Zentr. 1938, II, 3480; C.A. 34, 3108-9 (1940).

"The oils of the varieties of Aleurites dry more rapidly than linseed oil although they have a lower apparent I no. This is due to the fact that the α- and β-elaeostearic acids, constituents of Aleurites oil, possess a system of 3 conjugated double bonds. It dries rapidly but reacts with the theoretical amt. of I only very slowly. Of the oils which are obtained in the Belgian Congo, the following characteristic properties are reported: Oil from Aleurites triloba: d^{15} 0.9276, $n^{22.5}$ 1.4745, acid no. 33.1, sapon. no. 193.9, apparent I no. (Wijs) 156.1-162; two oils of Aleurites cordata; d^{15} 0.9378 and 0.9390, n^{45} 1.5180 and $n^{20.5}$ 1.4989, acid no. 2.0 and 1.42, sapon. no. 201.6

and 189.0, apparent I no. (Wijs) 167.0-71 and 162.9, true I no. for the 2nd oil (Wijs) 196.0; 2 oils from *Aleurites montana* d^{15} 0.9402 and 0.9275; $n^{20.5}$ 1.4983 and n^{20} 1.4761, acid no. 0.92 and 1.69; sapon. no. 196.86 and 199.0, apparent I no. (Wijs) 170.8 and 143.7-51.5, true I no. (Wijs) 196.0 and 158.8. Varieties of *Aleurites* acclimated in Belgian Congo yield oils with the properties of wood and tung oils. The oils from *Aleurites montana* contain 1 or 2 eleostearic acids." From C.A.

Barry, T. Hedley

OIL FROM MALAYAN *ALEURITES MONTANA* AND THE PROPERTIES OF HONG KONG OIL.
Analyst *57*, 85-93 (1932); C. A. *26*, 2069 (1932).

"As a general conclusion from the samples examd. it would appear that Hong Kong wood oil frequently has a *n* below the accepted min. of 1.518 and this may be due to the presence of oil from *A. montana*. There is at present no standard method of detg. the presence of the latter in China wood oil and more work upon the characteristic properties of these 2 oils is necessary and is of practical importance to the varnish maker." From C. A.

Bauer, K. H.

JAPANESE WOOD OIL.
Chem. Umschau *32*, 3-4 (1925); C. A. *19*, 1501 (1925).

"A sample of Japanese wood oil showed the following consts.; I no. 144.1 (Hanus), sapon. no. 193.5, d_{20} 0.929, n_D^{20} 1.5046. The fatty acid, liberated and recrystd. from 75% alc., was eleostearic acid. No satd. acids were found by the LiOAc method, but the presence of oleic acid was confirmed. The smeary oxidation product was dried with sand, and extd. with petroleum ether and with ether, and the latter ext. dried and recrystd. from alc., yielding crystals of dihydroxystearic acid, m. 130°. A detn. of oleic acid was attempted by exposure of the oil to light in the presence of I, to convert the α into β-eleostearic acid, sepn. and neutralization of the fatty acids, filtration, sepn. of the fatty acids from the filtrate and isolation of the oleic acid by extn. with ether, yielding an acid of 102 I no. (Hanus), which gave with NO a white cryst. mass m. 50-51° (elaidic acid). The detn. was unsuccessful on account of the ready soly. of K β-eleostearate (in H_2O 23.3%, in 50% alc. 18% and in 96% alc. 13% at 20°). Further tests by heating the oil 12 hrs. to 200° yielded a soft, sticky mass for Japanese oil, while Chinese wood oil turned into a solid of rubber consistency; exposure to light in the presence of 1.3% I started a pptn. of the β-eleostearic acid in 2 hrs. for Chinese and in 6 hrs. for Japanese wood oil; both became solid after 36 hrs. The fatty acids, dissolved in petroleum ether, gave on exposure to light in the presence of I results similar to those with the oil itself." From C. A.

Benedikt, R.

JAPANESE WOOD OIL.
In Lewkowitsch, J. (translator). Chemical Analysis of Oils, Fats and Waxes. Macmillan, London, 1895, p. 295.

The oil of *Elaeococca vernicia* (also huile de bois, oelfirnisbaumoel, tungoel) is yellow if cold-pressed, brown if hot-pressed. It thickens on cooling to -18° C. but does not solidify, has a sp. gr. of 0.940 (15°) and a sap. value of 211. It has been reported (Cloez) to be composed of glycerides of oleic and elaeomargaric acids.

Bless, A. A.

POLARIZATION AND ELECTRIC MOMENT OF TUNG OIL.

Physical Rev. [2] 37, 1149-1154 (1931); Brit. Chem. Abstracts 1931, A, 786.

"The method of mixtures gave the values 360 c.c. and 2.29 x 10^{-18} e.s.u. for the molar polarisation and moment, respectively. Values of the moment of tung oil and of Et_2O determined from the variation of the polarisation with temp. disagree with those from the method of mixtures, due probably to the nonelimination of the internal field." From C. A.

Boekenoogen, H. A.

THE VISCOSITY OF THE VEGETABLE OILS AND FATS.

Chem. Weekblad 34, 759-61 (1937)*; C.A. 32, 4365 (1938).

"A list of the viscosities of a large no. of vegetable oils and fats at different temperatures as well as I absorption nos. is given. The Heppler viscometer was used. A comparison with the results of Engelhard shows on the whole good agreements. The following oils showed viscosities that different considerably from those found by Engelhard: safflower-, groundnut-, wood (*Aleurites montana*)- and ongokea oils." From C. A.

Boelman, A. B.

WOOD OIL OF ALEURITES MONTANA.

Indische Mercuur. 60, 191-4 (1937)*; C.A. 31, 4513 (1937).

"Analysis of numerous samples of Dutch-Indian tung oil shows the following range; d_{15}^{15} 0.9421-0.936, acid no. (KPH/g. oil) 6.7-0.2, sapon. no. 194.7-190.2, unsapon. 1.05-0.41, n_D^{25} 1.52-1.486, I. No. (Wijs) 166.9-160.3, gelatinizing time (min.) 24-5/6 - 12-3/4. dispersion (n_f - n_c X 10^4) 206-192. Although these variations are wider than those for Chinese tung oil (from *A. fordii*) the technological values of the 2 oils are practically equiv." From C.A.

Böeseken, J.

CHARACTERISTIC ACIDS OF DRYING OILS.

Chem. Weekblad 31, 418-19 (1934); C.A. 29, 2002 (1935).

"Drying oils are divided according to their compn. into 2 classes, of which linseed oil and tung oil, resp., are representative members." From C. A.

Bolton, E. R., and Williams, K. A.

THE GROUPING OF FATTY OILS WITH SPECIAL REFERENCE TO OLIVE OIL.

Analyst 55, 5-11 (1930)*; C.A. 24, 1755-6 (1930).

Tung oil falls in group III, oils having iodine numbers of 117-124.

Bruno, Francesco.

EXPERIMENTS ON ALEURITES.

Agr. coloniale 34, 479-80 (1940)*; C.A. 35, 3740 (1941).

"From the seeds of *A. moluccana* cultivated in Sicily (contg. H_2O 4.73, protein 22.60, fat 54.40, N-free ext. 8.50, ash 3.80%) an oil was extd. of d_{20} 0.9250-7, acid no. 0.315-0.375, sapon. no. 190-192, I no. 160.38-163.2, unsapon. matter 0.8-1.0%, n_{25} 1.4747-1.4759; av. yield on extn. with Et_2O 53.50%." From C.A.

Caldwell, B. P., and Payne, H. F.

DIELECTRIC CONSTANT AND EFFECTIVE DIPOLE MOMENT OF DRYING OILS.

Ind. Eng. Chem. 33, 954-60 (1941); C.A. 35, 6471-2 (1941).

"To aid in identifying drying oils and mixts. thereof and to study the effect of heat bodying dielec. consts. were detd. on the Schering bridge at 60 cycles and by resonance at 45-60 megacycles for linseed, perilla and tung oils, which give similar values, and also for oiticica oil, in which the ketonic group gives a large increase in polarity. Mixts. of tung and oiticica oils can be identified by d. and dielec. const., while mixts. of tung with linseed or perilla can be identified from n. The dielec. const. of linseed oils increases with heat bodying when measured on the Schering bridge, but decreases according to the resonance method at high frequency. Results agree with the work of Stoops (C.A. 26, 2627)." From C. A.

Clark, Paul E., Waldeland, C. R., and Cross, Robert P.

SPECIFIC HEATS OF VEGETABLE OILS FROM 0° to 280°C.

Ind. Eng. Chem. 38, 350-3 (1946); C.A. 40, 2655 (1946).

"Sp. heats were obtained by measuring the temp. rise-heat input relation for a known wt. of oil in a Dewar flask. The detns. consisted of a series of runs carried out at a temp. interval of 10 degrees or more higher than the preceding one without changing the oil. Despite a N atm., polymerization occurred as evidenced by drop in I no. and rise in η for all the oils except castor oil for which the reverse occurred; tung oil gelled at 200°. The sp. heat-temp. curves are almost linear and have the same slope for all the oils over most of the temp. range, though they rise slightly at the higher temps. Sp. heat values (best straight line) range from 0° to 280° as follows; hydrogenated cottonseed oil - 0.48 to 0.64, castor oil - 0.49 to 0.64, soybean oil - 0.45 to 0.65, tung oil - 0.44 to 0.60, linseed oil - 0.44 to 0.63 and perilla oil - 0.41 to 0.57 cal./g. degree." From C. A.

Davis, N.S., Jr. and Curtis, H.A.

PREFERENTIAL WETTING OF SOLIDS BY LIQUIDS.

Ind. Eng. Chem. 24, 1137-40 (1932); C.A. 26 5816 (1932).

"A study was made of the preferential wetting of H_2O versus xylene, toluene, aniline, turpentine, $CHCl_3$, $PhNO_2$ nitrobenzene, amyl alc., cottonseed oil, linseed oil, paraffin oil, mineral oil, lard oil, rosin oil, olive oil, oleic acid, corn oil, oil of sesame, sperm oil, castor oil, coconut oil, EtOAc, $PhNMe_2$, furfural, BzH, and tung oil for S, pptd. $CaCO_3$, ZnO, $PbCO_3$ sphalerite, pyrolusite, hematite, malachite, galena, smithsonite, covellite, realgar, cerusite, stibnite and pyrite." From C. A.

Dingman, S. T.

OILS FOR FINISHING MATERIALS.

Metal Finishing 1943, 41, 597-600, 613 (1943)*; C.A. 39, 2890 (1945).

"Drying and semidrying oils are discussed, with special reference to linseed, tung, soybean, perilla, oiticica, and fish oils. Iodine values, sapon values, and d. of 37 oils are given. The use of drying agents, especially those contg. Co, Pb, or Mn, is considered."
From C.A.

Drinberg, A. Ya., and Shepelev, A. I.

INVESTIGATIONS IN THE FIELD OF POLYMERIZATION AND DRYING OF OILS AND ESTERS OF FAT ACIDS. II. HEAT OF POLYMERIZATION AND THE PROBABLE CHARACTER OF POLYMERS OF OILS.

J. Gen. Chem (U.S.S.R.) 10, 2059-64 (1940) (in Russian)*; C.A. 35, 4615 (1941).

"The process of polymerization of 4 oils, tung (I), linseed (II), sunflower (III), and cottonseed (IV) were investigated, in order to verify the basic theses of our first report. The heat of polymerization of the vegetable oils was detd. as the difference between the heat of combustion of the raw and polymerized oil. 2 series of heat detns. in the absence of air and in an atm. of N were made: 1 during 3 hrs. at 300° and the 2nd between 280-90° until gelation. The heat of polymerization of the investigated oils at 280-90° till gelation were: I U found 9378-9060 = 318 cal./g. Correction for the heat of combustion of the fuse = qi = 22.25 cal./g. II U found 9436-9206 = 230 cal./g., calcd. 238 cal./g., qi = 19 cal./g. III U found 9522-9377 = 145 cal./g., calcd. 181 cal./g., qi = 19 cal./g. IV U found 9490-9375 = 115 cal./g., calcd. 167 cal./g., qi 19 cal./g. From these and other exptl. considerations the following conclusions were drawn: The chosen method of calcn. of potential functionality, heat of polymerization and depth of reaction that take place on the polymerization of vegetable oils give results, which approach those found experimentally. The study of coeff. of reaction completion shows that on heating oils for a short period 2 functional groups are seemingly spent on the intermol. reaction for each functional group spent on the intermol. process of polymerization. Linseed oil is an exception, where as an av. 1.5 functional groups are spent on the intermol. reaction. A rearrangement occurs on prolonged heating of semidrying oils, as a result of which the no. of functional groups used for the intermol. reaction is increased. The thermochem. method is not accurate enough on account of the calorimeter error, the absence of calcns. of heat of gel formation and inaccuracies of the cryoscopic method of mol. wt. detn. of oil. Further investigations were to be made to eliminate these shortcomings." From C. A.

Eibner, A.

CLASSIFICATION OF DRYING FATTY OILS ACCORDING TO THEIR DRYING PROPERTIES.

Farbe u. Lack 1926, 463-4, 472-3*; C. A. 21,184 (1927).

"The quant. analysis of the fatty oils gives the basis for their classification as pigment cement. E. gives the percentage of α-, β-linolenic, α-, β-linoleic and oleic acids for the following oils: perilla, linseed, pineseed, firseed, walnut, soy, poppy and sunflower oil. These oils are listed in the order of decreasing usefulness. Fish oils were found unsatisfactory for paints. Wood oils, although different in constitution, have properties similar to linseed oil." From C. A.

Fauve, M.

POSTWAR DRYING OILS IN THE PAINT AND VARNISH INDUSTRY.

Peintures, pigments, vernis 20,43-7 (1944); C.A. 40,6835 (1946).

The production of dehydrated castor oil is discussed and its properties compared with those of tung and other oils.

Frahm, E.D.G.,and Koolhaas, D. R.
RELATIONS BETWEEN THE CONSTANTS OF WOOD OIL.
Rec. trav. chim. 57, 79-89 (1938) (in English); C.A. 32, 3174 (1938).

"The diene no. (D. N.) was detd. by the method of Ellis and Jones (C.A. 31, 897) for 75 samples of fresh wood oil from *Aleurites montana* seeds obtained from various parts of Java and was found to be related to the n as follows: D. N. = 1400 (n_D^{25} - 1.4681). The agreement between found and calcd. values was good for fresh oil but not always for old samples where the oil had partly polymerized or had an abnormally high acid no. The bromometric I no. (Br. I. N.), with 50% excess of 0.1 N Br in MeOH satd. with NaBr and a reaction time of 5-15 min., was found to equal 925 (n_D^{25} - 1.3414) and the Wijs I no. (I. N.) = 1300 (n_D^{25}- 1.3883). Hence Br. I. N. = 0.66 D. N. + 117.2 and I. N. = 0.93 D. N. + 103.7. The dispersion, $n_F - n_C$ = 0.25 (n_D - 1.4367). The variations in $d_{15.5}^{15.5}$, 0.938-0.941, and in sapon. no., 190.6-196.3, were too small to be correlated with n_D. The gelatinizing time at 282° is given by 71.4 - 6/7 D. N. + 0.3 A. N. (acid no.) This equation indicates that pure beta-trielecstearin (D. N. = 87.4, A. N. = 0) would gel instantly even below 282°, as is partly borne out experimentally. The D. N. and n_D^{25} of fresh *montana* oil at various stages of polymerization at 180° are related by a linear equation similar to that for fresh oil. Values obtained in the polymerization of old *montana* oil and of oil from *A. fordii* give similar equations. The Br. I. N. and dispersion are similarly related to n_D^{25} for each oil. All decreased with n_D^{25}. Detn. of the intersections of the lines representing these relations for fresh and polymerized oils enables one to est. the consts. of a sample of oil in its original condition even though only polymerized samples are available." From C. A.

Frahm, E.D.G.,and Koolhaas, D.R.
CHEMICAL COMPOSITION AND EXAMINATION OF ALEURITES (TUNG) OILS.
Chem. Weekblad, 35, 643-655 (1938)*; Brit. Chem. Abstracts B, 1186 (1938).

"From a review of the literature the following consts. are recorded for *A. trisperma*, *A. cordata*, and *A. moluccana*, respectively, new measurements being recorded in parentheses: $d_{15.5}^{15.5}$ 0.935-0.937 (0.9344), 0.930-0.940, 0.925-0.931 (0.9273); n_d^{25} 1.4869-1.4971 (1.4980), 1.498-1.508, 1.476-1.478 (1.4759); $10^4(n_f-n_c)$ (162), -, (97); acid val. 1-42 (4.9), 0.4-0.6, 0.5-8.1 (0.3); sap. val. 191-200 (190.8), 185-197, 175-214 (193.0); I val. (Wijs) 111-166 (133.1), 149-176, 101-160 (159.2); SCN val. 69.9; 78-87, 97.1; diene val. (43.2), -, (2.0), unsaponifiable matter 0.5 (0.5), 0.4-0.6, 0.3-0.9%. The following data are recorded on *A. trisperma* and *A. moluccana*: average seed wt. 4-5.5 (6.4), - (8.1; 9.5); kernel wt. on seed 51-64 (67.6), 30-43 (22.2; 35.4%); % of oil in dry kernel 53.7-62.5 (62.8), 59-69 (59.9-66.5). The difficulty of detecting adulteration is discussed. Analyses of press cakes from representative Aleurites are recorded for moisture, ash, N, oil, P_2O_5, K_2O, and CaO. This material is not suitable for food, but it makes a satisfactory manure." From Brit. Chem. Abstracts.

Fryer, P. J., and Weston, F. E.
OPTICAL DISPERSION FROM AN ANALYTICAL POINT OF VIEW.
Analyst 43, 311-7 (1918); C.A. 12, 2699 (1918).
"The dispersive power of fatty oils and fats is not in general of interest, the figure being inferior in discriminative value to the refractive index. Exceptions are China wood oil and coconut oil, which give relatively high and low figures, resp. Linseed oil is also well above the average. Free fatty acid has little effect on the dispersive power and slightly increases the value. Oxidation increases both n and dispersion. Polymerization increases the refractivity and lowers the dispersion except in the case of tung oil, which on heating gives a product showing a decrease in both the refractivity and dispersion." From C. A.

Gamble, D. L., and Barnett, C. E.
INFRARED ABSORPTION SPECTRA OF DRYING OILS.
Ind. Eng. Chem. 32, 375-8 (1940); C.A. 34, 2254 (1940).
"Results are given indicative of the possibilities of the method of infrared absorption spectra as applied to a study of phys. and chem. changes which take place during the formation and decompn. of films of drying oils. Advantages of this method are that it entails no chem. action on the paint film and permits study of the effects of infrared-transparent pigments on the changes occurring in the vehicle during drying and aging. Absorption spectra from 2 to 12μ are shown for linseed, China wood and oiticica oils, and for 4 glyceryl esters. Changes in the infrared absorption spectra caused by exposure of the esters to ultraviolet light and oxygen are discussed. They are believed to be due to polymerization of the ester to large mol. aggregates which effectively scatter the infrared radiation." From C. A.

Gardner, H. A.
AMERICAN TUNG-OIL EXPLORATION. CLIMATIC AND CULTURAL CONDITIONS, EXAMINATION OF OILS, ETC.
Paint Mfrs. Assoc. U. S. Circ. 123, 20 pp. (April 1921); C.A. 15, 2196 (1921).
"G. reports on the inspection of the principal tung plantations in the South. Oils expressed from 100 lb. lots of tung fruits from different communities, were all of a very light color, neutral, and in general of the very highest quality, -- superior to the best importations from China. Complete data are tabulated." From C. A.

Gardner, H. A.
AMERICAN TUNG OIL SUITABILITY.
Am. Paint Varnish Mfrs. Assoc. Sci. Sect. Circ. 342, 40-52 (Jan. 1929)
A compilation of comments and test results submitted by a number of users of tung oil pertaining to the quality of American tung oil in relation to that of the imported Chinese product.

Gardner, H. A., and Reilly, A.
JAPANESE TUNG OIL.
Paint Mfrs. Assoc. U. S. Circ. 138, 77-83 (1921); C.A. 16, 841 (1922).
"Japanese tung nuts from *Aleurites cordata* showed 37% shells and 63% meats contg. 51% oil. Examn. of the oil gave I no. (Wijs) 150, (Hübl) 154, sapon. no. 193, acid no. 0.9, $d^{15.5}_{15.5}$ 0.9342, n_{25} 1.4981,

A.S.T.M. heat test negative, drying time 43 hrs., viscosity 1.25 poises (cf. C.A. 7, 2315). The dried film was soft and opaque similar to that from Chinese tung oil. The oil bleaches readily on heating and becomes very viscous. Most of the heat treated oil when thinned with mineral spirits dried more slowly than the original to a similar soft opaque film; but on addn. of 10% of a Pb. Mn liquid drier, dried more quickly to a tougher, more brilliant and H_2O-resistant, clear film than bodied linseed oil thinned and treated in the same manner. The oil could possibly replace Chinese tung oil." From C. A.

Gardner, H. A., and Yarnall, W. P.
REPORT ON SPECIAL TUNG OILS.
Paint Mfrs. Assoc. U. S. Circ. [illegible]. 160, 96-8 (Dec. 1922).

"A tabulation and discussion of the phys. and chem. properties of 5 special tung oils produced by a modern process at Shanghai." From C.A.

Georgi, C.D.V., and Teik, Gunn L.
OIL FROM ALEURITES MONTANA.
Malayan Agr. J. 16, 296-8 (1928); C.A. 23, 1296 (1929).

"The oil content of the whole seed is 22.8%, and of the kernel 43.2%. The consts. of the oil are: $d_{15°}$ 0.939, $n_{20°}$ 1.5098, sapon. no. 195.5, I no. 160.3, unsapon. 0.6%, titer 36.8°, mean mol. wt. of fatty acids 298.4, neutralization value of fatty acids 188.0, I no. of fatty acids 164.7. The consts. are similar to those of Chinese wood oil, except for a small diff. in I no.; but there are marked differences from candlenut oil." From C.A.

Guiselin, A.
CHINESE WOOD OIL.
Mat. grasses, 3, 1689-91, 1729-31, 1762-4 (1910); C.A. 4, 1908-9 (1910).

"Oil imported into France under the name of Chinese wood oil is of two distinct kinds, one the product of *Elaeococca vernicifera* or abrasin; the other, of *Aleurites cordata*, also called camiri or bancoulier. The constants given by various authorities for "wood oil" apply sometimes to one, sometimes to the other, and sometimes partly to each. The oil of *Aleurites* appears to have the higher I value (and corresponds more closely to the commercial oil used in the U. S. -- Abstractor). The author obtained some seeds of *Elaeococca*, and found for different samples of the oil pressed or extracted from them, d_{15} 0.9340-0.9461; I no. of fatty acids, 123-157. He recommends that authentic samples of both varieties of seeds be obtained, and new detns. of the constants made." From C.A.

Halden, W.
SYSTEMATIC CLASSIFICATION OF FATS. II. PROPOSED CLASSIFICATION OF VEGETABLE FATS ACCORDING TO SCIENTIFIC AND PRACTICAL VIEWPOINTS.
Chem. Umschau 36, 109-15 (1929); C.A. 23, 3360 (1929).

"A new classification system is proposed for vegetable fats and oils, based on the botanical grouping by Engler and Gilg ("Syllabus der Pflanzenfamilien"). There are 37 botanical families, the members producing mainly drying oils; 64 families producing non-drying oils and fats; 14 families with members among both the drying and the non-drying oils, and 1 family (castor plant) which necessitated a 3rd division. The botanical character of the plants takes preference over the chem. properties of their oils. Members of one family produce mostly one type of oil and certain relationships exist between the oils of adjacent groups." From C. A.

Euphobiaceae family has members which produce drying oils (e.g., tung oil) and other members which produce non-drying oils.

Hall, C. H.

PHYSICAL AND CHEMICAL PROPERTIES OF WOOD OIL.

Seifenfabrikant 1904, . 393-4.

China wood oil has found extensive use in varnish manufacturing but its property of drying flat has prevented its use in paints. It is more viscous than linseed, has a flash point of 280° C. and a d^{15} of 0.944. It is light in color, becoming even lighter when heated with manganese borate. A gelatinous water-white solution can be prepared by heating the oil (100 parts) with white manganese borate (8) at 270° C. until foam appears, adding benzine (700) and allowing it to stand in air a few days.

Hall, C. H.

CHINA WOOD OIL.

Oil, Paint Drug Reptr. 27, (Feb. 22, 1904) .

This article is similar to "Physical and Chemical Properties of Wood Oil" (Der Seifenfabrikant 1904, pp. 393-4) by the same author.

Hauser, E. A., and Kolb, F. J., Jr.

APPLICATION OF THE SPECTROGRAPHIC METHOD FOR STUDYING THE RESIN BODYING OF DRYING OILS.

Official Digest Federation Paint Varnish Production Clubs No. 276, 84-95 (1948); C. A. 42, 2783 (1948).

"An effort was made to det. the nature of reaction in the varnish kettle, during resin-bodying of drying oils, by spectrographic methods. Since an acid-radical dimer by a Diels-Alder addn. is formed in heat-bodying of drying oils, and while evidence is lacking on whether such a reaction takes place with oils heated with resin, the existence of such a reaction was explored. Raman-spectrum methods proved impossible owing to fluorescence, evidently of impurities. Infrared spectra proved of interest, and with an instrument of resolving ability of no more than 10 $cm.^{-1}$; much useful information could be found." From C. A.

Two graphs contain data obtained on tung oil. Fig. 1 shows the fluorescent Raman spectrum (relative grundmolecular fluorescence as a function of wave no. shifts for 5460.7 A. incident illumination). Fig. 7 gives the grundmolecular absorption E as a function of wave no. (870-43,800 $cm.^{-1}$).

Hertkorn, J.

CHINESE WOOD (TUNG) OIL.

Chem. Ztg. 27 (50), 635 (1903); J. Soc. Chem. Ind. 22, 874 (1903).

"Numerous patents have been taken out for the use of this oil in cosmetic and similar preparations, the fact that it produces severe ulcers when brought in contact with the skin being apparently lost sight of. The author describes several instances of the oil causing severe wounds to the workmen and others who have carelessly handled it, and considers that its use in cosmetic preparations should be strictly prohibited. Moreover, in his opinion, all wood oils that have been imperfectly refined, yield slimy deposits with penetrating odour, and ought to be excluded from commerce. Candlenut oil has similar toxic effects on the skin, though only to a slight extent. It is an open question whether the poisonous properties of these oils must be attributed solely to substances in the slimy deposit, or whether the fatty acids also play a part." From J. Soc. Chem. Ind.

Holley, C. D., and Roberts, J. P.
CHINESE WOOD OIL.
Drugs, Oils & Paints 32, 263 (1917); C. A. 11, 709 (1917).

"Tests on tung oils during the past year indicate an unusually large number of adulterations, but acceptable samples showed considerably higher "turning points" (20 to 21) than those for the 3 preceding years. Pure oleomargaric glyceride has a turning point of 25 to 25.5; a special oil from primary Chinese merchants showed 24.9, indicating that the oil was very close to theoretical purity. Tables show the relation between turning points, acid nos., and time (Brown's heat test) for a series of oils." From C. A.

Holley, C. D., and Roberts, J. P.
DOMESTIC CHINESE WOOD OIL.
Drugs, Oils & Paints 32, 415-6 (1917); C. A. 11, 2156 (1917).

"Samples of oil from nuts grown in Ala., Fla., Ga., and Cal. were examd. The nut meats were ground, heated to 80° and the oil expressed under pressure. Approx. 32% by wt. of oil was obtained. All the oils were pale in color and all except two from Cal. gave normal constants with an av. "turning point" of 23.6. Practical tests indicate that they are similar to genuine Chinese oils, and are superior to recent commercial shipments of the latter. The two Cal. oils were very abnormal with d. 0.9368 and 0.9365; "turning point," 9.0 and 8.0; acid value, 0.45 and 0.50, resp. They did not conform to the Browne heat test (C. A. 7, 2315) and behaved similarly to oils adulterated 10 to 15%. Results were confirmed by expressing oil from a second lot of nuts. The Cal. nuts were grown under semi-arid conditions, but the authors are not prepd. to state whether climatic conditions caused the abnormal oils." From C. A.

Holmes, R. L., and Pack, F. C.
STUDIES ON THE REFRACTIVE INDEX AND DISPERSION OF AMERICAN TUNG OIL.
J. Am. Oil Chemists' Soc. 25, 163-7 (1948); C. A. 42, 4767 (1948).

"The dispersion and n of tung oil are so far above those of other common oils that both are valuable criteria for identification purposes. Mixts. of tung oil with another vegetable oil, except oiticica and other rare conjugated oils, can be analyzed to within 0.5% from n for either the Na or the Hg line if the n of the sep. oils are known. The mixts. can be analyzed from the dispersion to within about 1% of the correct compn. if the dispersions of the sep. oils are known. If the adulterating oil is not known, the adulteration can be more closely estd. from the depression of the dispersion than from the depression of n.

When tung oil is bodied by heat the *n* for the Na and Hg lines and and the dispersion fall rapidly and continuously to the point of gelation, but the changes are so similar that no worthwhile addnl. information is obtained by detg. more than one *n*. The fact that *n* decreases as viscosity increases suggests the use of the *n* in controlling the bodying of tung oil. Other things being equal, the *n* for the Hg line should give more accurate information on tung oil than that for the Na line, because of the greater changes in the *n* for the Hg line on adulteration or heating. A correlation coeff. of 0.83 was found for *n* with the diene no. of tung oil. A lower coeff. of correlation was found for *n* with the I no., but the latter would probably be higher if a more accurate method for the detn. of the I no. of tung oil were available. 23 references." From C. A.

Hou, D. B.
PROSPECTS FOR CHINA'S OIL INDUSTRY.
Science (China) 4, 321-5, 448-59 (1918)*; C. A. 13, 1160 (1919).

" H. discusses the specific properties of 19 vegetable oils produced in China, and indicates the industrial use for which each oil is best suited. Particular attention is drawn to the possibilities of tung oil (Chinese wood oil), and soy bean oil." From C. A.

Hsü, T. Y., and Kwei, C. T.
THE POLARIZATION AND ELECTRIC MOMENT OF TUNG OIL.
J. Chinese Chem. Soc. 4, 105-16 (1936)*; C. A. 30, 8657 (1936).

"Density, *n*, polarization and elec. moment of pure tung oil are measured over the temp. range 20-100°. Density and *n* vary almost linearly with temp. The polarization curve indicates that the internal field of tung oil cannot be entirely ignored; the internal field almost vanishes in C_6H_6 soln." From C. A.

Hulst, L. J. N. van der
USE OF ABSORPTION SPECTRA IN CHEMICO-TECHNICAL INVESTIGATIONS. (TUNG AND PO-YOAK OILS.)
Chem. Weekblad, 31, 422-423 (1934)*; Brit, Chem. Abstracts 1934, B, 769.

"A preliminary note of work on the absorption spectra of the constituents of these oils and of hydrogenated tung oil. The conjugated linkings of elaeostearin are saturated by H in accordance with Thiele's law. The couepic acid of Po-yoak oil is identical with that from oiticica oil, and its absorption spectrum bears a remarkable resemblance to that of elaeostearic acid from tung oil." From Brit. Chem. Abstracts

Jenkins, J. H. B.
JAPANESE WOOD OIL.
J. Soc. Chem. Ind. 16, 195 (1897).

Physical properties and chemical tests are reported for an oil which the author calls Japanese wood oil, an oil expressed in enormous quantities in China and Japan from the seeds of *Aleurites cordata*. This might have come from trees of the species subsequently to be named *A. fordii*. The author has stated elsewhere that Japanese wood oil is practically the same as Chinese oil. J. Soc. Chem. Ind. 16, 194 (1897). The following properties were reported:

Sp. g. (60° F.), 0.9385; solidifying point, below -17° C., iodine value (Hubl), 165.7; sap. value, 194; Hehner value (insol. fatty acids), 96.4%; free fatty acids (calc. as oleic), 3.84%. The mixed fatty acids gave: m. p., 37° C.; solidifying point, 34° C.; iodine value, 150.1. The oil was blackened by H_2SO_4 and solidified by HNO_3, iodine or heating to 250° C.

Jenkins, J. H. B.

JAPANESE WOOD OIL (TUNG OIL).

Analyst, 23 (266), 113-118 (1898); J. Soc. Chem. Ind. 17, 674 (1898).

"The analysis of a sample of this oil gave results which were as a general rule considerably lower than those found by the author for a previous sample (this Journal 1897, 193, and 195). The figures for the two samples were as follows:

	Present Sample	Earlier Sample
Specific gravity at 60° F.	0.9343	0.9385
Insoluble fatty acids	96.0%	96.4%
Unsaponifiable matter	0.63%	0.44%
Glycerin	10.6%	10.4%
Free fatty matters (as oleic)	1.83%	3.84%
Solidifying point	Below -17° C.	Below -17° C.
Bromo-thermal rise (= x°)	21.4° C.	23.4° C.
Calc. iodine value (x x 5.7)	122.0	133.4
" " " (x x 7.0)	149.8	163.8
Iodine value (Hubl)	149.7	165.7
Saponification value	192	194
Specific temperature reaction	298	330

The insoluble fatty acids gave:

	Present Sample	Earlier Sample
Melting point	30° - 31°C.	37° C.
Bromo-thermal rise (= x°)	21.0° C.	22.1°C.
Calc. iodine value (x x 5.7)	119.7	126.0
" " " (x x 7.0)	147.0	154.7
Iodine value (Hubl)	144.1	150.1

With regard to these results the author mentions that the viscosity was determined in Redwood's instrument, and that in the Maumene test olive oil was used as the diluent and a correction applied. With Valenta's test the two samples became turbid at 44° and 47°C. respectively. In the elaidin test the latter sample darkened considerably, and, after standing for 24 hours, showed signes of partial solidification at the bottom of the tube. Unlike the earlier sample the later one did not reduce the silver nitrate in Becchi's test. Negative results, however, were given by both samples in Halphen's test for cotton oil (Rev. de Chim. Ind., Feb. 1898). On exposure to the atmosphere in a shallow dish heated on the water-bath, the later sample increased in weight during the first eight hours' exposure at the rate of 0.26 per cent per hour, and in six hours the surface of the oil was covered with a skin. The earlier sample gained during four hours at the rate of 0.36 per cent per hour, and was covered with a skin in two hours. A sample of linseed oil

similarly treated, gained during eight hours at the rate of 0.10 per cent per hour, and at the end of the period showed no sign of any skin on the surface. The refractive index of the later sample with sodium light was 1.503 at 19°C. On heating this oil out of contact with air (which was effected in a flask with a mercury valve) it remained liquid for two hours at 200° C. The temperature was then raised to 250° C., and maintained at that for two hours, during which time the oil thickened and some gas was evolved. When cold it was found to have been converted into a semi-solid product. The author suggests that the difference in the viscosity of the two samples may have been due to a similar partial polymerization of one of them. It is stated that, by an error of calculation in the former paper (this Journal, 1897, 193) it was found that for the bromo-thermal test the factor 5.7, applicable to all other known fatty oils, could be used with the fatty acids of Japanese oil; but it is now established that the fatty acids, as well as the oil, require the factor 7.0. On treating Japanese wood-oil with a saturated solution of iodine in chloroform or other solvents, a jelly-like mass is produced, the stiffness of which is proportional to the amount of oil taken. No similar action was observed in the case of bromine, whether by itself or in solution."
From J. Soc. Chem. Ind.

Kafuku, K. et al.
FORMOSAN PLANT - SEED OILS. I. II. AKAGI-SEED OIL.
J. Chem. Soc. Japan 53, 388-94, 395-8 (1932)*; C. A. 27, 201 (1933).

Oils from the seeds of 9 plants were examined. For two the following data were obtained:

	Aleurites fordii	Aleurites Moluccana
$d\frac{16}{4}$	0.9357	0.9269 ($d\frac{15}{4}$)
$n\frac{16}{D}$	1.5165	1.4784 ($n\frac{15}{D}$)
Sapon. no.	194.23	184.70
I no.	154.95	160.31
Acid no.	1.14	1.79

Kametaka, Tokuhei
JAPANESE VEGETABLE OILS.
J. Coll. Sci. Tokyo 25 (Art. 4) . 1-7 (1908); Mat. grasses 1909, 1318; C. A. 3, 1098 (1909); J. Chem. Soc. 94, 850-1 (1908).

"Japanese wood oil (kiri-abura). The iodine number of the fresh, cold-drawn oil was found by Hubl's method to be 161.3; after storing in a stoppered bottle in the dark for eleven months, the value obtained by the same method was 150.0. The iodine number after three months, determined by Wys' method, was 156.3, and after eleven months, 153.2. The low iodine number of Japanese wood oil cannot, therefore, be ascribed to previous oxidation, as stated by some chemists (compare Ingle, J. Soc. Chem. Ind., 21, 187, 1902), although the value does decrease on oxidation. Using the number

161.3, it is found by calculation that the oil consists of about 86% of elaeomargarin and 14% of olein. The following constants were determined: acid number, 3.81; D^{24}_{24} 0.9307; saponification number, 196.0. An enzyme, capable of hydrolysing the oil and also ethyl acetate, was obtained from the seeds of <u>Elaeococca vernicia</u>. Since this enzyme is present in small quantities in the oil itself, it possibly plays some part in the rapid drying of this oil." From J. Chem. Soc.

Kanthack, R. (Comp.) and Goldsmith, J. N. (Ed.)
TABLES OF REFRACTIVE INDICES. II. OILS, FATS, AND WAXES.
Adam Hilger, Ltd. London, 1921. Vol. 2, pp. 79-81, 133, 287, 289, 291.

Refractive indices determined by numerous investigators on China wood oil and Japanese wood oil are collected and sources cited. Appendix III discusses optical dispersion and gives values for fresh and heated tung oils.

Katz, J. R.
THE EFFECT OF POLYMERIZATION UPON THE X-RAY DIAGRAM. I. HIGH POLYMERIZATION FROM AMORPHOUS X-RAY SPECTRA.
Z. physik Chem. <u>125</u>, 321-30 (1927); C. A. <u>21</u>, 1730 (1927).

"Unusual interest is attached to x-ray studies of substances of high mol. wts. since dimensions calcd. from such data always correspond to a substance of much simpler compn. K. studies the spacings of the principal amorphous ring for the following pairs of substances (resp. simple liquid and polymerized solid): styrol-metastyrol; isoprene-rubber; dicyclopentadiene-cyclopentadiene rubber; acrylic acid-polymerized acrylic acid; liquid and polymerized Chinese wood oil. In all cases the diam. of the ring is unaffected by polymerization." From C. A.

Kitt, M.
ELAEOCOCCA OILS.
Chem. Ztg. <u>23</u> (3), 23, 38 (1899); J. Soc. Chem. Ind. <u>18</u>, 283 (1899)

"The analytical figures recorded by different observers for this oil show considerable variations as seen in the following table compiled by the authors:-

---	Cloez	Davies	De Negri and Sburlati	Zucker	Jean
Specific gravity at 15°C	0.9362	0.9400	0.936 0.941	0.937	0.940
Saponification value	..	211	155.6, 172	197	..
Saponification value of fatty acids	..	..	188.8	..	..
Iodine value....	..	..	159, 161	163	..
Iodine value of fatty acids	..	..	159.4	..	..
Melting point of fatty acids	..	..	43.8°	43.8°	44°
Solidification point of fatty acids	..	..	31.2°	31.4	..
Acidity, percent...	..	..	1.18, 0.39 (as oleic acid)	..	0.784 (as H_2SO_4)
Refractometer value	..	..	..	..	1.80°
Flashing point.....	..	..	..	..	260° "

Kolb, F. J., Jr, and Hauser, E. A.

APPLICATIONS OF THE SPECTROGRAPHIC METHOD FOR STUDYING THE RESIN-BODYING OF DRYING OILS.

Paint, Oil Chem. Rev. 110, (23), 104-9 (1947); C.A. 42, 3587 (1948).

"Spectrographic methods were examd. to det. applicability in proving data on resin-bodying reactions. Raman spectrum detns. were hampered by strong, continuous fluorescence, which obscured sharp, discrete lines. Ultraviolet absorption was not useful. Infrared absorption spectra can be developed as a useful tool in studying varnish cooking and should be further studied. Infrared absorption data are given for tung oil, dehydrated castor oil, methyl esters of dehydrated castor oil acids and for 2 phenolic resins." From C. A.

Kolke, F. R.

THE INFLUENCE OF SOLVENTS ON THE VISCOSITY OF OIL VARNISHES.

Farben-Chem. 5, 16-17 (1934); C.A. 28, 2202 (1934).

"The viscosities of linseed and tung oil, stand oils thinned with 10-60% of each of 'crystal oil 21,' solvent naphtha, 'crystal oil 30,' turpentine oil, petroleum and decalin are tabulated. The values for the different thinners increased in the order named." From C. A.

Kwei, C. T., and Tao, S. C.

EXPERIMENTS ON THE DIELECTRIC CONSTANT OF TUNG OIL.

Lingnan Sci. J. 12, Suppl. 93-100 (1933); C.A. 27, 3863 (1933).

"Employing an improved circuit involving (a) a piezoelec. oscillator, (b) a radio-frequency amplifier, and (c) a vacuum-tube oscillator, the dielec. const. of a fresh supply of tung oil varied from 3.455 at 14.2° to 2.812 at 88.3°, and that of tung oil previously heated to 88.3° varied from 3.241 at 8.5° to 2.696 at 99.2°. The dielec. properties of tung oil are permanently changed when it is heated above a certain temp." From C. A.

Li, Norman C. C.

DIELECTRIC STUDIES. V. ELECTRIC MOMENTS OF SOME VEGETABLE OILS IN SOLVENTS OF UNKNOWN AND INDEFINITE MOLECULAR WEIGHTS.

J. Chinese Chem. Soc. 13, 8-10 (1946) (in English); C. A. 41, 3672 (1947).

"Dipole moments of castor oil in gasoline and tung oil in kerosene were calcd. to be 3.62 and 2.92 Debye units, resp. The significant point is that solvents that have no definite mol. wts. were used. The results agree well with 3.7 for castor oil and 2.90 for tung oil (recalcd. by L.) obtained by Stoops (C.A. 26, 2627) by means of the classical method with C_6H_6 as the solvent." From C. A.

Long, J. S., Reynolds, J. B., and Napravnik, Joseph

STUDIES IN THE DRYING OILS. XVIII. SPECIFIC HEAT AND FEATURES OF HEATING DRYING OILS.

Ind. Eng. Chem. 26, 864-8 (1934); C.A. 28, 5688 (1934).

"Sp. heat of linseed, China wood, and soy-bean oils have been detd. over much of the temp. range employed in heating them to make industrial products. The math. design of a kettle permits the maintenance of a nearly const. ratio of air-oil interface to vol. of oil in the kettle.

The app. for sp.-heat detn. is illustrated, and a sample calcn. of sp. heat and of heat capacity of app. given. Kettle design for specific objectives is discussed. Heat bodying of drying oils over direct fires with little agitation yields products not homogeneous, but simply dispersions of highly associated mols. in liquid contg. mols. in much lower state of assoc. or aggregation." From C. A.

Maher, Colin
TUNG OIL IN KENYA.
E. African Agr. J. 2, 101-6 (1936): C.A. 31, 1641 (1937).

"Samples of tung nuts (*Aleurites fordii*) grown at Nairobi, Kenya in 1931 and 1932 contained H_2O 6.3, 6.4 and oil (extd. by petr. ether) 35.3, 36.3%, resp. The characteristics of the oils were n_D^{25} 1.5181, 1.5181; d_{25} 0.9361, 0.9358; heat test 12.25, 12.25 min., acid value 0.6, 0.4; I value 167.7, 168.0; sapon. value 192.6, 194,4; and color (Lovibond 10 mm.) 0.30, 0.36 for red and 1.0, 1.4 for yellow, resp." From C. A.

Mikusch, J. D. von
THE MEASUREMENT OF THE VISCOSITY OF STAND OILS.
Farbe u. Lack 55, 241-7 (1949);* C.A. 43, 8700 (1949).

"Cylindrical bubble viscometer tubes (internal diam. 10-11 mm., length 15 cm.) can be used to det. the abs. viscosity (η) of stand oils (I) directly as the time t required by the bubble to rise a distance X at 20 ± 0.1°. To standardize the tubes, X is obtained by accurately measuring t for X = 100 mm. for I of accurately known η, because X = 100 η/t. In bubble viscometer tubes, t is not equal to η without a correction for d. of the liquid tested. Thus, the d^{20}, η (at 20 ± 0.1°), kinematic viscosity η/d., and t (for X = 70 mm.) are 0.922, 7.177, 7.78, and 6.98 for mineral oil, 0.961, 10.60, 11.03, and 10.03 for castor oil, and 1.255, 11.04, 8.79, and 9.28 for glycerol. Good agreement of η and t was obtained by using the equation $t = \eta/\text{const.}\sqrt{d.}$ The tubes are standardized with I of known η and d. To use the tubes for liquids of different densities d_1, the equation becomes $t = \eta/\text{const.}\sqrt{d./d_1}$. Measurement of η by this method is applied to control and prediction of the rate of increase of η during the heat bodying of drying (chinawood, cameline) oils (log η vs. heating time is a straight-line function); prediction of the increase of η during the heating-up and cooling-down periods of the heat bodying of oils as shown by Mikusch (C.A. 34, 7125); prediction of η of mixt. of I from the η of the component oils is made by using the rule of Gussmann (C.A. 34, 8973). It is found that this rule does not hold when oleo-resinous vehicles are involved, e.g., a mixt. of tall-oil triglyceride with tall-oil pentaerythritol ester (II) (small deviation), or a mixt. of linseed oil I with II (large deviation). The latter mixt. did not follow the Bingham equation, but approached it." From C. A.

Miller, N. F.
THE WETTING OF STEEL SURFACES BY ESTERS OF UNSATURATED FAT ACIDS.
J. Phys. Chem. 50, 300-19 (1946); C. A. 40, 5686 (1946).

"The wetting properties of linseed oil and of a series of pure esters of unsatd. fat acids toward polished 48-S-5 steel armor plate were measured. Unrusted steel is organophilic but the surface rapidly becomes hydrophilic as rusting begins. The Me esters of oleic, linoleic, linolenic, and β-eleostearic acids have very similar surface tensions, interfacial tensions with water, film pressures, and contact angles on steel. The wetting of unrusted steel by 3 linoleate esters decreases in the order methyl $>$ glycol $>$ glyceryl. Atm. oxidation of methyl linoleate decreases its wetting power for unrusted steel. A discussion is given of the significance of advancing, receding, dynamic, and static contact angles. The adhesion of paint to steel is affected more directly by the contact angle than by the work of adhesion, since contact angles apparently det. the ability to displace adsorbed films from steel." From C. A.

Miura, I.

CONSTITUENTS OF FOREST TREES IN JAPAN. II. TUNG OILS FROM VARIOUS SPECIES.

J. Chem. Ind. (Japan) <u>26</u>, 316-21 (1923) (in Japanese)*; Analyst <u>49</u>, 542 (Nov., 1924) (abstract); C.A. <u>18</u>, 1398 (1924).

"There are 4 species of tung oil trees in Japan, viz., (a) Japanese tung oil tree, <u>Aleurites cordata</u>, (b) Chinese tung oil tree, <u>A. fordii</u>, (c) Kangtong tung oil tree, <u>A. montana</u>, and (d) Bakoly (or tropical) tung oil tree, <u>A. moluccana</u>. Of these (a) is grown all over the interior of the country and the others are grown in Formosa. The results are:

	a	b	c	d
Oil contents -				
In seeds, %	37.77	44.11	37.43	23.61
In endosperm, %	59.15	66.29	59.78	70.66
Time for drying at 95° (min.)	65.0	55.0	60.0	270.0
Sp. gr. (15°)	0.9340	0.9488	0.9372	0.9267
Acid value	0.47	1.52	0.59	0.80
Sapon. value	194.79	196.76	194.31	195.13
I value (Wijs)	151.37	157.17	154.85	146.31
Refractive index (25°)	1.5065	1.5210	1.5147	1.4785
Reichert-Meissl value	0.39	1.10	0.35	0.71
Unsaponifiable matter, %	0.41	0.59	0.99	0.97 "

From J. Soc. Chem. Ind.

Miura, I.

SOME USEFUL MATTERS CONTAINED IN FOREST TREES IN JAPAN.

J. Coll. Agr. Imp. Univ. Tokyo <u>9</u>, 85-100 (1927); Expt. Sta. Record <u>58</u>, 202-3 (1928); C.A. <u>22</u>, 3287 (1928).

"A study is made of the oil product of 4 species of tung oil trees <u>Aleurites cordata</u>, the abura giri or Japanese tung oil tree; <u>A. fordii</u>, the Shina-abura giri or Chinese tung oil tree; <u>A. montana</u>, the Kwantung-abura giri or Kwantung tung oil tree; and <u>A. moluccana</u>, the kukuinoki or tropical tung oil tree. In addition to the data given for the oils, the percentage found in the whole seeds and in the endosperm and the time required for drying at 95° are given for the 4 types of oil." From C. A.

Munroe, C. L.

THE EFFECT OF AGEING ON THE IODINE ABSORPTION AND SAPONIFICATION NUMBERS OF CHINESE WOOD OIL.

Thesis, University of Illinois, 1913.*

Constants were determined (Hubl method) on 8 samples of Chinese wood oil and compared with those of the same oils 8 yrs. previously. Aging lowered the I No. probably due to oxidation of double bonds. The method of Ingle (J. Soc. Chem. Ind. 21, 587) was not applicable to Chinese wood oil. For consistant results the excess of I must at least equal the I absorbed. The absorption of I is fast at first, then slow, requiring 14 hrs. for completion. Ageing increases the sap. no. presumably because of a splitting of the fatty acids into acids of shorter chain length.

Penfold, A. R.

TUNG OIL FROM AUSTRALIAN GROWN TREES OF ALEURITES FORDII (HEMSLEY)

Tech. Museum Sydney, Bull. 12, 9 pp. (1926)*; Brit. Chem. Abstracts 1927, B, 451.

"The yield and analytical constants of oils obtained from tung oil trees grown in New South Wales are given. Although the quantity of fruit obtained is rather small, the quality of the oil is at least equivelent to Chinese oil." From Brit. Chem. Abstracts.

Rathje, Arnold

CHINESE AND JAPANESE WOOD OIL.

Arch. Pharm. 246, 692-709 (1908)*; Rev. chim. ind. (Paris) 20, 142 (1909); Chem. Zentr. 1909, I, 196-7; J. Chem. Soc. 96, II, 86-7(1909)

Constants are tabulated for the 2 oils. Both gelled on heating to 250°C. (Note by abstractor: Both appear to be adulterated samples.)

Reichert, B.

TUNG-OIL FRUITS FROM PARAGUAY.

Pharm. Zentr. 75, 282 (1934); C.A. 28, 6578 (1934).

"Phys. characteristics of the fruit and chem. consts. of the oil are given." From C. A.

Rhodes, F. H. and Goldsmith, H. E.

VARIATION OF REFRACTIVE INDEX OF CHINA WOOD OIL WITH TEMPERATURE.

Ind. Eng. Chem. 15, 786 (1923); C. A. 17, 2967 (1923).

"The n of China wood oil decreases 0.000395 for each increase of 1° in temp." From C. A.

Rossmann, E.

THE FREEZING POINT OF TUNG OIL.

Farbe u. Lack 1933, 341-2; C.A. 27, 4696 (1933).

"A sample of tung oil from Florida and a sample expressed from seed obtained via Russia did not freeze at 0° as stated by Fritz (C.A. 27, 2048). A com. sample, however, did freeze. Examn. by ultra-violet light indicated the com. sample contained oxidized oil and β-eleostearin, both of which were absent in the fresh oils." From C. A.

Scofield, F.

DRYING OILS INDEX FOR 1949.

Natl. Paint, Varnish and Lacquer Assoc. Circ. 730, 79 pp.

There are tabulated (p. 45) for 10 tung oils, the source, trade name and the following properties: acid no., I no., sap. no., unsaponifiables, $\underline{d}\,^{15.5}_{15.5}$, $\underline{n}^{25}$, color and viscosity.

Seeman, Willard

OILS USED IN FINISHING MATERIALS.

Ind. Finishing 18, (8),36, 38, 40, 42 (1942)*; C.A. 36, 5363 (1942).

"A review of the sources and properties (color, sp. gr. and I no.) of castor, corn, cottonseed, herring, menhaden, sardine, hempseed, linseed, olive, peanut, perilla, rapeseed, soybean, sunflower and tung oils." From C. A.

Stock, Erich

THE DIFFERENCE BETWEEN HANKOW AND CANTON WOOD OIL.

Farben-Ztg, 30, 2480-1 (1925); C. A. 19, 3026 (1925).

"Tabulated consts. on 48 samples of wood oil of known source confirm the inability to differentiate oils from these 2 sources." From C. A.

Stutz, G. F. A.

ABSORPTION OF ULTRA-VIOLET LIGHT BY PAINT VEHICLES.

Ind. Eng. Chem. 19, 897-901 (1927); C.A. 21, 3136 (1927).

"Ultra-violet absorption was measured in wet and dry films of various paint vehicles. These included the various linseed paint and varnish oils, perilla, China wood, soy and poppy-seed oils, and different types of varnishes and lacquers. The change in absorption due to exposure of the films to sunlight and the Hg arc was also detd. Tabulated data and curves show wide differences in transparency between raw and variously treated oils and between the other films measured. Practically all vehicles have high absorption at the shorter wave lengths, below the limit of the sun's spectrum. On exposing a film to such radiations (2800 A.U. or less), the energy is largely absorbed at the surface. This accelerates decompn., hardening, etc., at the surface only, the underlying film not being affected. Sunlight radiations, being above 2900 A.U., are sometimes able to penetrate a considerable distance in the film before complete absorption. This difference should be considered in interpreting accelerated weather tests made under short wave-length light." From C. A.

Swaney, M. W.

DERMATITIC PROPERTIES OF TUNG OIL.

Ind. Eng. Chem. 30, 514-15 (1938); C.A. 32, 5235 (1938).

"Acute dermatitis caused by exposure to the vapors from hot tung oil (I) was cured by injection of a soln. in olive oil of the oily distillate obtained by heating I(2-3% yield). The literature of dermatitis caused by I, Chinese lacquer oil and other drying oils is reviewed." From C. A.

Sward, G. G.

OPTICAL DISPERSION OF TUNG OIL AS AN INDEX OF PURITY.
Natl. Paint, Varnish Lacquer Assoc. Circ. . 481, 154-5 (1935); C. A. 29, 4190 (1935).

"Optical-dispersion data obtained with an Abbé refractometer are not as reliable as those obtained with a spectrometer and hollow prism." From C. A.

Taran, E. N.

EXAMINATION OF A SAMPLE OF SUKHUM TUNG OIL.
J. Applied Chem. (U.S.S.R.) 14, 239-49 (1941)*; Brit. Chem. Abstracts 1942 B, II, 19; C.A. 36, 2167 (1942).

"A sample of tung oil, from *Aleurites fordii* Hemsl. grown at an experiment station near Sukhum (U.S.S.R.), had a light straw color and on drying on a glass plate formed a characteristic wrinkled film. The oil had d^{20}_{20} 0.9366, n^{20}_{D} 1.5238, I no. 164.52, acid no. 0.5; by the standard test procedure it gelatinized in 10.5 min. at 282°. It contained eleostearic acid 73.6, linoleic acid 8.8, oleic acid 5.0, satd. acids 6.0, unsaponifiable matter 0.3%, traces of volatile matter and 4.2% glycerol (as radical), as well as possibly 0.5% linolenic acid." From C. A.

Taylor, T. I., Larson, L., and Johnson, W.

MISCIBILITY OF ALCOHOL AND OILS.
Ind. Eng. Chem. 28, 616-18 (1936); C.A. 30, 4345-6 (1936).

"The amt. of oil which dissolves in abs. or 90% EtOH at 25° and the amt. of alc. dissolving in the oil were detd. for almond, apricot-kernel, China-wood, cod-liver, corn, linseed, neat's-foot, olive, peach-kernel, poppy-seed, rapeseed, sesame, soybean, sunflower, walnut and whale oils. The vols. of the phases and the stability of emulsions were measured in the various systems. The results show that 2 or 3 times as much alc. goes into the oil phase as oil into the alc. phase. Increasing amts. of oleic acid when added to mixts. of alc. and oil gradually decrease the vol. of the alc. phase and the stability and fineness of the emulsion." From C. A.

Sward, G. G.

ABRASIN OIL (MU OIL). QUICK DRYING OIL FROM *ALEURITES MONTANA*.
Natl. Paint, Varnish Lacquer Assoc.Circ. . 491, 258-61 (1935); C. A. 29, 8365 (1935).

"A brief review of the literature of *Aleurites montana* is given from whence it is concluded that "mu" oil is a more logical name for its oil than abrasin oil." From C. A.

Chemical and physical properties of the oil from *A. montana* are tabulated and compared with the oil of *A. fordii*. Eleostearin contents are approx. 76-77% for the former and 81% for the latter.

Ueno, S. I. and Nakaguchi, S. I.,

COOLING CURVES OF OILS, FATS, NATURAL AND HARDENED (HYDROGENATED) WAXES AND PARAFFINS. I. THE COOLING CURVES OF FATS, NATURAL SOLID WAXES AND SIMILAR SUBSTANCES.
J. Soc. Chem. Ind. Japan 39, Suppl. binding 79-82 (1936) (in French); C. A. 30, 5437-38 (1936).

"Hydrogenation of the substances was carried out for 2-4 hrs. at a pressure of 50 atm. and 180°, with a Ni catalyst. Except for wood and sesame oil, which had an I no. slightly greater than 3, all samples had I nos. less than 3. The cooling curves were obtained by heating the samples somewhat more than 10° above the solidification point, agitating them while cooling to within 10° of this point, and then continuing cooling without stirring. Cooling curves (time vs. temp.) are presented for 29 substances (16 hardened and 13 natural). In general, a remarkable temp. elevation was observed after superfusion for each hardened oil and fat. Only hardened sardine and herring oil showed a weak, though definite, temp. rise. However, all kinds of solid waxes and paraffin did not show any temp. rise. With hardened wax a small rise was observed, but that was probably due to the presence of glyceride." From C. A.

Westgate, Mark W.
CHEMICAL AND BOTANICAL STUDIES ON NEWER HARD DRYING VEGETABLE OILS.
Natl. Paint, Varnish Lacquer Assoc., Sci. Sect. Circ. 672, 129-34 (1944); C. A. 38, 2835 (1944).

"Further studies on oils obtained from the *Garcia nutans* and *Aleurites trisperma* are disclosed. Confirmation is obtained for an earlier report that *Garcia nutans* oil is superior to American tung oil as a varnish oil. Explorations in Mexico and Central America reveal few *Garcia nutans* trees. Seeds planted at a Florida Expt. Station germinated better than 95%, producing vigorous rapidly growing seedlings. Compared with *Garcia nutans* oil, *Aleurites trisperma* oil was slower bodying and resulted in slower-drying varnishes. *Garcia nutans* oil gave an I no. (Wijs. 1 hr.) of 177.9, n^{25} of 1.5252 and a gelation time (Browne heat test, min.) of 7-3/4. *Aleurites trisperma* oil showed, on the above basis, an I no. of 127.7, n^{25} of 1.4948 and was fluid at the end of a 30-min. Browne heat test." [*Aleurites fordii* gave an I no. of 165, n^{25} of 1.5170, gelation time of 12 min. and dried somewhat slower than *Garcia nutans*]. "Samples of African 'Tung Oil' and 'Ongokea Oil' dried poorly and decompd. explosively when heated above 260°." From C.A.

Wise, Louis E.
THE INDICES OF REFRACTION OF CHINA WOOD OIL.
J. Ind. Eng. Chem. 4, 497-8 (1912); C.A. 6, 2544 (1912).

"*n* varies from 1.5099 to 1.5186 at 25° in commercial oils used in varnish industry (1911-1912). Soy bean, tallow and linseed oils lower *n*." From C. A.

Wolff, Hans
WHAT IS HANKOW WOOD OIL?
Farben-Ztg. 29, 21 (1924); C.A. 19, 409 (1925).

"There is no principal difference between Hankow and other wood oils." From C. A.

Wolff, Hans
HANKOW AND CANTON WOOD OIL.
Farben-Ztg. 30, 1383-4 (1925); C. A. 19, 2419 (1925).

"The tabulated consts. on 44 authentic Hankow and 31 Canton tung oils show no significant differences between oils from these 2 sources.

Higher acid nos., lower I nos., lower *n*, and slower gelatinization periods in the heat test occurred somewhat more frequently in the Canton oils, but the differences are so slight that no significance can be attached to them." From C. A.

Wolff, H. and Toeldte, W.
THE SOLVENT CAPACITIES OF SOLVENTS FOR STAND OILS.
Paint Varnish Production Mgr. 18, 43-4, 45, 62, 77, 79-80, 106*, Farben-Chem. 9, 47-52 (1938)*; C. A. 32, 8804 (1938).

"The viscosities of mixts. of stand oils with various amounts of toluene, turpentine, benzene and CCl_4 were studied. From the viscosity equation of Arrhenius, the "relative solvation" (degree of solvation/mol. weight) was detd. This was const. for benzene in the heavier oils, but increased with concn. for the other solvents. In medium-bodied oils, the degree of solvation remains const. for all solvents. In wood oil stand oil, the degree of solvation remained const. for benzene and turpentine. Degree of solvation appears to increase proportionally to mol. wt." From C. A.

Yamasaki, R., Itahara, K., and Arisaka, K.
STUDIES ON TUNG OIL. I. THE QUALITIES OF JAPANESE AND CHINESE TUNG OILS.
J. Soc. Chem. Ind. Japan 43, Suppl. binding 154 (1940); C.A. 34, 6463 (1940).

"Yields, I nos. (Wijs and Hanus methods), *n*s. densities, acid values, sapon. values, percentage of unsaponifiable matter, maleic anhydride values, and times of gelation (Bacon's heat test) are listed for samples of (1) *Aleurites fordii* (Chinese tung oil) grown in Hankow, China and Wakayama Prefecture, Japan, resp., and (2) *Aleurites cordata* (Japanese tung oil), grown in Tiba, Simane and Hukui Prefectures, resp. Results obtained for Wijs I no. (2 hrs.), Hanus I no. (3 hrs.), maleic anhydride value and time of gelation were: 161-167, 216-235, 64.1-64.7 and 6 min. (Chinese tung oil); 154-164, 194-198, 50.3-54.1 and 32-70 min. (Japanese tung oil). Tung oil is best evaluated by the time of gelation and to a lesser degree by the *n*. Oils of the *A. cordata* variety are far inferior in quality to those of the *A. fordii* variety and of the *A. cordata* oils, that grown at Tiba Prefecture is highest in quality." From C. A.

Yamazaki, R. and Itahara, K.
SOME SEED FATS OF KOREAN ORIGIN.
Kwagaku to Kogyo (Science and Ind.) 15, 419-20 (1940*; C.A. 36, 285 (1940).

"Chinese tung oil and castor oil from the seeds of Korean origin had normal characteristics. The fatty oil was obtained by extg. the seeds of *Cornus officinalis* with petr. ether. It was light yellow and viscous; yield 6.91% of the seeds. It had d_{15} 0.9645, n_D^{15} 1.4849, n_D^{20} 1.4832, acid value 3.4 sapon. value 196, I value (Wijs) 112, and Ac value 23.4." From C. A.

Yokota, K. and Tatimori, M.

RELATION BETWEEN DENSITIES AND IODINE VALUES OF FATTY OILS.

J. Soc. Chem. Ind. Japan 40, Suppl. binding 426-9 (1937)*; C.A. 32, 1962 (1938).

"In the com. examn. of 33 linseed oils, 27 perilla oils, 18 soybean oils, 12 rape oils and 20 Chinese tung oils, it was found that the relation between d. and I no. was nearly const. By plotting these values in a graph it was found that all points are between 2 close parallel lines forming a band. Other vegetable and animal oils were likewise plotted. Exceptions to this rule are the following: (1) oils having special group such as hydroxyl, e.g., castor oil, (2) oils which contain glycerides of fat acids of low mol. wt., e.g., croton oil, (3) oils which contain hydrocarbons of low densities, e. g., most liver oils, (4) oils which contain free fat acids or esters of monohydric alcs., e. g., rice oil." From C. A.

Zucker, A.

CHINESE AND JAPANESE WOOD OIL.

Pharm. Ztg. 43, 628 (1898); Z[illegible] Untersuch. Nahr. u. Genussm. 2 (12), 959 (1899) (abstract)*; J. Soc. Chem. Ind. 19, 156 (1900).

"This oil is obtained in China and Japan from the kernels of the fruit of *aleurites cordata* and *eleaococca vernicia*, by hot and cold expressing. The 'hot expressed' oil dries much more quickly than that which is 'cold expressed.' The kernels contain about 53 percent of oil, of which only 40 percent can be pressed out. The oil is known in commerce under two names: Canton oil and Hankow oil. The imported oil is clear, yellow, and tasteless. The author examined a sample which had a specific gravity of 0.937; saponification number, 197; and iodine number 163. The fatty acids of the oil melted at 43.84°C. The acidity was 2.06 percent (as oleic acid) and viscosity (Redwood's viscosimeter) 38. The oil is soluble in the usual media. 5 grms. of wood oil when mixed with 2 c.c. of carbon bisulphide and 2 c.c. of sulphur chloride form a jelly-like mass. This does not take place when the oil is adulterated with the oil of dipterocarpus turbinates. Unadulterated wood oil when subjected to the elaidin test gives a red-brown mass, whereas, when adulterated, a dark brown viscous fluid is obtained. Wood oil is extremely useful for varnish making on account of its drying properties." From J. Soc. Chem. Ind.

(d) Heat Bodying and Gelation

Anonymous

OILS AND FATS. USES OF WOOD OIL.
Seifenfabrikant 1903, 12.

The writer prefers to body wood oil by heating it for several hours at 180° C. without the addition of any drier. When making varnishes he prefers Pb acetate for the drier. Wood oil is used in floor and furniture varnishes, making them excellent in elasticity, hardness and waterproofness.

Anonymous

SOLID WOOD OIL.
Oils, Colours, and Drysalteries, Vol. 17, No. 1; Chem. Rev. Fett-u.Harz-Ind. 12, 56 (1905) (abstract).

Wood oil solidifies suddenly when heated to 250° C., yielding a clear, yellow gel of which 15-20% is an oil extractable with ether. Lumps of gelled oil react with air when taken from the kettle and frequently char or burn. Uses for the gelled oil are being developed.

Anonymous

WOOD OIL IN VARNISHES.
Farben-Ztg. 18, 1117 (1913); C.A. 7, 2125 (1913).

"Practical paper on the prop. and uses of "heavy oil" (dick öel) produced from China wood oil. Soy-bean oil may also be used in heavy oil manuf. by heating to 340° (which may cause partial decomp., although author claims a lighter colored product)." From C.A.

Anonymous

COOKING AND DRYING OF TUNG OIL.
Farben-Ztg. 26, 358-9 (1920); C.A. 15, 766 (1921).

"The author disagree with the method of Schlick (C.A. 14, 3161) for cooking tung oil. The best method consists in heating the rosin and tung oil together and then adding CaO and driers. Addition of linseed oil is usually not desirable except that 10 parts linseed plus 2 parts tung oil cooked to a heavy body in 5 to 6 hrs. at 280-90° produces a very satisfactory light-colored vehicle for white interior and exterior enamels which dry much harder than those made with bodied linseed oil alone. Addition of CaO causes whitening of the varnish films with H_2O. To overcome this the rosin may be hardened by esterifying with glycerol and then blowing air through the molten ester. The heat treatment recommended by Schlick may overcome the "alligatoring" effect of combustion products on the film, but not the effect of drafts. The test for the latter is conducted by hanging a freshly varnished panel on a side of the window frame in a warm room and opening the window 1 to 2 cm. The air in passing out from the room will usually cause frosting in 1 to 2 hrs. on practically all tung oil varnish films even though they contain 20 to 30% linseed oil. This defect may be overcome by heating the oil to 280-90°, but since this is above its polymerization point, the heating cannot be carried out on an oil which does not contain rosin or fatty acids, except on a lab. scale. The hard drying film produced by tung oil makes possible the use of some soy oil in the cooking process." From C.A.

Anonymous

SOYBEAN OIL-TUNG OIL MIXTURES.
Oil & Colour Trades J. 113 (2573), 313 (1948)* Oleagineux 3 (8/9), 436 (1948).

"The thickening of such mixtures in different proportions has been compared with that of linseed by heating at given temperatures. Comparative drying tests were also carried out. A proportion of 60 soybean oil to 40 tung oil appears best." Translated from Oleagineux.

Agranenko, N. P.

A COMPARISON OF OIL LACQUERS PREPARED BY DIFFERENT METHODS WITH WOOD OIL.
Byull. Lakokrasochnoi Prom. 1938, N. 9-10, 62-3*; Khim. Referat. Zhur. 2 (5), 108-9 (1939)*; C.A. 34, 3515 (1940).

"The method of prepn. of lacquer which contains wood oil affects considerably the properties of lacquer films, especially their atm. stability. The findings of Fonrobert, Holdt and Wilborn (cf. C.A. 28, 2925) that the films most resistant to the atm. are obtained from the polymerization of wood oil and that the most stable films are obtained from the polymerization of wood and linseed oil separately was not confirmed. The polymerization of wood oil alone often leads to a gelatinization, and to spontaneous combustion. An increase of the fat content of the lacquers and hot drying lead to a considerable increase of atm. stability of the lacquers." From C.A.

Andes, L.

NEWS OF THE VARNISH AND LACQUER MANUFACTURING INDUSTRY.
Chem. Ztg. 22, 768-70 (1898).

Chinese wood oil, derived from the seeds of Aleurites cordata (elaeococca vernicia) is being imported in increasing quantities from China and Japan. On heating to 200° it thickens releasing the odor of acrolein. At 260-280° C. it gelatinizes. On boiling with borate of manganese it turns into a jelly-like mass insoluble in benzine or turpentine. The original oil and oil boiled without anything being added to it dried quickly to an opaque, white finish. Oil boiled with litharge dries to a clear, glossy film. It has been used for varnishes and lacquers and a fair range of uses will be found for it as soon as more thorough experiments have been made with it.

Andes, L. E.

USE OF CHINESE WOOD TUNG OIL (ELAEOCOCCA) IN THE MANUFACTURE OF BODY-COLOUR OILS.
Chem. Rev. Fett-u. Harz-Ind. 8 (12), 252-253 (Dec. 12, 1901)*; J. Soc. Chem. Ind. 21, 56 (1902).

"For some time past, products known as "hard-drying oils," "rapid oils," & c. have been sold. These have the property of drying in a relatively short time when mixed with body colours. They are essentially very thin varnishes composed of copal, drying oil (usually boiled linseed) and turpentine. The colours mixed with them dry very rapidly, but are wanting in lustre and require subsequent varnishing.

When Tung oil became more commonly known, attempts were made to use it in place of these products, but although it dries rapidly, it has the drawback of becoming moist and of separating from the surface on which it has dried. To render it suitable for the purpose, special treatment is necessary. It is first heated for two hours at about 170° C. in an enamelled boiler, and allowed to cool slowly and to stand for several days. The clear oil is then withdrawn, and the lower layer used for inferior paints. The clear oil is again heated at 180° C., with the result that it becomes fairly thick after an hour. It is then cooled to 130° C., and 2 per cent. of powdered litharge gradually sprinkled in, after which the requisite amount of turpentine to thin the oil to the right consistency, is added, and the product stored and left to clarify.

A good body-colour oil should have the consistency of ordinary linseed-oil varnish, and when incorporated with a body colour should dry within 5-6 hours. The dried paint can receive a coat of varnish which will dry without affecting the layer beneath it." From J. Soc. Chem. Ind.

Bastian, Erich.
TEMPERATURES FOR COOKING TUNG OIL.
Farbe u. Lack 1933, 106; C.A. 27, 4696 (1933).

"The oil is rapidly heated to 280° and withdrawn from the fire. As soon as the temperature begins to rise, enough previously thickened cold oil is added to reduce the temp. to 180°. It is doubtful whether oil heated to over 300° possesses any advantages." From C.A.

Behr, O. M. (Los Angeles Paint & Varnish Production Club).
A STUDY OF POLYMERIZED OILS.
Am. Paint J. 23, 14, 16, 18, 20, 22-3, 62-3 (Nov. 14, 1938)*; C.A. 33, 883-4 (1939).

"A report of exptl. work to det. the effect of after-yellowing of sardine oils in relation to the degree of polymerization or viscosity of the polymerized sardine oils and some work on the elimination or repression of the "polymer cloud" formation. The polymer cloud is a function of the heating rate and the temp. and results whenever an attempt is made to polymerize high-I value sardine oil beyond the V viscosity. Dehydrated castor oils and polymerized tung oils especially the tung-soybean mixts. and "segregated polymers" (natural polymerized triglycerides, produced from combinations of semidrying and drying oils) are discussed. Polymerized tung oil is very much less waterproof and caustic-resistant than raw or unpolymerized tung oil. Segregated polymers are composed largely of polymerized glycerides made up of fatty acids contg. 2 or more double bonds and contain a small percentage only of the single double-bond oleic type acids. In the segregated polymers, great elasticity, flexibility and adhesion are retained by polymerization and due to the retention of a small but very effective percentage of natural olein partially polymerized or attached to the more highly unsatd. glycerides by polymerization or cross linkage. Phys. and chem. consts. of an oil of this type and of polymerized tung oil are tabulated." From C.A.

Bennet, R. G.
CHINA, THE CHINESE, AND CHINA-WOOD OIL.
Drugs, Oils, & Paints 51, 187-189 (1936); Brit. Chem. Abstracts 1936, B, 700.

"Chinese methods for the working up of tung oil are described." From Brit. Chem. Abstracts.

Blakeman, W. N.

PREPARATION OF OILS FOR THE PAINTER.

Corps gras ind. 35, 370-1(1909)*; Chem. Zentr. 1909, II, 943; C.A. 5, 593 (1911).

"The author recommends that wood oil be made rancid in order to be better fitted for the painter's art. This is done by adding 2% H_2O to the oil in a suitable vessel, heating to 65° and shaking and then allowing to stand 10-15 hrs., or the oil can be exposed over a large surface to light and air for 8-10 days until the proper rancidity has been secured. An oil treated in this manner allows the incorporation of all colors with ease, which cause difficulty with linseed oil." From C. A.

Blom, A. V.

THEORY OF DRYING OF OIL.

Paint Varnish Production Mgr. 15, 24, 26-9, 30 (1936)*; C.A. 30, 8653-4 (1936).

"A discussion of: (1) the typical structure of the oil mol., and (2) film formation. The oil mol. may be compared to a 3-armed polyp having a suction cup (double bond) on the foremost half of each arm with which objects (atoms and mols.) can be caught and held. The different types of drying oils are grouped into: (a) linseed oil, (b) Scheiber's Synouryn oil, and (c) tung (wood) oil. Fresh oils require treatment to hasten their drying properties or to effect a wrinkled surface. This is effected by boiling, blowing and addn. of driers. In boiling the main process is polymerization; in blowing it is autoxidation. The processes of synthesis and degradation (chain reactions and reticulation) which take place in pretreating the oil and in film formation are analogous with the formation of synthetic resins. An effort is made to explain the chem., colloidal and elastic properties of the films from the oxyn model from which conclusions may be drawn concerning possible improvements in the processing of oils." From C.A.

Bradley, T. F.

DRYING OILS AND RESINS. POLYMERIC FUNCTIONALITY WITH RELATION TO THE ADDITION POLYMERIZATION OF DRYING OILS.

Ind. Eng. Chem. 30, 689-96 (1938); C.A. 32, 6080 (1938).

"Concepts of polymerization previously developed by B. are believed to be sufficient to explain the phenomena of the bodying of drying oils, without recourse to colloidal consideration. Analysis of existing data on the variation of I no. with mol. wt. of bodied linseed and tung oils indicates, if allowance is made for intramol. addn. and hydrolysis, that these oils are hexafunctional." From C.A.

Bradley, T. F.

CHEMISTRY OF BODIED OILS.

Paint Ind. Mag., 56, No. 1, 11-14 (1941); Brit. Chem. Abstracts 1941, B, II, 155.

"Theoretical grounds for supposing the polymerization of drying oils to involve both inter- and intra-mol. reactions amongst the triglyceride mols. are advanced; the latter type of reaction promotes the formation of dibasic acids. Analysis of heat-gelled oiticica oil confirmed this view. Derivatives of dibasic acids of this type were obtained by heat-treating the Me esters of the fatty acids of linseed, tung, soya-bean, and dehydrated castor oils; mol. distillation in the last case showed the product to be mainly dimeric, with some monomeride and a little tirmeride, thus indicating analogy to butadiene polymerization. The results are supported by ultraviolet absorption spectra data, which also show that isomerization to conjugated double linking systems precedes polymerization in these mols. The analytical figures obtained in the experimental work are not quoted textually." From Brit. Chem. Abstracts.

Bradley, T. F.

A SURVEY OF THE CHEMISTRY OF DRYING OILS.

Paint Technol. 6, 85-8, 100, 108-10, 126, 133-4, 146 (1941); C.A. 35, 8323 (1941).

"A review from the standpoint of (1) chem. constitution of drying oils, (2) mechanism of heat-induced polmyerization, (3) mechanism of heat-induced gelation and (4) oxidation of drying oils. Forty-one references." From C.A.

Brendel, Hans

PREPARATION OF BODIED TUNG OIL.

Farbe u. Lack 1932, 145-7; C.A. 26, 3123 (1932).

"Two general methods for cooking tung oil so that its films will not wrinkle or "frost" are long cooking below the gelling point and rapid heating to above the gelling point. Other methods involving various reagents, e.g., S, halogens, aromatic amines, etc., have been used. It is suggested that the term "Albertol no." (C.A. 26, 322) should be changed to "structure no." From C.A.

Budowski, J.

NEW METHODS IN THE VARNISH INDUSTRY.

Farben-Ztg. 26, 469 (1920); C.A. 15, 1406 (1921).

"The varnish industry has been built up on empirical methods largely because of the chem. complexity of raw materials and finished products. Recent investigations show that certain naphthenic acids prevent polymerization of tung oil, and some of their heavy metal salts add durability to varnishes. The results of these investigations are reported to have been successfully applied to large scale production." From C.A.

Bürstenbinder, R.

THE ACTION OF SUBSTANCES WHICH RETARD OR PREVENT THE SOLIDIFICATION OF WOOD OIL.

Farben-Ztg. 23, 243 (1917-18)*; C.A. 13, 2139 (1919).

"Very little is known about the action of certain substances used in the manuf. of wood-oil varnishes to prevent solidification of the wood oil. Rosin and resins, S and SCl_2 are known to prevent polymerization, while linseed oil and other fatty oils are known to retard it somewhat. Krumbhaar (C.A. 9, 2155) maintains that this action is due to organic acids, but B. points out that some neutral substances, e.g., cumarone resin, also prevent polymerization. It is concluded that the action, except of S compounds, is merely mechanical, and from this viewpoint, the methods for the prevention of polymerization covered by several

German patents are discussed. The presence of even 0.01% S has a decided retarding action; this is due to the well known formation of a factis which no longer possesses the power of polymerization. The "flatting" and "alligatoring" effect of gas lights on a drying film of wood-oil varnish is ascribed to the presence of S acids in the products of combustion of the gas. Raw wood oil on drying, seps. into 2 layers, the one constitutes 80-85% of the oil, and dries in 12-16 hrs. to a turbid, soft film; while the other dries in 3-4 days to a smooth transparent film. The addition of driers however causes drying to proceed so rapidly that this sepn. is prevented, and the film is therefore uniformly smooth, hard, and transparent. This explains the action of oxidized turpentine oil in overcoming the formation of opaque wood oil films." From C.A.

Bürstenbinder, R.

THE WOOD-OIL THEORY IN PRACTICE.

Chem. Umschau Fette, Oele, Wachse Harze 36, 35-8 (1929); C.A. 23, 2051 (1929).

"Polymerization is only one factor in the coagulation of wood oil; reesterification and condensation are the other factors. The various colloidal phases corresponding to these factors have different phys. characteristics and solubilities. Reagents which are added to hasten or prevent coagulation of wood oil act by depolymerizing, by esterifying or by the formation of mixed glycerides. Depolymerization of the coagulated oil may also occur by reesterification, by hydrolysis or by syneresis." From C.A.

Bürstenbinder, R.

RELIQUEFACTION OF COAGULATED WOOD OIL.

Chem. Umschau Fette, Oele, Wachse Harze 38, 229-30 (1931); C.A. 25, 5582 (1931).

"Reliquefaction of coagulated wood oil by means of heat is impossible when coagulation has been "carried too far," but it becomes possible on this side of such limit. When coagulated wood oil is liquefied by fusion with resins or oils, an esterification occurs." From C.A.

Bürstenbinder

INTERCHANGE OF ESTER RADICALS IN RESIN BOILING.

Fette u. Seifen 49, 668 (1942); Chem. Zentr. 1943, I, 1524; C.A. 38, 4457 (1944).

"Boiling 1 part by wt. of rosin with 2 of wood oil at 240°, dilg. with C_6H_6 and pptg. with 90% alc. produced a heavy oil which contained 26% resin acids. This indicates interchanges of ester radicals." From C.A.

Cannegieter, D.

GELATION RATES OF TUNG AND OITICICA OILS.

Paint Varnish Production Mgr. 19, 366-8 (1939)*; C.A. 34, 2190 (1940).

"Gelation times are given for tung and oiticica oils for certain temps. between 261° and 359°, a min. occurring at approx. 350° for tung oil and at approx. 295° for oiticica oil. Increase in acid no. increases gelation time. Decompn. of tung oil starts at 350° for oiticica oil it is evident at 295°." From C.A.

Cannegieter, D.

PREPARATION OF BODIED OIL, PARTICULARLY WITH SULFUROUS ACID.
Central Inst. Materiaal Onderzoek Afdel. Circ. 31, 6 pp. (1946)*; C.A. 41, 3978 (1947).

"In the heat polymerization of drying oils $\log \eta_{t2} - \log \eta_{t1} = k(t_2 - t_1)$ and $d \log k/dT = Q/RT^2$ (t = reaction time, Q = heat of reaction). For linseed oil, k (250°) = $0,703 \times 10^{-3}$; k (300°) = 4.0×10^{-3}; for tung oil, k (250°) = 55×10^{-3}. No induction period was found. Bubbling SO_2 through linseed oil raised k (300°) to 13×10^{-3} when the SO_2 flow was 215 g./100 l./hr. At low SO_2 concns. k was proportional to SO_2 flow. SO_2 acts by conjugating the double bonds and does not influence k for oiticica oil. The course of the reaction is more satisfactorily expressed by $dc/dt = k'$ (c = concn. of polymer)." From C.A.

Cannegieter, D.

POLYMERIZATION OF DRYING OILS AND THE INFLUENCE OF SULFUR DIOXIDE UPON THIS PROCESS.
Paint, Oil Chem. Rev. 110 (4) 17-8, 38, 40-1 (1947); J. Am. Oil Chemists' Soc. 24, 255 (1947) (abstract); C.A. 41, 2913 (1947).

"The polymerization of linseed oil, with and without SO_2 as a catalyst, was studied from the point of view of reaction kinetics. Equations are derived which relate the increase in log viscosity to time. The bodying of tung and oiticica oils follow the same equations. It is concluded that the bodying both of slow- and of fast-bodying oils follows the same uniform mechanism and that SO_2 increases the rate of polymerization of slow bodying oils by catalyzing the shifting of isolated double bonds into a conjugated system." From J. Am. Oil Chemists' Soc.

Cardon, E., et al

SOME PROBLEMS CONNECTED WITH FORMULATING VARNISHES WITH AMERICAN TUNG OIL.
Official Digest Federation Paint Varnish Production Clubs No. 154, 79-81 (1936); C.A. 30, 7881 (1936).

American wood oil differs from the Chinese oil in having a lighter color, faster polymerization, greater purity and lower acid number. Chinese oil seems to increase in body progressively as the temperature rises while the domestic oil tends to hold a very thin body until the gel temperature is reached, when polymerization takes place very rapidly. The rate of bodying can be controlled by lowering kettle temperatures or by adding other oils or resins.

Carriere, M.

MODIFICATIONS PRODUCTS FORMED DURING THE BLOWING OF DRYING OILS.
Peintures, pigments, vernis 21, 49-53 (1945).

"The blowing of oils consists of an oxidation followed by a polymerization. By the determination of certain indices the author studied the influence of temperature on the blowing of linseed oil, compared the blowing of linseed oil and of China wood oil, then attempted to determine a mechanism of the oxidizing polymerization." Translated from the summary of the article.

Chatfield, H. W.
THE HEAT-TREATMENT OF VARNISH OILS. II.
Paint Manuf. 7, 144-5 (1937)*; C.A. 31, 5186 (1937).

"Com. stand-oil production is outlined and the chief advantages and disadvantages of this type of polymerized drying oils are listed. Pb driers do not ppt. in vacuum-distd. oils. Tung stand oils show greater stability toward water if treated at 320° rather than at lower temps. Perilla oil can be valuable as a substitute for tung oil or mixts. of tung oil and linseed oil. Soybean oil stand oils can be admixed in small amts. with linseed oil stand oil or tung oil. Stand oils from rapeseed oil are of little value to the paint trade." From C.A.

Cincinnati-Dayton-Indianapolis-Club.
A STUDY OF TREATED TUNG OILS.
National Paint Varnish Assoc. Circ. 495, 324-326 (1935); Brit. Chem. Abstracts 1936, B, 648.

"The tendency of 4 commercial treated tung oils to show "gas-checking" when stoved in a foul oven decreased with increase in their d, acid, val., drying and gelling time, and colour. Modified phenolic resin varnishes prepared with them underwent less "gas-checking" than raw tung oil varnishes, but the drying time and durability were also reduced." From Brit. Chem. Abs.

Cincinnati-Dayton-Indianapolis-Columbus Club.
PROPERTIES OF CHINA WOOD OIL VARNISHES COOKED AT DIFFERENT TEMPERATURES.
Paint, Oil Chem. Rev. 98, 24, 106-11; Natl. Paint, Varnish Lacquer Assoc., Sci. Sect. Circ. 523, 355-64 (1936); C.A. 31, 4513 (1937).
(no abstract).

Cutter, J. O.
THE POLYMERIZATION OF DRYING OILS.
J. Oil & Colour Chemists' Assoc. 13, 66-83 (1930); C.A. 24, 2901 (1930).

"The general properties and the theories accounting for the changes in the properties of drying oils when bodied by heat treatment are reviewed. The theories may be classed as chem. or colloidal. The preponderance of evidence favors the colloidal theory. Heat-bodied oils, when hydrogenated, always yield stearic acid glycerides, indicating that the so-called polymerization is an extra-molecular pheonomenon. Heat-bodied oils possess many characteristics of the associated type of liquid. Discussion." From C.A.

It is not believed that any investigator has yet synthesized beyond doubt any constituent glyceride of linseed or tung oils. It is assumed, largely from negative evidence, that the main glyceride of tung oil is alpha-eleostearic glyceride. Although the possibilities for space isomerism exists they are not well understood. No investigations have been made on the unsaponifiable matter in tung oil.

Cutter, J. O., and Jordan, L. A.
A SURVEY OF THE MECHANISM OF POLYMERIZATION.
J. Oil & Colour Chemists' Assoc. 18, 5-11 (1935); C.A. 29, 2762 (1935).

"The importance of the diene synthesis reaction (cf. C.A. 22, 1144) in bringing about the formation of large mols. and hence changes in phys. properties, when cooking tung and linseed oils, is discussed further." From C.A.

Davidson, D.
EFFECT OF HEAT TREATMENT ON DRYING OF TUNG OIL.
Paint, Oil Chem. Rev. 80. 8, 10 (1925); C.A. 19,3380 (1925).

"D. believes that the speed of drying of tung oil-rosin varnishes varies inversely with the temp. applied, but the results obtained on expt. lab. batches do not strictly agree with this. The decompn. products liberated when the oil is heated to 500° F. diminish its drying power, and account for the fact that tung oil does not gelatinize when heated very rapidly to about 605° F." From C.A.

Davidson, D.
THE TREATMENT OF TUNG OIL.
Paint, Oil Chem. Rev. 100 (17) 11 (1938); C.A. 32, 8168 (1938).

"About 100 undescribed lab. expts. on the effect of heating tung oil (I) to 215-675° F. for varying lengths of time led to the following conclusions: (1) With air excluded decrease in tendency to wrinkle was not obtained without diminishing the tendency to dry. (2) The presence of air during heating increases the tendency to gelatinize and also darkens the product. (3) If heated in a closed flask contg. an atm. of CO_2 to any temp. between 215° and 675° F., I will gelatinize. At 215° F. the time required was 76 and 107 days for I of American and Chinese origin, resp. Recommended method for treating I is partial oxidation at a temp. below 400° F., e.g., 60-hr. heating in an open vessel to 234° F." From C.A.

Dunbrook, R. F.
CONTRIBUTIONS OF ORGANIC CHEMISTRY TO THE WAR EFFORT. SYNTHETIC RUBBER. V.
India Rubber World 117, 745-8 (1948)*; C.A. 42, 8510-1 (1948).

When linseed and tung oil are irradiated (Mazda lamp) they thicken and give peroxide tests. Extensive discussion of other polymerizations.

Eisenschiml, Gerald.
CHANGES IN WOOD OIL AND TUNG OIL ON PROLONGED STORAGE.
Am. Paint J. 30, (28) 76, 78, 80*; Paint Oil Chem. Rev. 109 (7) 16, 18 (1946); Official Digest Federation Paint & Varnish Production Clubs No. 255, 170-2 (1946)*; C.A. 40, 3621 (1946).

"In this paper tung oil is regarded as the domestic oil and wood oil as the Chinese tung oil. Chinese oil after 4-yrs. storage showed an increase in acid value of 4 to 8, with a max. of 9. The Worstall test of the oil is shortened from about 7 min. to 5.5 min. Tung oil of such a length of storage was unavailable. Skin formed in 1 yr. and 1.5 yrs. on storage of tung oil in open tanks. The skin consisted of completely polymerized tung oil which could not be recovered by any known methods. Below the top skin was a gel layer not completely polymerized, recoverable by fluxing with rosin. The remainder of the oil was unaffected. Wood oil can be stored at least 4 yrs. in most parts of the U.S.A. without appreciable damage. Tung oil can be stored for a considerable time in large quantities. Inside storage is advisable for quantities under 17,000 gals. Circulation by frequent transfer from one tank to another prevents dangerous formation of top polymerization, which may lead to further gelation in the main body of the oil." From C.A.

Elm, A. C.

PHYSICAL AND CHEMICAL TREATMENT OF DRYING OILS.
Paint, Oil Chem. Rev. 111 (13) 11-12, 14, 16, 18-19, 34-6 (1948); C.A. 42, 7063 (1948).

"Chem. compn. and methods for treatment of various drying oils are given. Emphasis is placed on dehydration, isomerization, and theories of blowing and heat-bodying of oils." From C.A.

The reactions of the conjugated oils (represented by tung and oiticica and of the linseed-like oils are considered separately. Considerable attention is devoted to mechanisms of reactions.

Erastona, R. M., Oleshkonich, M. and Aelanov, G.

POLYMERIZATION OF WOOD OIL.
Trudy Inst. Lakov i Krasok 2, 94-103 (1939)*; C.A. 34, 2190 (1940).

"The manuf. of varnish can be simplified by effecting in one operation the polymerization of the wood oil and production of rosin ester followed by evapn. of the mixt. The oil can be heat-treated only when pure to produce a standard product. The painting and technical properties of the oil are a function of the polymerization temp. The expts. are described." From C.A.

Fahrion, W.

POLYMERIZATION OF LINSEED OIL AND WOOD OIL.
Chem. Umschau Fette, Oele, Wachse, u.Harze 24, 102-4, 117, 144-5 (1917); 25, 14-5, 27-8, 39-40, 51-2, 63-4, 74-7, 87-8 (1918); C.A. 13, 267 (1919)

"A critical review." From C.A.

Fokin, S. A.

POLYMERIZATION OF VEGETABLE OILS. PRELIMINARY COMMUNICATION.
J. Russ. Phys. Chem. Soc. 39, 308-10*; C.A. 1, 1775 (1907).

"On heating linseed oil in an indifferent atmosphere (CO_2, N. H. etc.) or in sealed tubes it is possible to separate out linoleic acid from the oil, the acid polymerizing much quicker than its glyceride. The polymerized glyceride of linoleic acid is not acted on even by lipase from Chelidonium majus. In determining the molecular weight by the lowering of the freezing point of benzene it is necessary to remember that fatty acids form a complex of two parts, while glycerides are not polymerized. On treating the polymerized compound with lipase and then boiling with petroleum ether in presence of some bone charcoal, depolymerization takes place. Heating under high pressure to 250-70° does not increase polymerization, but increases the viscosity; hence a physical condensation takes place. Wood oil and sunflower oil were also found to be polymerizable by heat. The latter was depolymerized under some conditions which were not yet investigated." From C.A.

Fonrobert, E.

TUNG OIL AS A RAW MATERIAL FOR VARNISHES AND SYNTHETIC RESINS. II.
Paint Manuf. 6, 4-7 (1936).

A discussion of the preparation of (1) tung-oil stand oil, (2) tung-linseed stand oil, (3) alkyl-phenol resins and (4) alkyd resins.

Fonrobert, E. and Boller, C.

COOKING OF TUNG OIL.

Farben-Ztg. 36, 2196-7, 2239-40 (1930), 37, 15-7 (1931); Albertschrift No. 22; Nitrocellulose 3, 25 (1931); C.A. 26, 322, 3123 (1932).

"To det. the optimum conditions for cooking tung oil so that it will dry with a clear film, the following test was devised: Increasing amts. of a 50% soln. of Albertol 111 L in benzine is added to the oil contg. 0.1% Co (as rosinate) until the film dries clear in an English oven (one receiving the fumes from a luminous Bunsen flame). The Albertol no. constitutes the parts of Albertol required for 100 parts oil. This value is given for samples of tung oil cooked for varying periods to temps. from 220° to 280°. To render bodied tung oil gas-proof it must be heated quickly to 280° and cooled immediately. Sp. gr., n, and viscosity do not indicate the ability of bodied tung oil to produce clear films." From C.A. (p. 322).

Fonrobert, E. and Pallauf, F.

CHINESE WOOD OIL - THE CHEMISTRY OF ITS GELATINIZING AND WOOD OIL "ERSCHEINUNG."

Chem. Umschau Fette, Oele, Wachse u. Harze 33, 41-51 (1926); C.A. 20, 2418 (1926).

"Illus. When wood oil is heated its triglyceride of eleostearic acid its active double C bonds polymerizes to 2 basic or polybasic acids by chem. change within its mols. and the tervalent glycerol causes a re-esterization on further heating to form complexes of high mol. wt. by extramol. polymerization, ending in thickening and gelatinization. Varying compn. of the oil and different methods of heating cause variations in the final product. The gelatinizing of wood oil belongs to a general reaction between polybasic acids and polyvalent alcs., forming high mol. gels or insol. resins, similar to the chain formation between phenols or ketones and aldehydes or between urea and HCHO, or between glycerol and phthalic acid anhydride which latter on heating form first a sol. then an insol. gel. which solidifies on cooling. As exptl. proofs for polymerization F. and P. give, besides increased sp. gr. and viscosity, the decrease of I no. from 160-170 to 80 and the increase of its mol. wt., which is nearly doubled. As proof for the active role of the glycerol the following expts. are mentioned: univalent esters of the wood oil acid (Me, Et, Am, cyclohexyl and methylcyclohexyl) do not gel on heating and show only little increased viscosity; bivalent glycol ester thickens at 300°., while the mono- and di-glycerides of wood acid gel at 250° and glycerol plus wood oil acid form a gel similar to the normal gel. Further; the viscosity of wood oil increases suddenly only after the Br no. has become const., which indicates polymerization within the mol.; whether formation of the β-variety of the acid occurs in all cases is uncertain. The re-liquefying of the gel by ethereal HCl is probably due to splitting into smaller mols., while the gelatinizing of raw wood oil by ethereal HCl may mean a re-arrangement to the β form of the glyceride, this polymerization being made possible by the shifting of the double bond. The following methods are mentioned to prevent gelatinizing; the customary addn. of oxidized turpentine oil or phenols; addn. of large amts. of resins, linseed or perilla-oil-acids, acid resinates etc. (these prevent gel formation by producing mixed glycerides) addn. of drying oils, resin esters, etc., while also form mixed glycerides; addn. of solvents, including decalin and varnish solvents, cumarone resin, naphthalene, etc., which act by decreasing the concn.; addn. of small amts. of S or sulfides, Se or selenides, S chlorides, aniline or other aromatic amines; they probably act by adding themselves at the double C bonds, or by forming the β-isomers which contain a smaller amt. of energy and thereby make polymerization difficult; substituting uni- or bivalent alcs. in place of glycerol; this method is useless industrially since it yields non-drying products; adding preheated raw wood oil to hot linseed oil at 300° to 340° or to hot thickened wood oil. The wood oil "Erscheinung" ("mat" drying or "crazed" drying) is caused by the action of light, which changes the α-eleostearic glyceride into the difficulty sol. β-variety that separates in crystallized needle clusters, embedded in the unchanged oil. O_2 alone is not responsible for "crazing" since almost complete crazing occurred when the wt. increased by O_2 absorption was only 1% while the final wt. increase amounted to 15.6%. A wood oil film with drier in an atm. of CO_2 and exposed to diffused daylight formed fan-shaped crystals on a mat and soft film, but a film of oil without a drier did not turn mat, also indicating that the O_2 plays some role. Transferring the mat, cryst. film from the CO_2 into the oven at 100° caused melting of the crystals and the film dried comparatively smooth. The severest test for observing "matting" or "crazing" consists in exposing a thin film without any drier to diffused daylight. Under these conditions esters of the univalent alc. remained clear while all wood oils turned mat. The prevention of crazing by addition of oxidized turpentine oil or phenols is of too short an experience for a final oonclusion." From C.A.

Fonrobert, E. and Pallauf, F.
CHINESE WOOD OIL. II.
Chem. Umschau Fette, Oele, Wachse u. Harze 34, 1-6 (1927); C.A. 21 1193 (1927).

"Correction: the film of glycolide of the fatty acids of wood oil does not remain clear and sticky as stated, but dries in 2 hrs. to a mat, non-sticky film. Recapitulation: The thickening and gelatinizing of wood oil is a process involving re-esterification and polymerization, the latter of the order of formaldehyde and phenol; it is, therefore, mainly of a chem. nature in which the viscosity increase is partly due to the glycerol radical, as shown by the lowering of viscosity when glycerol is replaced by a monohydric alc. Formation of crystals of β-eleostearin was observed with catalysts, such as I in CCl_4, Se in CS_2, and with CS_2 alone. During conversion of the α into β variety there is little or no polymerization. Expts. show that the "wrinkling" of films during drying at elevated temp. is due to a rapid absorption of O_2 on the surface, forming a thin film which increases its vol. by further O_2 absorption and thereby causes folds and wrinkles. Of the many possible polymerization compds. one case is illustrated schematically in which a caboxyl group seps. from a polymerized glyceride and enters another mol. of an intramolecularly polymerized glyceride. By heating wood oil rapidly to 330-340°, a viscous oil is obtained which does not gelatinize. This result is due to a very rapid mol. motion, which breaks up the long chains of polymers into smaller ones that do not readily gelatinize." From C.A.

S in CS_2 was also used as a catalyst for the formation of β-eleostearin.

Fonrobert, E. and Wachholtz, F.

REACTIONS OCCURRING DURING THE POLYMERIZATION OF TUNG OIL, ALONE AND MIXED WITH LINSEED OIL. (THERMAL MEASUREMENTS.)

Farben-Ztg. 40, 477-9, 505-7, 533-5, 560-2, 586-7 (1935); C.A. 29, 6776-6777 (1935).

"A study was made of the temp. changes occurring in tung oil (I), linseed oil (II) and mixts. thereof, when 170-g. samples were heated by an elec. heater of the sumberged type in a small beaker, which was provided with good stirring and protected from drafts by means of a cardboard tube having a bottom but no top. Comparison of the shape of the curves showing temp. of the oil sample as a function of the time of heating show clearly that I evolved considerable heat once a moderately high temp. was attained. This was confirmed by other expts. in which rates of cooling of heated oil samples were detd. On plotting the rate of temp. increase against temp. of oil sample, a straight line was obtained with II, while above 180° I showed a continually rising rate of temp. increase. Data obtained during the period of heating as well as during subsequent cooling of mixts. of I and II in the ratios 1:1, 2:8, 1:9 show that at least during the early stages of polymerization the reaction is mainly monomol. The theory is advanced that first 2 eleostearic residues within the same glyceride mol. unite and that subsequent reesterification reactions involving other glyceride mols. lead to increase in both mol. wt. and viscosity. Reactions of this type apparently continued even after gelation had occurred. Other graphs show heat developed by reactions in the oil mixts, as a function of the proportion of I in mixts. of I and II and of I and salad oil. It appears that when mixts. of I and II were heated, mixed polymerization also occurred. This tendency of the double bonds of I to react with those of II increased with the proportion of II, rise in temp. and contact of the oil mixt. with the O of the air." From C.A.

Fritz, F.

CAN WOOD OIL BE PREVENTED FROM GELATINIZING BY NAPHTHENIC ACIDS?

Chem. Rev. Fett-u. Harz-Ind. 20, 182 (1913); C.A. 7, 3669 (1913).

"Exception is taken to the claim in German Pat. No. 253,845 that addition of 15% naphthenic acids to wood-oil prevents gelatinizing of the latter. An expt. with 20% naphthenic acid from Baku showed only retardation of the solidifying process but not prevention." From C.A.

Fritz, F.

THE LIQUEFYING OF WOOD OIL GELS.

Farben-Ztg. 30, 399-400 (1924); C.A. 19, 738 (1925).

The methods variously suggested for liquefying wood oil gels, such as melting alone at 300°, melting with rosin, with other oils, etc. are reviewed. All of these methods have been reported ineffective at times. Whether the liquefaction is successful or not depends on the character of the gel. Soft gels can probably be liquefied, but the dry, crumbly ones are likely to resist all suggested methodsof bringing them back to liquid form usable in paints or varnish; they can be made up in small proportions in linoleum cements." From C.A.

Fritz, F.

OXIDIZED CHINESE WOOD OIL.

Paint Varnish Production Mgr. 10 (7) , 18 (1934); C.A. 29, 2002 (1935).

"Directions are given for prepg. a blown tung-linseed oil mixt. especially suitable for use in printing inks and linoleum." From C.A.

Gardner, H. A.

STORAGE CHANGES IN VEGETABLE AND ANIMAL OILS.

Ind. Eng. Chem. 8, 997-8 (1916); Paint Mfrs. Assoc. U. S. Ed. Bur., Circ. o. 40, 4 pp. (Nov. 1, 1916); C.A. 10, 3168 (1916).

"G. finds, on examn. of linseed oils stored in contact with pigments and alone, changes in constants which indicate that hydrolysis has taken place. A drop in I no. is generally accompanied by a rise in Sp. gr. and acid no. Analyses after storing, show similar changes in a large variety of oils. [including raw tung oil] Results are tabulated." From C.A.

Gardner, H. A.

CHANGES IN OILS UPON STORAGE.

Ind. Eng. Chem. 11, 759-61 (1919); Drugs, Oils & Paints 35, 9-10 (1919); C.A. 13, 2139 (1919).

"G. has previously reported on the changes occurring in oils when ground with pigments (C.A. 5, 3920; 7, 2265; 9, 2154; 10, 3168), and now finds that similar but less marked changes occur in pure oils without the presence of pigments. The sp. gr., I no., sapon. no., acid no., and a detd. at intervals on a large number of drying and semi-drying vegetable and fish oils that had been stored in glass for a period of 6 yrs., are tabulated." From C.A. (Includes data on 7 tung oils).

Gardner, H. A.

VARNISHES PRODUCED BY BLOWING.

Am. Paint Varnish Mfrs.' Assoc.. Circ. o. 414, 223-38 (1932); C.A. 26, 5774 (1932).

"Tung oil blown with air for 15 or more hrs. in the presence of turpentine loses its property of drying to an opaque film. In the process, considerable amts. of turpentine are converted to a non-volatile phase. Oleo-resinous varnishes may be prepd. by blowing mixts. of tung oil, resin, drier and turpentine. The tung oil and resin may be in any suitable proportion, but the oil; turpentine ratio is preferably about 30:70. The temp. may range from that of the room to 100°. Exposure tests indicated good durability. Non-penetrative properties on porous surfaces are acquired by the product." From C.A.

Gardner, H.A., Carmick, G., and Heckel, E.

ACTION OF HEAT ON THE CHEMICAL CONSTANTS OF LINSEED, WOOD, AND SOY BEAN OIL.

Seifensieder-Ztg., 41, 541 (1914); C.A. 8, 2631 (1914).

"The above oils were heated for 10 min. at 150, 175, 205, 230, and 260°. Great changes were noted in the acid nos. of the oils, all growing less with increased temp. owing to the distn. of the free acids. Heating had little effect on the sapon. no. The I no. showed little change except in the case of Chinese wood oil. Over 200° polymerization proceeds rapidly." From C.A.

Gardner, H. A., and Parks, H. C.

ALPHA- AND BETA-ELEOSTEARIN. LIQUID AND SOLID GRANULAR LIGHT-INDUCED PRODUCTS FROM TUNG OIL.

Paint Mfrs. Assoc. U. S., Circ. 256, 207-15 (1925); C.A. 20, 1329 (1926).

"β-Eleostearin formed in light-struck tung oil does not render the oil unsuitable for varnish making. The crystals sepd. from the oil by washing with cold Me_2CO gave a shorter heat test than the original oil. Dissolved in C_6H_6 and poured on glass, the crystals dried slightly faster than the liquid residue so dissolved and poured." From C.A.

Hadert, Hans.

BOILING WOOD OIL.

Farb u. Lack 1928, 558; C.A. 23, 721 (1929).

"Wood oil when heated below 200° for about 12 hrs. and subsequently at 250-300° with addn. of various agents such as oxidizers, reducers, terpenes, halogen compds., acetates, phthalic compds. and aldehydes, does not gel in the usual manner and dries clear." From C.A.

Hadert, Hans.

WRINKLE FORMATION IN COATINGS.

Farbe u. Lack 55, 2 (1949); C.A. 43, 3631 (1949).

"To inhibit or prevent the wrinkling of wood oil or medium oil-length alkyd vehicles, small amts. of glycol, solvent naphtha, or turpentine, limed rosin, maleic or oil-sol. phenolic resins, cyclohexanol, diacetone alc., phthalic anhydride, high-boiling solvents, or antioxidants (thymene) can be added. Other methods are rapid heating to 400° and quick chilling of wood oil, or its partial oxidation at 204° with 0.0003% Co and 0.0009% Pb (naphthanates) present." From C.A.

Hofmann, H. E.

THE VALUE OF CRYOSCOPY IN THE TECHNICAL INVESTIGATION OF VARNISHES.

Ind. Eng. Chem. 17, 175-6 (1925); C.A. 19, 1060 (1925).

"The differences previously observed between the mol. wts. of oil-resin mixts. calcd. from the mol. wts. of the constituents heated individually in exactly the same manner, are due to the retarding effect of the acidic portions of the resins on the polymerization of the oil. This is shown by calcd. and detd. mol. wts. on heated mixts. of tung oil-rosin, and ester-gum, which are tabulated. Raw rosin has about twice as great a retardant action on the polymerization of tung oil as ester gum. Correction. Ibid 323." From C.A.

Hollihan, J. P. and Briggs, D. R.

VISCOMETRIC ESTIMATION OF PARTICLE DIMENSIONS.

J. Phys. Chem. 46 (6), 685-93 (1942)*; Biol. Abstracts 20, 1603, Abs. No. 14,968 (1946).

"Micellar changes involved in the heat-bodying of tung oil. --Viscosity data for dilute CCl_4 solns. of tung oils which had undergone various degrees of nonoxidative heat treatment can be interpreted as indicative of a progressive increase in degree of asymmetry of the oil micelles with time of bodying. These data can also be satisfactorily represented by the exponential form of the Einstein equation for spherical particles. In the latter instance a progressive increase in the viscometrically effective partial specific volume of the oil micelles (in carbon tetrachloride) is indicated. Evidence in the favor of the suggestion that the bodying process occurs in successive stages is presented. No conclusions regarding possible gelation mechanisms are drawn." From Biol. Abstracts.

Hollihan, J. P. and Briggs, D. R.
VISCOMETRIC ESTIMATION OF PARTICLE DIMENSIONS. II. MICELLAR CHANGES INVOLVED IN THE HEAT-BODYING OF TUNG OILS.
J. Phys. Chem. 47, 30-9 (1943); C.A. 37, 2636-7 (1943).

"The relative viscosities of dil. solns. of tung oil in CCl_4 were detd. by the method previously described. The data can be treated by extrapolating the (sp. η)/c vs. c plot to infinite diln. (c = concn.). The results indicate a progressive increase in the degree of asymmetry of the oil micelles with the time of bodying. The data can also be satisfactorily represented by the complete form of the Einstein η equation, which indicates that the particles are spherical. In this case the progressive increase in η with bodying time could be explained as resulting from a greater swelling tendency in the micelles of the higher bodied oils. No conclusions are drawn regarding possible gelation mechanisms." From C.A.

Houck, R. L.
SOME OBSERVATIONS ON THE COOKING OF CHINA WOOD OIL.
Paint, Oil Chem. Rev. 86 (21) 10 (1928); C.A. 23, 5336 (1929).

"China wood oil is better regarded as a polymerizing than as a drying oil. Polymerization is a factor of time and temp. In a China wood oil varnish the combination with gum is, in part at least, chem. It appears to be the case that the monobasic eleostearic acid radicals become linked at the double bonds to form polybasic acids which with the polyhydric alc., glycerol, form polymers of which the so-called glyptal resins are only another example. Possibly the acid resins react at high temps. to form mixed esters so that the varnish film might be regarded as a synthetic resin. The course of polymerization of China wood oil when cooked with amberol is indicated by the livering of overbodied amberol wood oil varnishes with basic pigments. Although amberol is less easily sapond. than ester gum or rosin and does not liver in linseed oil, the China wood oil-amberol is apparently in a condition of polymerization which is stable except in the presence of basic pigments, which catalyze the further polymerization." From C.A.

Huff, R. H.
SCIENTIFIC METHODS OF VARNISH MANUFACTURE. III. ESTER GUM VARNISHES.
Am. Paint J. 23, 12, 14, 46, 48, 50 (Jan. 9, 1939)*; 23, 45-8 (Jan. 16, 1939)*; C.A. 33, 1970 (1939).

"As the acid value of ester gum increases, the retarding action on oil polymerization becomes more perceptible. Ester gum-tung oil varnishes should be heated to temps. as close to 302° or 305° as the particular varnish will safely permit, to insure gas-proofing of the tung oil. Since ester gums exert very little retarding effect on the gelation of tung oil, the bath must be cooled quickly to safer temps. for the final bodying action. Methods of cooling are discussed. Four typical ester gum varnish formulas are given. III. Ester gum varnishes. Ibid. 45-8 (Jan. 16, 1939). At 30-gal. length or higher, where only tung oil and ester gum are used, Pb compds. must be included and should be added as soon as possible after the batch has reached a temp. of about 232°. PbO is added to the extent of 2-2.5%. Several formulas are given for long oil varnishes suitable for special purposes." From C.A.

Huff, R. H.

SCIENTIFIC METHODS OF VARNISH MANUFACTURE. IX. HEAT-BODIED OILS AND TREATED OIL.

Am. Paint J. 23, 55-9 (Dec. 25, 1939); 24, 52, 54, 56, 58, 60, 62 (Jan. 8, 1940); 24, 50, 52, 54, 56, 58 (Jan. 22, 1940); 24, 50-5 (Feb. 5, 1940) 24, 22-3, 26, 29-30 (Mar. 11, 1940); C.A. 34, 3933 (1940).

"A review of drying and polymerization taking place during heat-treatments. Theories of the structure and polymerizing action are discussed. Tung oil is considered fundamentally a pure triglyceride, and this is made the basis of a lab. test by means of which the eleostearic triglyceride content of tung oil can be detd. accurately enough for routine testing pruposes. A portion of the solid gel produced in the Browne heat test is weighed and thoroughly extd. with petr. ether. The solid residue is dried and weighed. This residue represents the total amt. of polymerizable eleostearic triglyceride present in the oil. The presence of 3% adulteration can be detected by an experienced operator. Tabular results show the accuracy of the test on mixts. of soybean and tung oils and of linseed and tung oils, also a comparison of kettle bodying of tung oil bodied at 232° and of oiticica oil bodied at 250-5°. Oiticica oil heated in an open kettle at 232° requires a longer time to acquire a given viscosity than does tung oil similarly heated; at 250-5° oiticica requires approx. the same length of time to reach the given viscosity as does tung oil at 232°. Ibid. 50, 52, 54, 56, 58 (Jan. 22, 1940). - Consideration is given of the mol. rearrangements taking place when tung and oiticica oil films are dried. The exact mechanism of the chem. reactions which result in gas-proofness in these oils has not been definitely established but it seems to depend upon the nature of the reaction of the particular type of double-bond structure and upon the differences of relative positional activity of the fatty acid "arms" extending from the glycerol axis of the mol. Ibid. 50-5 (Feb. 5, 1940). - The production of bodied oils and the application of theory to practice are outlined. The polymerization speed of varnish oils increases with the content of fatty acids having 2 or more double bonds. Formulas are given for several treated-oil varnishes, and several treated-oil vehicles with some detail of prepn. of each. Ibid. 22-3, 26, 29-30 (Mar. 11, 1940) - Newer methods of oil polymerization consist of passing varnish oils through a spiral coil at a controlled rate of flow. The temp. employed depends upon the oil or blend, as does the rate of passage through the coil. Several heating schedules are outlined. β-Naphthol, β-thionaphthol, aniline, diphenylguanidine, resorcinol, α-aminoanthraquinone and other products have been used to improve the gasproofness of low-temp.-bodied tung oil. Oiticica and tung oils have similar heat-bodying characteristics. Dehydrated castor oil has bodying characteristics similar to those of tung oil yet also similar to those displayed by linseed oil." From C.A.

Jeu, Kia-Khwe; Tong, Chia-Cheng; Lin, Chi-Tsiang; Ma, Hsueh-Fang.

THE EFFECT OF ORGANIC SUBSTANCES ON THE DRYING OF OILS.

J. Chinese Chem. Soc. 11, 25-53 (1944)*; C.A. 39, 1302 (1945).

"Samples of tung, stillingia and linseed oils (1.5 g.) contg. a small amt. of Cu soap as catalyst are treated with org. substances in AcOEt soln. and dild. with the solvent to 25 ml. Aliquots are removed, evapd. and the iodine no. of the oil is detd. after definite time intervals. All the substances examd. inhibited oxidation of the oil in descending order of potency as follows: pyrogallol, p-aminophenol, thiourea, catechol, hydroquinone, resorcinol." From C.A.

Jordan, L. A.

TUNG OIL. TECHNICAL STUDIES.

J. Oil & Colour Chemists' Assoc. 17, 47-67 (1934); C.A. 28, 4612 (1934).

"The acetone-insol. portion of heat-treated tung oil can be used to measure the rate of gel formation. This rate is directly proportional to the temp. and duration of heating and inversely proportional to the acidity of the oil. Above 270° a gel of lower soly. is formed. The acetone-sol. portion is responsible for the frosted (wrinkled) appearance of dried tung oil films. Pigments selectively absorb this portion, thus reducing the frosting tendencies." Cf. C.A. 28, 2201. From C.A.

K.

THICKENING OF VARNISHES WITH ZINC AND LEAD COLORS.

Farben-Ztg. 18, 702-3 (1913).

To prevent varnishes containing wood oil from thickening all materials used must possess a neutral (not acid) reaction.

Kadison, L.

COMPATIBILITY OF DRYING OILS WITH SYNTHETIC RESINS.

Plastics Trends 2 (4) 7-8 (1942); C.A. 37 3284 (1943).

"Monomeric $C_6H_5CH{:}CH_2$ and $CH_2{:}C(CH_3)CO_2CH_3$ were heated with perilla, linseed, tung and "liqurola" oils and the degree of compatibility was reported at various stages of polymerization." From C. A.

Kappelmeier, C. P. A.

CHEMICAL PROCESS OF STAND-OIL FORMATION.

Farben-Ztg. 38, 1018-20, 1077-9 (1933); C.A. 27, 4425 (1933).

"One of the principal reactions occurring during the cooking of tung oil and linseed oils is the Diels and Alder diene synthesis. In addn. thermal decompn. of linseed oil may result in the formation of dicarboxylic acids. Linseed oil also undergoes reesterification. The sapon. of stand oils yields products similar to those of alkyds but isolation of such products has not yet been accomplished." From C.A.

Kappelmeier, C. P. A.

THE THERMAL POLYMERIZATION OF DRYING OILS. I AND II.

Chem.-Ztg. 62, 821-3, 843-5 (1938); C.A. 33, 1969 (1939).

"Tung and oiticica oils, which contain glycerides of eleostearic and licanic acids with conjugated double bonds, polymerize by means of a Diels-Alder type of reaction of cyclohexene derivs. instead of the previously postulated cyclobutane derivs. Linseed and perilla oils, which contain glycerides of linoleic and linolenic acids with no conjugated double bonds, require a higher temp. or a longer time for their polymerization, which proceeds first through rearrangement to conjugated compds. which in turn polymerize in the usual manner. Some free fat acids are also formed at the time of rearrangement." From C.A.

Karsten, E.

STAND OILS.

Farben-Ztg. 40, 77-9 (1935); C.A. 29, 3178-9 (1935).

"A tung oil-stand oil and a series of linseed oil samples heat-treated at various temps., and also blown in some cases, were dissolved in CCl_4, treated with a 100% excess of IBr dissolved in AcOH and the halogen absorption was detd. at intervals over a 33-day period. In spite of great differences in viscosity, the variously treated linseed oil samples finally absorbed an amt. of halogen equiv. to I nos. of 156-162. The difference between these values and 188 (the I no. of the untreated oil) is ascribed to inactivation of the double bond and to formation of isolinoleic acid." From C.A.

Kaufmann, H. P., Baltes, J., and Büter, H.

THE FIELD OF FATS. XXXVII. THE POLYMERIZATION OF FATS. 1. THE HEAT POLYMERIZATION OF DRYING FATS.

Fette u. Seifen 44, 289-92 (1937); C.A. 31, 7677-78 (1937).

"Changes in diene no. (cf. C.A. 30, 7885), I no. and thiocyanogen no. of drying oils during heat polymerization were studied. Oiticica oil and 2 samples of tung oil showed, during heating to 180-190° for 12-16 hrs., initially a rapid drop in diene no.; at gelation, however, the diene no. was still quite high. The I no. of the tung oils also decreased somewhat. The thiocyanogen no. was not affected appreciably in any case. Similar expts. with linseed oil (heating time 30 hrs. to 285°) showed a drop in both I no. and thiocyanogen no. while the initially small diene no. dropped to a negligible value. Oiticica oil when heated to 140-150° for 30 hrs. showed substantially no decrease in diene no. nor in thiocyanogen no. A diene type of reaction, which does not occur below a certain min. temp., is very probably involved in the mechanism of the heat polymerization of drying oils. With linseed oil, this theory is less well established, since it has not been possible, as yet, to detect any substantial amts. of conjugated double bonds in this oil either before, during or after heat treatment." From C.A.

Keghel, Maurice de

BOILED AND POLYMERIZED LINSEED OIL AND OTHER OILS USED IN THE MANUFACTURE OF ENAMEL AND VARNISH PAINTS.

Rev. prod. chim. 25, 613-8, 757-64, 829-38 (1922)*; C.A. 17, 1156 (1923).

"A description of the methods of prepn. of boiled and polymerized linseed oil, China wood oil, perilla oil, and soy-bean oil, of the properties of copal, dammar and sandarac, and of the prepn. of enamel and varnish paints, "zapon" and "cellon" varnishes, and black asphalt varnishes." From C.A.

Klauenfeld, H.

USE OF CHINA WOOD OIL.

Farbe u. Lack 1924, 97-8; Chimie & industrie 12, 735 (1924); C.A. 19, 408 (1925).

"Brief review of its properties and of the Wiegmann process for preventing its gelatinization, consisting in cooking in the presence of suitable driers, and ultimately in the presence of rosin and of linseed oil." From C.A.

Kohler, Friedrich.

COOKING TEMPERATURES OF TUNG OIL.
Farbe u. Lack 1933, 67; C.A. 27, 4696 (1933).

"Tung oils cooked at low and high temps. differ in their proportions of polymerized complexes. A method for cooking tung oil safely at high temp. is described." From C.A.

Kolln.

SEVERAL WOOD OIL TREATMENTS.
Farben-Ztg. 31, 920*; Chem. Zentr. 1926, I, 1899.

Processes are described for preparing wood oil stand oils of various degrees of consistency with or without the addition of resins.

Kölln, H.

THE HEAT-BODYING OF OILS.
Farben. Lacke, Anstrichstoffe 2, 83-4 (1948); C.A. 42, 7547 (1948).

"When stand oils from linseed oil (I) are prepd. in closed Al kettles at 300° and under CO_2 pale products of low acid no. result. Though little wt. is lost, the vol. is reduced by 1/5. Where suitable closed kettles are not available, the bodying can be carried out in open kettles by covering the oil with a "floating" Al cover of slightly smaller diam. than that of the kettle at the final oil level, with an opening for the thermometer. This yields pale oils of low acid no. without the use of CO_2. China wood oil (II) is heated up to 280° to prevent it from wrinkling and gas-checking, best with agitation. It is better to add resin to the heat-treated II than to body them together. Mixts. of raw II with I stand oil differ from a similar mixt. which was heat-bodied together, e.g., in H_2O resistance. Castor oil dehydrated at 280° tends to gel and is inferior to Synourin oil (Scheiber). Drying petroleum oils (Polyöle may be thickened by cooking with I and blowing with air in the presence of Co or Mn catalysts. The floating-cover method can be used to body mixts. of fish oil or I with II." From C.A.

Krumbhaar, Dr.

MODERN METHODS OF USING CHINA WOOD OIL.
Farben-Ztg. 20, 877-9 (1915); C.A. 9, 2155 (1915) (no abstract).

A review of the newer methods of heat treating tung oil.

Krumbhaar.

LINSEED AND CHINESE WOOD OILS.
Chem. Ztg. 40, 937-8 (1916); J. Soc. Chem. Ind. 35, 1225 (1916); C.A. 11, 1314 (1917).

"The difficulties encountered in the use of wood oil, suggest fundamental differences between it and linseed oil in polymerization, but expts. fail to show these differences. K. agrees with Fahrion (C.A. 7, 269) that the polymerization product is partly sol. in the unchanged oil, and the viscosity increases with the amount of polymer until the saturation point is reached, when the polymer is suddenly thrown out of soln. and the whole mass gelatinizes. To study polymerization analogies linseed and wood oil were heated in an atm. of CO_2 at 200, 260, and 300°. Results of the examn. of samples taken at various time intervals are tabulated and include acid, saponification, and I nos., viscosity, refractive index, and sp. gr. The changes in these constants are very analogous except in the case of the refractive index which is increased by decomposition products formed in the linseed oil. Wood oil gels very rapidly at 300° with a marked exothermic reaction. This rise in temp. is very noticeable even when the visible gel formation is prevented by the presence of rosin and linseed oil. The speed of the polymerization reaction constitutes the greatest difference in the behavior of wood and linseed oil, and the greater time of heating required by the latter sets free greater quantities of fatty acids which prevent the gel formation; but if these acids are removed by heating *in vacuo*, linseed oil after 3 or 4 hrs. at 280°, suddenly stiffens just like wood oil." From C.A.

Kurz, H.

THE CHEMISTRY OF STAND OILS. III.
Fette u. Seifen 46, 343-4 (1939); C.A. 34, 3514 (1940).

"Tung oil was converted into stand oil (I) by heat-treating under various conditions with exclusion of air with CO_2. The fat acids obtained by sapong. the various I prepns. were sepd. into monomeric and dimeric (II) fractions by chromatographic adsorption on silica gel. Cases were observed where a I prepn. having a higher viscosity (60 vs. 42 poise) contained a lower proportion of II (10% vs. 12%). The II content of tung-oil gels varied from 47 to 65%. Evidently, the viscosity of glyceride oils is increased effectively by polymerization only if it takes place intermolecularly rather than intramolecularly. Cf. C.A. 33, 1969." From C.A.

Leithe, Wolfgang.

REFRACTIVE INDEX AND THE STAND-OIL QUESTION.
Fette u. Seifen 44, 14 (1937); C.A. 31, 4513-4 (1937).

"The prepn. of stand oil from linseed oil causes an increase in *n* but also a simultaneous increase in d., so that the sp. or mol. *n*, as calcd. by the Lorenz-Lorentz equation, decreases. With tung oil, the situation is qualitatively the same, except that in this case both *n* and sp. *n* decrease. As only sp. or mol. *n* is of significance as indicating changes in chem. structure, observed changes in n do not indicate different mechanisms of stand-oil formation from the 2 oils." From C.A.

Lin, Y.

POLYMERIZATION OF TUNG OIL.
Chemical Industry (China) 9 (1), 35-42 (1934) (in Chinese).

Lippert, W.

ABSORPTION OF OXYGEN BY DRYING OILS AND BOILED OILS.
Z. angew. Chem. 11, 412-5 (1898); J. Soc. Chem. Ind. 17, 588 (1898) (abstract).

"Linseed oil, strongly boiled without driers (stout lithographic varnish) dries more slowly than raw oil and is more difficult to manipulate owing to its great viscosity, but eventually it absorbs within 2 percent of the oxygen taken up by the untreated product, in spite of the partial oxidation and the assumed polymerization which occurs during the boiling process. Tung oil behaves in a very similar manner, but gain in weight more slowly, although the amount of oxygen ultimately absorbed, is very nearly the same." From J. Soc. Chem. Ind. (abridged).

Long, J. S. and McCarter, W. S. W.

STUDIES IN THE DRYING OILS. XV. SOME ASPECTS OF THE OXIDATION OF LINSEED OIL UP TO GELATION.

Ind. Eng. Chem. 23, 786-91 (1931); C.A. 25, 4417 (1931).

"Polymerization or gelation of oils during bodying is accelerated by heat, light and elec. energy. Polymerization takes place at room temp. in the presence of metallic chlorides or at very high pressure. Its course depends upon the size, complexity, polarity and free energy of the mols. Oxidation is a contributary cause. Forces which cause polymerization are likened to those which cause crystn. but are not as strong. The addn. of solvents or O breaks down the gel. Metallic driers function as polymerization catalysts. The assocn. of mols. appears to be through primary rather than through secondary valences. Linseed oil (I), linseed oil acids (II), the Me (III), glycol and pentaerythritol (IV) esters of I, heat-bodied I (V) and the triglycerides (III, IV, V, resp.) of oleic, linolenic and α-eleostearic acids were blown with O in an improved set-up of the app. described earlier (C.A. 25, 1105). The effect on rate and character of oxidation of the following factors was studied: temp., driers, inhibitors, degree of unsatn. and complexity of the mol. and acid value. Tables are shown giving the time of gelation, total O absorbed, partition of O between gel and volatile products and compn. of the latter. Elevation of temp. from 110° to 200° greatly shortens the time of gelation of I and lowers somewhat the absorption and amt. of volatile products. II gels more slowly and absorbs more O at 160° than I. Mixts. of I and II gel sooner than either I or II alone and absorb less O. Comparison of the acid values before and after gelation shows that II unites with I to form complex mols., thus facilitating gelation. III absorbs 30% more O than I but does not gel, whereas IV gels very quickly after absorbing only 29% of the amt. of O absorbed by I. V requires much less O and gels sooner than I. VII and VIII gel much sooner and with less O absorption than VI, but differ greatly one from the other, showing that the arrangement of double bonds is an influential factor. VII gels somewhat sooner than I but the 2 gels contain about the same amt. of O. Pb, Co and Fe greatly shorten the time of gelation of I. Also, in the presence of Pb, the oil absorbs less O; hence this metal is a polymerization as well as an oxidation catalyst. Na oleate and powd. Se delay gelation of I." From C.A.

Long, J. S., and Moore, C. N.

ACTION OF CATHODE RAYS ON DRYING OILS.

Ind. Eng. Chem. 19, 901-3 (1927); C.A. 21, 3136 (1927).

"Raw and treated linseed, perilla and China wood oils were given various short exposures to cathode rays and the changes in n, I no., mol. wt. and hexabromide no. tabulated. The drying time of the oils was considerably decreased. In all cases the oils were greatly bleached by the rays. The possible mechanism of the chem. change due to the rays is discussed." From C.A.

Long, J. S. and Smull, J. G.

A CONTROL METHOD FOR BOILING DRYING OILS.

Ind. Eng. Chem. 17, 138-41 (1925); C.A. 19, 901 (1925).

"The uniformity of litho oils and all kinds of heat-bodied linseed oils can be controlled in lab. expts, and in factory practise by the detn. of mol. wts. at various stages of the boiling process, by the f.p. method in C_6H_6. Tabulated exptl. results indicate that the mol. wt. increase is much larger than can be accounted for by the addn. of C, calcd. from decrease in I no. Oils heated in absence of O show much lower mol. wts. than those similarly heated in air. The method appears to be applicable also, to control of the heat treatment of China wood oil." From C.A.

Long, J. S. and Wentz, G.

RATE OF MOLECULAR WEIGHT INCREASE IN THE BOILING OF LINSEED AND CHINA WOOD OILS.

Ind. Eng. Chem. 18, 1245-8 (1926); C.A. 21, 658 (1927).

"The use of various solvents in the f.p. method for mol. wts. gave comparable results with linseed and China wood oil. The use of hot solvents permits the mol. wt. detn. of very thick oils. Evidence shows reactions during oil boiling to be condensations. The effect of various substances, including steam, on the rate of mol. wt. increase is given." From C.A.

Loon, J. van

POLYMERIZATION OF LINSEED AND TUNG OILS.

Chem. Weekblad. 31, 419-20 (1934); C.A. 29, 2002 (1935).

"A review, with special reference to high-vacuum fractionation of the free acids (or their esters) derived from polymerized oils." From C.A.

Los Angeles Paint and Varnish Production Club.

POLYMERIZED OILS.

Natl. Paint, Varnish Lacquer Assoc. Sci. Sect.. Circ. 568, 363-70 (1938); C.A. 33, 8040 (1939).

"Heat-bodying sardine oils with rapid agitation does not prevent formation of "polymeride cloud" when the product is cooled; changes in n and free fatty acid when the oil is heated under reduced pressure in CO_2 are tabulated. After-yellowing takes place with light-bodied sardine oil under severe conditions, but there should be little in a paint under ordinary conditions. The properties of "Thermoil A" (a polymerized oil contg. only low olein content) are set out; it can be used as a substitute for tung oil." From C.A.

Mabery, C. F.

THE HEAT TREATMENT OF CHINA WOOD AND LINSEED OILS.

Ind. Eng. Chem. 15, 365-7 (1923); C.A. 17, 1722 (1923).

"The I nos. of tung and linseed oils heated for various lengths of time at temps. up to 200° in air, in CO_2, and in closed vessels, indicate that the fatty acids in these oils polymerize to the condition of satn. of oleic acid. Mol. wts., ultimate analyses, I nos., and n of the heated oils and of their isolated fatty acids are tabulated." From C.A.

Marcusson, J.

POLYMERIZATION OF FATTY OILS. II.

Z. angew. Chem. 35, 543-4 (1922); C.A. 17, 216 (1923).

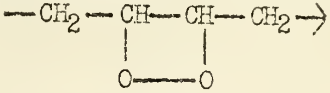
"Oils kept free from air in daylight underwent an intramolecular polymerization; the I no. dropped and the sp. gr. increased. Ultra-violet light causes a more rapid polymerization, Chinese wood oil in the absence of O forms a white mass m. 32°, which cannot be considered a polymerized product as the I no. and sapon. no. are unchanged. The fatty acids from this product, m. 71° and consist of β-eleostearic acid which is the isomer of α-eleostearic acid present in the original oil. The formation of β-eleostearic acid is similar to the transformation of allocinnamic acid into cinnamic acid in sterile storage. By extg. the polymerization product with acetone and saponifying the residue and acidifying, thick oily to soft waxy fatty acids are obtained of I no. 1/4 that of eleostearic acid and double the mol. wt. The sp. gr. is greater than 1. The property of wood oil first to form isomers under the influence of light and then to polymerize can also be observed in the drying process. By putting a thin coating on glass there appear after several hrs. ice-like crystals which eventually permeate the entire mass. They consist of β-eleostearin, which hinders drying. For use in the lacquer industry wood oil is heated to a high temp. to prevent the formation of β-eleostearin. The polymerization following the drying of fatty oils is intramolecular; the film contains unchanged oil, free fatty and hydroxy acids and neutral polymerization and oxidation products." From C.A.

Marcusson, J.

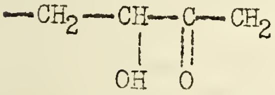
THE POLYMERIZATION OF FATTY OILS. IV.

Z. angew. Chem. 38, 780-2 (1925); C.A. 20, 2756 (1926).

"Analytical data are given to show that the concns. used in the mol. wt. detns. of polymerized linseed and wood oil had been customary concns. and that the mol. wts. found were double the normal wts. Additional mol. wt. detns. of the gel portion of freshly prepd. wood oil films confirmed the above results. Fahrion's idea that autoxidation of fats occurs in accordance with the Engler-Weissberg theory by addn. of O_2 to a double C bond:

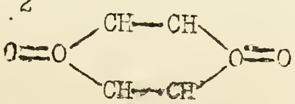


$$—CH_2—\underset{O—}{CH}—\underset{O}{CH}—CH_2 \rightarrow$$

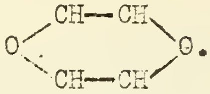


$$—CH_2—\underset{OH}{CH}—\underset{\|O}{C}—CH_2$$

is untenable because such a ketohydroxy acid should furnish a dihydroxy acid by reduction with Na in alc. soln., thereby increasing its acetyl value, which in fact is not the case. Oxidation occurs more probably by the union of 2 mols. of the unsatd. acid with addn. of 2 mold. of O_2:



as shown by their peroxide reaction (sepn. of I from an acid KI soln. etc.); half of the O_2 then splits off to oxidize neighboring H to OH and a final splitting of the C chain may take place to form fatty acids of lower mol. wt. together with aldehydes which are regularly found in oxidized acids; there remains then the characteristic 1,4-dioxan ring of oxidized acids:



By liberation of H_2O from the COOH and OH group lactones are formed which are also normal constituents of oxidized acids." From C.A.

Marcusson, J.

THE BEHAVIOR OF WOOD OIL UNDER HEAT AND LIGHT.

Z. deut. Öl- u. Fett-Ind. 43, 162-3 (1923); C.A. 17, 2198 (1923).

"Action of heat: From soly. tests of the heated wood oil in acetone and from analytical data M. concludes that the coagulated wood oil contains 3 constituents, besides oxidation products and anhydrides: (1) unchanged oil, (2) an oily polymerization product, (3) a solid polymerization product; their amts. vary according to the conditions of heating. Nos. 2 and 3 are chemically identical, the former being the sol- and the latter the gel-form. When rosin, naphthenic acid or linseed oil is added to wood oil to avoid its coagulation during heating, polymerization is not prevented thereby, only the gel formation is hindered; the liquefaction of coagulated wood oil on renewed heating indicates that the gel and sol reactions are reversible. Action of light: The solid product resulting from the action of light on wood oil differs from that obtained by heat. Light isomerizes the α-eleostearin (cis-form) to β-eleostearin (trans-form) and this latter is the light-product proper; but in addn. there is formed a small amt. of a polymerization product of β-eleostearin which is infusible and insol. in fat solvents; larger amts. of it are formed in strong sunlight and at temps. above 32°. The acids obtainable from this solid β-eleostearin by sapon. and acidifying are of soft resin consistency, with an I no. of about 1/4 of that of eleostearic acid but double its mol. wt. and of a sp. gr. above 1.0." From C.A.

Marcusson, J.

THE POLYMERIZATION OF FATTY OILS. III.

Z. angew. Chem. 38, 148-9 (1925); C.A. 19, 1957 (1925).

"Discussion of recent researches by Salway and Wolff." From C.A.

Includes the polymerization of tung oil.

Marcusson, J.

THE POLYMERIZATION OF FATTY OILS. V.

Z. angew. Chem. 39, 476-9 (1926); C.A. 20, 2757-8 (1926).

"The wood oil film examd. contained 83% of acetone-insol. gel and 17% sol. constituents. The gel was incompletely sol. in camphor but a 10 hr. treatment in the boiling H_2O bath with freshly distd. furfural produced swelling at first and then complete soln. from which it was repptd. by H_2O and then taken up with ether. After evapg. the latter, the oil was monomol. and passed back into gel form on standing, mol. wt. 1033. The acetone-sol. portion of the film dissolved in benzine with the exception of a small residue, in contrast to the acetone-sol. portion from linseed and poppyseed oil films. These investigations show again that unsatd. fatty acid radicals of drying oils unite at room temp. intramolecularly while heat causes the reaction to become polymolecular. Isomerization occurs prior to polymerization which is contrary to Eibner's view who worked with a 2 weeks' old tung oil film, too old to show any more β-eleostearic acid. The presence of this β-acid during the beginning of drying is shown by the following expts: (1) Fresh wood oil films and also drops of the oil on a glass slide show crystals of the β-acid at the beginning of drying, gradually increasing in amt. and later disappearing to give way to wrinkles and folds; old oils which probably already contain some β-eleostearin show this crystn. plainly, while some fresh oils require first inoculation by a few β-crystals. (2) Acetone solns. of films furnish crystals of β-eleostearic acid after evapn. of the solvent and subsequent treatment with strongly cooled acetone. (3) Films on glass plates, when exposed to winter air at 7°, form fern-like flowers around the edges while inside a white tallowy mass appears which consists principally of β-crystals. (4) Forty g. of wood oil in a porcelain dish assumed lard-like consistency on standing in the air with a wrinkled skin on the surface and crystals of β-eleostearin on the bottom. Wood oil first shows isomerism, then polymerization. Halogens and S act upon wood oil in a similar manner, forming β-eleostearin at low activity and solid polymers at intensive action. Identification of wood oil in mixts. Stir 5 cc. of a cold satd. soln. of I in $CHCl_3$ into 5 g. of the oil in a large porcelain dish; pure wood oil becomes a solid mass after a few min.; all other oils, including boiled linseed oil, remain oily; mixts. of wood oil with other oils become solid more or less slowly, according to the amt. of wood oil present. If a sample remains oily on standing overnight (in cases when small quantities of wood oil are present) heat it for 15 min. on the bath; during cooling gelatinizing takes place; 15% of wood oil can thus be identified in mixts. For an approx. detn. triturate the solid reaction product with sand and then ext. with $CHCl_3$ in Graefe's extn. app. Shake the ext. with thiosulfate soln. to remove I, evap., dry and weigh. Tables of results from test mixts. are given and special precautions are detailed in cases when volatile solvents are present, as in some varnishes." From C.A.

Marcusson, J.

CATALYTIC POLYMERIZATION OF FATTY OILS.

Chem. Umschau Fette, Oele, Wachse Harze <u>36</u>, 53-4 (1929); C.A. <u>23</u>, 2052 (1929).

"By the use of a 5% soln. of anhyd. $SnCl_4$ in CS_2, M. was able to polymerize wood oil in CS_2 soln. to a jelly at room temp. overnight; there was a 56% yield of an acetone-insol. gel. By using 1/2 the quantity of $SnCl_4$ (0.5%) but applying heat for 1 hr. under reflux, the same jelly formed, yielding 77% of a solid acetone-insol gel. The acid liberated from this gel is a light yellow resin of 183 acid no., 109 sapon. no., 72 I no. and a mol. wt. of 1011 (Rast's camphor method), which dropped to 590 when dried in vacuum instead of at 105°." From C.A.

Mazume, T. and Nagao, S.

HEAT POLYMERIZATION OF TUNG OIL AND OF THE ETHYL ESTER OF ELEOSTEARIC ACID.

J. Soc. Chem. Ind. (Japan) 31, 473-6; suppl. binding 114-5B (1928); C.A. 23, 531 (1929).

"When tung oil was heated to 200-300°, its mol. wt. was doubled, but its I value did not decrease much; therefore it was considered that the change was extramol. polymerization. With the Et ester of eleostearic acid, the change was similar, except that it did not solidify as the tung oil did." From C.A.

Meinel, K.

THE BEHAVIOR OF LINOLENIC ACID, LINSEED OIL AND WOOD OIL ON HEATING.

Naturwissenschaften 23, 721 (1935); C.A. 30, 2026 (1936).

"When linolenic acid (I) or linseed oil is heated in N_2 the isolated double bonds of I change over into conjugated bonds as shown by decrease in Br no. The Br no. of wood oil increases on heating; the eleostearic acid conjugated bonds move apart." From C.A.

Meister.

WOOD OIL.

Chem. Rev. Fett-u. Harz-Ind. 17, 150-4(1910); 18, 1-2(1911); C.A. 5, 1523 (1911)

"E. W. Boughton has examined wood oils according to Livache's drying method and found that the increase in wt. of wood oil is much less than that of linseed oil, but when drying it hot the wt. increase of wood oil is considerably greater than that of linseed oil. In contradiction to these results the author, finds the average wt. increase of wood oil to be 14.3%, that of linseed oil 16.5-17%; he never found it higher than 15.8% nor 1 lower than 11.9%. A comparison of boiled wood oil with boiled linseed oil showed that the former's increase in wt. during drying is but little less than that of the corresponding raw oil while the boiled linseed oils show 5-7% less wt. increase than their corresponding raw oils. These results were obtained by the glass-plate method, making the layer 0.6-0.7 mg. per sq. cm. Tables are added giving the drying tests of 12 oils in detail up to 140 hrs., also the acid, sapon. and I nos. of 2 tung oils during the drying process. The author also points out that in the drying of linseed oil the max. wt. increase is reached when the oil becomes dry, while in wood oils the increase of wt. goes on for a long time after the pellicle has formed, proving thereby that the two drying processes differ in character. This pellicle formation in wood oils occurs after 24-48 hrs. but it still feels greasy at that time and does not become solid and linoxin-like until after 5-6 days. For this reason wood oils are usually classified as more rapid drying oils than linseed (which dry after 80-120 hrs.) but the actual max. of wt. increase in wood oils takes place much later than is observed in linseed oils. This difference the author explains is due to the mol. rearrangement of the oleomargarin [sic] of the wood oil into eleostearin which causes pellicle formation and then O is absorbed with formation of some volatil organic compds., converting the eleostearin into a linoxin-like substance. Two distinct changes are thus observed in wood oil drying which have nothing in common with each other while linseed oil shows one of these changes, viz., the absorption of O so that its wt. increase and its pellicle formation go hand in hand and are observed simultaneously." From C.A.

Merz. O.

THE OXIDATION PROCESSES IN DRYING OF CHINESE WOOD OIL.
Kunststoffe 16, 53-4 (1926); C.A. 20, 2255 (1926).

"The rapid drying of Chinese wood oil has proved that the drying ability of fatty oils is not dependent on the presence of highly unsatd. glycerides of fatty acids but on the amt. of a rapidly oxidizable group of double bonds, or the ratio of these to the slowly oxidizing or non-drying glycerides. The best drying constituent of fatty oils is the glyceride of α-eleostearic acid (2 double bonds) and not the glyceride of linolenic acid (3 double bonds). This proved further that the identification numbers (I no., etc.) of fatty oils cannot be used for drawing any conclusions as to the drying ability. The I no. of the wood oil would place it among the slowly drying poppy-seed oils. The oxidation products of wood oil are mainly hydroxy acids, or oxyns. α-Eleostearic acid, f. p. 47°, could be isolated from the unoxidized acids, while no β-acid could be found. Through the absorption of O glycerol was liberated, forming free fatty acids, which was proved by the increase in acid no. of the oil during drying. Comparative "drying curves" for wood oil and linseed oil under various conditions are given." From C.A.

Mh. [Muehle?]

THICKENING OF STAND OIL WITH ZINC OXIDE.
Farben-Ztg. 18, 417 (1913).

The thickening of oil and varnish paints prepared with ZnO is due to fatty and resin acids. In some cases salts precipitate but, in wood oil compositions, the oil separates as a gel.

Morrell, R. S.

POLYMERIZED DRYING OILS.
J. Soc. Chem. Ind. 34, 105-9 (1915).

The polymerization of linseed, tung, poppyseed, castor and olive oils has been investigated and the properties of the thickened products determined. The bodying of tung oil takes place very rapidly and is difficult to control. The final product is a solid, insoluble in ordinary solvents, but readily saponified by alcoholic potash. When tung oil is warmed with acetic anhydride and, after cooling, a few drops of dimethyl sulfate are added a fugitive reddish-purple color is produced which resembles the rosin coloration in the Storch-Liebermann test. The material gels after the color appears. This indicates the formation of a ring substance before the gelatinization of tung oil.

Morrell, R. S.

THE POLYMERIZATION OF DRYING OILS.
J. Soc. Chem. Ind. 43 362T (1924); C.A. 19, 1501 (1925).

"Wolff's contention that heat-thickened linseed oils are essentially unimol. is not proven until data on their mol. wts. are presented; his data cover only the mol. wts. of the fatty acids of the thickened oils. That the fatty acids are unimol., but that the oils themselves are partly polymerized has been previously shown. Until more is known of the process of gelation it is inadvisable to dismiss the conclusion that some form of mol. polymerization occurs. The so-called polymerized oils may possibly be instances of special mol. complexes of dispersed material permeated by the dispersion medium which is of the same chem. compn." From C.A.

Morrell, R. S.

HEAT POLYMERIZATION OF DRYING OILS.
Paint Technol. 8, 130-2 (1943); C.A. 38, 1129 (1944).

"Theories of the formation of cyclic dimers during polymerization of drying oils are reviewed." From C.A.

Morrell, R. S., Boalm, T. R., Davis, W. R., Marks, S., Phillips, E. C., and Sim, W. S.

AUTOXIDATION OF DRYING OILS.
Trans. Faraday Soc, 38, 362-72 (1942); C.A. 37, 6143 (1943).

"The authors' previous works are reviewed on the maleic anhydride adducts of α- and β-eleostearic acids and their glycerides. The structural formulas of the adducts given are considered to be supported by adequate exptl. evidence." From C.A.

Morrell, R. S., and Marks, S.

THE POLYMERIZATION OF DRYING OILS.
J. Oil & Colour Chemists' Assoc. 13, 84-90 (1930); C.A. 24, 2901 (1930).

"When detd. in associating liquids such as C_6H_6 the mol. wt. of drying oils is greater than when detd. in dispersing liquids such as CCl_4. Iodine values also depend upon the dispersing properties of the solvent in which they are detcd. The authors favor an assocd. structure for heat-bodied oils and a macro-mol. structure for oxidized oils." From C.A.

Muehle.

ON THE THICKENING OF WOOD OIL VARNISHES.
Farben-Ztg.18:2058-9(1913).

M. disagrees with Rosicki (Farben-Ztg.18:2058 (1913)). Linseed oil varnishes can take up less PbO than wood oil varnishes without clouding because linseed oil contains more saturated fatty acids whose Pb salts are less soluble than the Pb salts of wood oil acids. The explanation that wood oil varnish thickens because the removal of acids which held polmerized glycerides in solution is supported by the fact that gelation is caused by esterification of those acids with glycerine as well as by their neutralization with basic pigments.

Nagel, I. W., and Grüss, J.

CHINESE WOOD OIL.
Z. angew. Chem. 39, 10-3 (1926); C.A. 20, 1144 (1926).

"The various theories advanced in explanation of the gel formation of tung oil on heating are reviewed. To study the gelatinization process, the Me esters were used instead of the glycerides. The β-eleostearic Me ester is easily produced by allowing 3% HCl in MeOH to react for 24 hrs. on α-eleostearic acid; transformation into the β-form occurs. α-Eleostearic Me ester is produced in almost theoretical yield from α-eleostearic acid and diazomethane in Et_2O; or more simply by the action of MeOH-KOH soln. on tung oil or its Et_2O soln. Contrary to expectation, this reaction, instead of causing sapon. converted the glyceryl ester into the Me ester. In the heating expts. on the Me esters at 240° in an atm. of CO_2, the progress of the polymerization was studied by detn. of I nos. Gel formation does not occur with the Me esters, but the I no. invariably falls to a min. of 80 to 90; this indicates the formation of a dimol. polymer. The various possible formulas for such a polymer are given. On heating wood oil itself, the I no. of the oil, just prior to gelatinization, is 110 to 120. Wolff has found that about 40% of a tung oil gel consists of unchanged oil, and 60% of polymerization product. The I no. found agrees fairly well with the calcd. I no. for 60% dimol. polymerization product. To avoid the uncertainty of obtaining a sample of the oil just prior to gel. formation, gelatinized oil was dissolved in 10% HCl in Et_2O, either in the cold or by boiling; after evapn. the residue showed the same I no. of 100 to 120 as the oil just before gelling and could again be gelatinized by repeated heating. All the possible formulas for the dipolymers are characterized by the formation of tetramethylene ring and attempts to identify this structure in the polymerized oils are being made. In expts. with esters of higher alcs., the tendency to gel formation increased with the mol. wt.; the glycol ester gels completely although it yields 36% distillate, as against 0 distillate for the glycerol ester. Wood oil can be gelatinized by the action of 10% HCl in Et_2O by careful regulation of the conditions, usually in 7 hrs. in the cold. The same HCl-Et_2O soln. dissolves wood oil gel. so that the reaction is reversible similar to that found by Harries and Nagel with Shellac. The gel formation appears to be due to the tendency of the heavy dipolymer to form aggregates." From C.A.

Nagel, W., and Have, R. von
CATALYTIC OXIDATION OF FATTY OILS.
Wiss. Veröffentl. Siemens-Werken 17, 48-58 (1938); Brit. Chem. Abstracts 1938, B, 811.
"The readiness of oxidation of linseed, tung, soya-bean, and olive oil linolenic, linoleic, α- and β-elaeostearic and elaidic acids, and Me oleate has been compared by the Evers-Schmidt method (B., 801, 1930, 749, 1931). CuO, NiO, CoO, Pt, and Ag_2O catalysts are compared in the oxidation of mineral oils; CuO catalysts prepared from $(HCO_2)_2Cu$ are the most active." From Brit. Chem. Abstracts.

Oppenheimer, M.
GELATINIZATION AND CRYSTALLIZATION OF WOOD OIL.
Farbe u. Lack 31, 28 (1926); C.A. 20, 1530 (1926).
"A review of articles and patents on the treatment of China wood oil." From C.A.

Pack, F. C. and Holmes, R. L.
THE TIME REQUIRED FOR THE GELATION OF TUNG OIL AT DIFFERENT TEMPERATURES.
Proc. Am. Tung Oil Assoc. 1947, Pt. I, 21-3; C.A. 42, 386 (1948).
"Gelling tests with a good grade American tung oil indicate that gelation takes place by heating with a steam coil at 80 lbs. pressure/sq. in. for 24 hrs. or for 12 hrs. at 140 lb./sq. in." From C.A.

Rasquin, H.
WOOD OIL AND THE POSSIBILITIES IN ITS TREATMENT.
Farbe u. Lack 1925, 420-1, 448; C.A. 20, 117 (1926).
"A brief review is given of the patents claiming to effect the production of a heat-bodied wood oil, similar to "stand oil," without the formation of a gel. Preliminary expts. were made in heating mixts.

of raw wood oil and of wood oil heated 2 hrs. at 200°, with various solvents under reflux condensers, until the consistency of the soln. after cooling approached that of varnish. The films produced by these varnishes were then examined for drying, freedom from the frosting effect characteristic of raw wood oil, hardness, gloss, etc. Those produced from solns. in turpentine and in other solvents with b.p. around 165° showed that the necessary degree of polymerization had not yet been reached to produce a clear hard, glossy film; but those produced from decalin, b 190-200°, produced good films. The method is suggested for research to det its com. manufg. possibilities."
From C.A.

Rasquin, H.
SOLIDIFIED TUNG OIL.
Farben-Ztg. 31, 971-972 (1926)*; Brit. Chem. Abstracts 1926, B, 201.

"Apart from any heat-gelatinized product, tung oil may yield solid bodies by freezing and by exposure to light. The fresh oil has been shown to freeze at +3°, whereas the oils of commerce, having usually experienced long periods of transport through preponderatingly warm regions, are found to remain fluid, albeit viscous, as low as -20°. Incipient polymerization is suggested as an explanation. Trouble from this source is not common but gentle warming will remedy any congealing or clouding that may occur. The action of light on tung oil converts α-elaeostearin, its main constituent, into the solid β-modification which can be isolated by virtue of its relatively sparing solubility in acetone. Its iodine value shows considerable fluctuation, which supports the view that β-elaeostearic acid is a conjugated triply-unsaturated isomeride of linolenic acid. The possibility of utilizing this solid product was investigated. Heating with benzol gave only temporary solution with reprecipitation on cooling. Digestion with thickened linseed oil and synthetic resin produced short-oil varnishes of good properties, but the longer-oil varnishes showed a slight tendency to precipitate." From Brit. Chem. Abstracts.

Rebs, Hans.
GLOSSY DRYING BOILED OIL FROM WOOD OIL.
Farbe u. Lack 1926, 128; Chem. Zentr. 1926, I, 3363.

Heat treatments improve the drying characteristics of wood oil.

Rhodes, F. H. and Ling, T. T.
OXIDATION OF CHINESE WOOD OIL.
Kunststoffe 15, 157-8 (1925); C.A. 20, 299 (1926).

This paper contains in slightly condensed form the same material as that in "The Oxidation of Chinese Wood Oil" (Ind. Eng. Chem. 17, 508-12 (1925)) by the same authors.

Rhodes, F. H. and Potts, T. J.
SUBSTANCES THAT PREVENT THE JELLYING OF TUNG OIL.
Chem. Met. Eng. 29, 533 (1923); C.A. 17, 3796 (1923).

"A detn. of the comparative efficiency of various substances in preventing the gelatinization of tung oil on heating, placed them as follows: glycerol, oleic acid, rosin, ester gum, paracoumarone resin, and linseed oil. Results are tabulated and shown graphically. The presence of 6% of glycerol prevents gelatinization of tung oil. This mixt. with lead linoleate added to give 0.02% Pb, heated to 280° until sufficiently bodied, and then thinned with turpentine gave rapid drying, smooth, tough, transparent films." From C.A.

Rhodes, F. H. and Welz, C. J.

THE CHEMISTRY OF CHINESE WOOD OIL.

Ind. Eng. Chem. 19, 68-73 (1927); C.A. 21, 658 (1927).

"The effect of heat treatment upon the mol. wt., I no. and O absorbing power of Chinese wood oil was detd. Stearic acid proved satisfactory as a solvent in the cryoscopic mol. wt. method. Gelatinized oil was extd. with petroleum ether and the sol. and insol. portions were examd. The heat of gelatinization of the oil was measured by a novel method. The O absorbing power of the oil decreases as the oil is bodied. A theory is formulated to account for the observed changes during bodying and gelatinization." From C.A.

Riemann, F.

RECENT DEVELOPMENTS IN MANIPULATING WOOD OIL.

Farbe u. Lack 1929, 6; C.A. 23, 1761-2 (1929).

"This is a short review of recent German patents for incorporating wood oil into varnishes. Instead of cooking the resin with the oil from the beginning, the oil, heated to a temp. of 220-250°, is added to the resin which has been heated to a temp. of 320-340°. Cooling and thinning are carried out in the usual manner." From C.A.

Rinse, J.

THE REFRACTIVE INDEX OF TUNG OIL.

Rec. trav. chim. 51, 529-32 (1932); C.A. 26, 4484 (1932).

"From changes in n the velocity of polymerization of tung oil by heat can be followed. The rate of decrease of n (or reaction velocity) is slow at the beginning because of the low temp., then increases and finally decreases before gelation occurs. At 249° the velocity decreased to zero before gelation began. The gelation time decreased from 38 min. at 249° to 7.2 min. at 306°; and the final n was lower for higher temp. The decrease in n for 249° was 0.0085; and for 306°, 0.0109. The addn. of small amts. of S modifies the polymerization of tung oil and may prevent gelation. Thus, at 285°, addition of 0.005%, 0.01%, and 0.05% of S caused lowerings of n, just before gelation, of 0.0117, 0.0128, and 0.0170, whereas without S the lowering was only 0.0097. Addn. of 0.1% S prevented gelation, and the decrease of n was 0.0193. It is suggested that two polymerization reactions may occur in tung oil, one at low temp. and the other at higher temp. The property of solidifying must be attributed to the low temp. polymerization product. The oil produced by high temp. has a lower n, and its drying properties resemble those of sulfurized oil. Therefore, the polymerization that is catalyzed by S is the one predominant at high temp." From C.A.

Rosicki, Dr.

ON THE THICKENING OF WOOD OIL VARNISHES.

Farben-Ztg. 18:2058(1913).

R. disagrees with Muehle (Farben-Ztg.18:2058-9(1913)). The absorption capacity of a varnish for metallic compounds is not the same as its "saponification quality." Since wood oil has a lower iodine number (162-5) than linseed oil (169-92) it must contain more saturated acids than linseed oil.

Rossman, E.

ELEOSTEARIC ACIDS. II. POLYMERIZATION. (1). POLYMERIZATION AT ROOM TEMPERATURE.

Fettchem. Umschau 40, 96-102, 117-23 (1933)*; C.A. 27, 5057 (1933).

"α and β-Eleostearic acids and American wood oil were sealed in test tubes, with and without solvents, and exposed to sunlight and quartz lamplight. The products yellowed more or less, the I no. decreased and the mol. wt. increased. The regular I no. did not decrease by more than one double bond, but the special I no. decreased in some cases by 2 double bonds. In the polymerization of 2 eleostearic acid mols. they may form various types of dimols. through the loss of a double bond each, or else the 1- and 6-C atom of the 3 conjugated groups may join, forming ring complexes. The probability of their formation is discussed on the basis of exptl. data. (2) Polymerization by heat. Ibid. 117-23. -- Eleostearic acid and its esters were exposed to heat, quartz-lamp radiation, etc., under various conditions in evacuated sealed tubes and the products were analyzed for I no., Br. no., n, d, mol. wt., by distn., crystn., ultimate analysis and special methods. Heat below 300° caused no decompn. but led to dimol. acids or mixts. of eleostearic acid with cyclomonoeleostearic acid, $C_{18}H_{30}O_2$, and cyclodieleostearic acid. Heating a few min. at 300° is as effective as heating 15 hrs. at 180° or 144 hrs. under the Hanau quartz lamp. The cyclomonoeleostearic acid contains a 6-ring, 2 conjugated double bonds, with normal I no. and normal mol. n, substitutions occur in the o-position and it is therefore 5-butyl-1,3-cyclohexadiene-6-caprylic acid. Wood-oil gel below 300° contains dimeric and monomeric cycloeleostearic acid; the mol. wt. of 408 indicates the same mixt.; higher mol. fatty acids are absent when O is excluded. When the Me ester of α or β-eleostearic acid is heated to 340° in N for 15-30 min. it polymerizes and forms the cyclomonoeleostearic ester. In the polymerization of eleostearic acid its mol. n is decreased not only by the value of the last double bonds but also by exaltation due to conjugation, while with linseed oil it is decreased only by satn. of the double bonds. The cyclomonoeleostearic acid and its esters are sol. in most org. solvents; with concd. HNO_3 they show a blood-red to violet color and with a 1:1 mixt. of alc. and H_2SO_4 a raspberry-red color; the non-polymerized eleostearic acid shows yellow to dirty-brown colors. Cycloeleostearic acid thickens on exposure to O or air. When heated it increases its mol. wt. but not its I no. Liquefaction of wood-oil gel is accomplished by heating the cyclodieleostearic ester to 290-350°. On distn. at 2 mm. it yields pure β-eleostearic acid, m. 71°, and some liquid cyclomono- and dieleostearic acid; the liquefaction is thus a depolymerization. When heated to 380° for a long time wood oil gel is no longer liquefied but is transformed into tricyclodieleostearic acid. The irreversible monomeric cycloeleostearic acid is a true intermediate product in the polymerization of wood oil." From C.A.

Ruff, A.

GELATION OF TUNG OIL AND THE LIQUEFACTION OF TUNG-OIL GELS.
Farben-Chem. 6, 415-16 (1935); C.A. 30, 3259 (1936).

"After briefly reviewing the literature, a brief account is given of expts. which show that the solid, acetone-insol. material, which ppts. out when linseed oil is first reacted with an excess of litharge and then allowed to stand, exerts a powerful liquefying action when mixed with tung-oil gels in the presence of a neutral liquid medium and heated to a relatively low temp., e.g., 100°. This result is perhaps due to the loosely bound metal attacking the gel glyceride." From C.A.

Salmony-Karsten, A.

A STEP FORWARD IN THE TECHNOLOGY OF HEATING IN THE CHEMICAL INDUSTRY AND RELATED ENTERPRISES.
Farben-Ztg. 41, 644 (1936)*; C.A. 30, 7881 (1936).

"Kettles, e.g., for heat-treating tung oil or cooking varnishes, of special design are heated by eddy currents produced in the metal walls of the kettle by induction windings with ordinary a.c. Ease of temp. control is the outstanding advantage." From C.A.

Salway, A. H.

A CONTRIBUTION TO THE THEORY OF POLYMERIZATION IN FATTY OILS.
J. Soc. Chem. Ind. 39, 324-6T (1920).

S. proposes that polymerization of fatty oils occurs by means of the following steps: (1) the hydrolysis of triglycerides to give fatty acids and diglycerides; (2) the union of a carboxylic group of a fatty acid with an unsaturated linkage or series of such linkages in the same manner as H_2SO_4 adds to double bonds and (3) the condensation of the resulting diglycerides by the elimination of H_2O from 2 glyceryl OH groups. The polymerization of tung oil is discussed but experimental work was limited to palm, linseed and whale oils. With the latter it is shown that the normal decrease in I no. that occurs on heating is accelerated by the presence of fatty acids (1-3%) and reduced by additions of glycerine (10-20%).

Scheiber, Johannes.

REACTIONS IN THE FORMATION OF STAND OILS.
Farbe u. Lack 1929, 585-7; C.A. 24, 978 (1930).

"The drying properties of tung oil stand oil are improved over those of the raw oil, but this is not true of other oils. This is conclusive evidence that the reactions involved in the formation of stand oil vary with the oil. Further evidence is the lowering of the n of tung oil as compared with its elevation in linseed oil. The formation of free fatty acids during heating (Kronstein's distn. no.) is negligible with tung oil but more or less proportional to the degree of satn. with other oils. In addn. to polymerization at the unsatd. linkages, it is suggested that condensation at the glycerol groups formed by hydrolysis occurs. The character of the stand oil is detd. by the extent to which this condensation takes place. The elevation of the n of linseed oil is ascribed to the rearrangement of the double bonds of linoleic and linolenic acids into the conjugated system found in tung oil." From C.A.

Scheiber, Johannes.
STAND-OIL PREPARATION.
Farbe u. Lack 1936, 315-16, 329-30, 341, 351-2*; Fette u. Seifen 43, 103-5 (1936); C.A. 30, 7880 (1936).

"Fatty oils contg. acid radicals characterized by the presence of conjugated double bonds, e.g., tung oil or the triglyceride of 9,11-octadecadienecarboxylic acid, undergo polymerization directly and rapidly on heating, e.g., to 280-5°. Other unsatd. fatty oils, e.g., linseed oil, are capable of heat polymerization only in so far as heat treatment results in rearrangements leading to the formation of systems of conjugated double bonds. Olive oil and impure olein can be made to form stand oils by prolonged heating to 280-5°. This is probably due to the presence of small amts. of combined linoleic acid, since chemically pure olein does not gel even after heating 70 hrs. The theories above outlined permit a ready explanation of changes in I no. and consistency brought about by heating. The appearance of free acid on heating is ascribed to the fat undergoing partial decompn. accompanied by partial dehydration of the glycerol radical (cf. Krafft, Ber. 16, 3020 (1883)). This type of decompn. is not pronounced at 230°, but becomes increasingly so at 250° or higher. The tendency of the dehydrated glycerol radical to polymerize is a factor complicating the heat treating of oils which heat-polymerize slowly." From C.A.

Schlick, Willy.
THE BOILING AND DRYING OF TUNG OIL.
Farben-Ztg. 25, 2025-7 (1920); C.A. 14, 3161 (1920).

"Expts. on various tung oils show that heating at 190° for 2-1/2 to 3 hrs. and then adding 4% liquid drier, will produce an oil of good body that will dry with a clear, smooth film. At 170-80° the oil begins to give off bluish vapors, which increase in intensity at 215-20°. In accordance with Krumbhaar's theory (C.A. 11, 1314) that gelatinization of linseed oil is prevented by the free fatty acids split off by the heating process, the more rapid polymerization of tung oil might be due to the fact that the free acids split off on heating tung oil are more volatile than in the case of linseed oil. If the temp. is kept at 190°, volatilization of the acids does not proceed so rapidly that polymerization of the tung oil gets beyond control. S. believes the drying process of tung oil is similar to that of linseed oil but merely more rapid. The frosted films produced by raw tung oil are due to a sepn. of the oil after 10 to 15 hrs. into a white solid and an oily liquid constituent, which is very much slower in drying. Clear films are produced by preliminary heating and addition of driers to cause the oily portion to dry as rapidly as the other constituent. The heating of large quantities of tung oil without addition of other materials, may safely be carried out without danger of its solidifying if the temp. is kept below 195° and the heating discontinued when test portions begin to string. At this point it is necessary to cool suddenly to prevent further polymerization; this is most easily accomplished by adding cold heavy bodied linseed oil in proportion desired for further use in making varnishes. Separate heating of the oils reduces the total time of heat treatment and also produces an oil less liable to dry with a frosted or alligatored film." From C.A.

Schumann, C. L.

POLYMERIZATION OF CHINESE WOOD OIL.

J. Ind. Eng. Chem. 8, 5-15 (1916); C.A. 10, 534 (1916).

"From his expts, S. concludes that the polymerization of Chinese wood oil is analogous to that of linseed oil, and takes place through the dissolution of one unsatd. linkage in each elaeomargaric chain, forming a triglyceride composed of dimolecular fatty acids. The formation of the gel is due to an insol. colloidal mass containing mol. complexes. The polymerization is "mesomorphic." The intermediate product is sol. in ordinary org. solvents, except very light petroleum ether, as well as in unchanged wood oil and rosin. The % of polymerized triglyceride in gels of the same apparent consistency is not necessarily the same. Elaeomargaric acid will cryst. from a dil EtOH soln. at a temp. of 0°, while the acids from the polymerized triglyceride remain sol. If Chinese wood oil is rapidly heated to 350° it will polymerize, but the decompn. products will prevent the formation of the gel. Chinese wood oil polymerizes more rapidly than linseed oil; CaO, PbO and oxidation products act as catalyzers accelerating the polymerization. The course of polymerization can be followed by the I value. Dissolving the gel in rosin or continually heating it above 250° constitutes a reformation of the sol. intermediate product. The darkening of rosin-Chinese wood oil mixts. is due to oxidation and may be avoided by the exclusion of air during heating. The pure polymerized product of Chinese wood oil dries very slowly." From C.A.

Schwarcman, A.

SOME KNOWN REACTIONS OF DRYING OIL FILMS AND POLYMERIZATION.

Oil & Soap 21, 204-6 (1944); C.A. 38, 5419 (1944).

"Polymerization is preceded by isomerization of the unsatd. acids contg. 2 or 3 double bonds resulting in a conjugated system. This theory is supported by direct analytical methods and also by the fact that triolein, which is unable to form a conjugated system, cannot be polymerized. The conjugated systems build larger mols. until a semirigid structure is reached, resulting in gelation. Tung oil already contg. a conjugated system is capable of almost instantaneous polymerization, while nonconjugated oils first must undergo isomerization, and hence slower polymerization. When the required amt. and proper size of mols. are built, colloidal forces cause gelation." From C.A.

Shuey, R. C.

OIL POLYMERIZATION UNDER THE INFLUENCE OF RESINS.

Paint Varnish Production Mgr. 19, 7-8 (1939); C.A. 33 4061 (1939).

"A discussion of the effects of resins on the bodying of China wood oil." From C.A.

Sorensen, S. O. and Beal, G. F.

RECENT DEVELOPMENTS IN PROCESSED OILS.

Official Digest Federation Paint Varnish Production Clubs No. 156, 207-12 (May, 1936); C.A. 30, 5432 (1936).

"A discussion of the properties of treated linseed and tung oils and their uses in paint formulation. Particular emphasis is laid on three new heat-bodied tung oils which retain the quick-drying and waterproofing properties of tung, but resemble bodied linseed oil in gloss and gasproofness." From C.A.

Sorenson, S. O., Schumann, C. J., Schumann, J. H., and Mattiello, J.
OITICICA AND TUNG OILS. CHANGES IN PHYSICAL AND CHEMICAL PROPERTIES DURING HEAT BODYING.
Ind. Eng. Chem. 30, 211-15 (1938); C.A. 32, 2766 (1938).

"The bodying of oiticica oil (I), (4-keto-9,11-13-octadecatrienoic glyceride) at 232° and 254° in air and at 232° in CO_2 and of tung oil (II) at 232° in air was followed by detns. of viscosity, mol. wt., acid no., sapon. no., sp. gr. and refractive index at regular intervals. Extensive data are given in graphs and tables. The refractive index of I and II decreased on heating while the other quantities, except the acid no. of II, increased. Viscosity increased faster for II than I. Otherwise the changes were similar and the refractive index, mol. wt, and sp. gr. plotted as functions of viscosity gave identical or parallel curves. This illustrates the similarity of I and II; the relationships for linseed oil are quite different. The gelling time of I is greater than that of II and passes through a min. at 293°. At 316° no gelling occurs even on prolonged heating. The temp. coeffs. of the refractive indexes of I and II are similar." From C.A.

Stark, Wm. F.
POLYMERIZATION AND ITS APPLICATION TO PAINT CHEMISTRY. II.
Natl. Paint Bull. 2, 12-3 (Oct., 1938); C.A. 33, 411 (1939).

"With drying oils it is known that heat conversion occurs by action of the unsatd. systems to form rings through the intermol. union of 2 mol. to form a dimer. This dimerization proceeds by the Diels-Alder reaction with heat-treated tung oil, and with linseed oil, rearrangement of the unsatd. system to a conjugated structure is assumed by some writers while others produce evidence of 4-membered rings. Some exptl. data show that prepns. which were heat-convertible were air-convertible as well." From C. A.

Steinhoff, E.
GLYCERIN USED TO RECLAIM CHINA WOOD (TUNG)OIL (VARNISHES).
Oil & Fat Inds. 6, 25, 43 (1929); Brit. Chem. Abstracts 1929, B, 989.

"Glycerin may be used for the purpose, whether the batch is cold and solid or has just begun to congeal. E.g. a long-oil varnish containing 60 gals. of tung oil is heated with 1 gal. of glycerin, 5 lb. of litharge being sprinkled on to reduce the froth; the mixture is cooled and thinned as usual. The glycerin, forming an ester with the rosin and tung oil, hardens the product and makes it more waterproof, whilst the litharge serves to accelerate the drying." From Brit. Chem. Abs.

Steger, A. and Loon, J. van
POLYMERIZATION OF FATTY OILS. V. POLYMERIZATION OF CHINESE WOOD OIL.
Rec. trav. chim. 53, 860-8 (1934);(in German); Brit. Chem. Abstracts 1934, B, 847.

"Gelatinization by heat of Hankow wood oil causes increase in d and decrease in n and I value, but the sap. and acid vals. do not change. Distillation of the Et esters of the products shows that the changes are gradual." From Brit. Chem. Abs.

Steger, A. and Loon, J. van

STUDIES IN THE POLYMERIZATION OF FATTY OILS. POLYMERIZATION OF TUNG OIL.

Paint Varnish Production Mgr. 12, 14-7, 36 (Apr., 1935); C.A. 29, 3536, (1935).

"A paper dealing with changes in tung oil resulting from polymerization under various exptl. conditions, also with the compn. of the resulting tung stand oils in connection with the formation of polymerize components. Eleostearic acid is regarded as the most important componen of the oil, so a comparative test was made by boiling Et eleostearate and testing the products thus obtained. During boiling of tung oil, the amt. of unsapond. matter remained practically unchanged at less than 1%; the acid likewise remained unchanged. The Et esters of the total fat acids were fractionated in a high vacuum and the resulting fractions further analyzed. Consts. of the total fat acids and their Et esters from tung stand oil products after b. 280° are tabulated. The ns of the esters show a decrease parallel with the decrease in boiled tung oil indicating that during the boiling, the conjugation of the double bonds within the mol. at least partially disappears. High-vacuum distn. of the Et esters of the fat acids resulted in products where av. mol. wts. calcd. from the sapon. nos. show that no decompn. sets in during the boiling, but that the flow of heat to the stand oil must stop immediately when gelation occurs. Other consts. of the first fraction show little change during the boiling." From C.A.

Steger, A., and Loon, J. van

STUDIES ON THE POLYMERIZATION OF FATTY OILS. VI. THE POLYMERIZATION OF CHINESE WOOD OILS (CONTINUATION)

Rec. trav. chim. 54, 387-95 (1935) (in German); C.A. 29, 4190-1 (1935).

"The influence of the cooking temp. on the polymerization of China wood oil was studied by converting the fat acids of the heated oil to Et esters and fractionating these esters. Samples of the oil were heated to 170°, 210°, 250°, 280°, 320°, and 340°. A different course was followed by the oils heated above 280°. With increasing cooking temp. the stand oils of equally thick consistency contain more highly polymerized and less highly dispersed constituents. The heat treatment gives a resultant oil contg. both highly polymerized and slightly polymerized substances which are to be differentiated by the characteristic consts. of the free acids or their Et esters. On the basis of refraction measurements it is concluded that heating of China wood oil results in a change of the eleostearin mol. and a loss in the amt. of unsatn." From C.A.

Steinhoff, E.

GLYCERINE USED TO RECLAIM CHINA WOOD OIL.

Paint Oil Chem. Rev. 87(34), 21(1929); C.A. 23, 4087 (1929).

"A batch of tung-oil varnish that has gelled may be liquefied by heating with glycerol and litharge, 1 gallon of glycerol and 5 lb. of litharge being used for each 60 gallons of varnish. A second addn. of glycerol and litharge may sometimes be necessary." From C.A.

Swern, D., Scanlan, J. T., and Knight, H. B.
MECHANISM OF THE REACTIONS OF OXYGEN WITH FATTY MATERIALS. ADVANCES FROM 1941 THROUGH 1946.
J. Am. Oil Chemists' Soc. 25, 193-200 (1948).

The oxidation of the eleostearic acids and tung oil is briefly but critically reviewed.

Taggart, M. F.
VALUE OF RECENT DEVELOPMENTS IN SOYBEAN OIL.
Drugs, Oils & Paints 53, 177-8 (1938)*; C.A. 32, 5645 (1938).

The use of soybean oil is growing rapidly in the paint industry. Mixed with tung oil and rapidly heat treated to 454°, soybean oil yields an oil excellent in quality for use in paints.

Tatimori, M.
GELATION OF TUNG OIL. I. EFFECTS OF VARIOUS FATTY OILS.
J. Soc. Chem. Ind. Japan, 41, 39-41B (1938)*; Brit. Chem. Abstracts 1938, B, 544.

"The fatty oils were added in various concs. to tung oil and the gelation time (t) under different conditions was noted. Preliminary tests showed that t is affected by the temp. of the experiment, the size of the test-tube used, and the kind of tung oil. When fatty oils were added the t of the tung oil was prolonged in every case.. 1/t and the % of fatty oil added were in linear relationship, under the same experimental conditions. The amount of substance to be added to make the t of the mixture infinitely long is fixed, irrespective of the size of the test-tube used. Vals. for this figure for various oils at 290° and 292° are given." From Brit. Chem. Abstracts.

Tatimori, M.
GELATION OF TUNG OIL. II. EFFECTS OF TEMPERATURE AND X OF VARIOUS FATTY OILS AT 270° AND 280° C.
J. Soc. Chem. Ind. Japan, 41, 100-102B (1938); Brit. Chem. Abstracts 1938, B, 1067.

"The gelation time (t) of the system tung oil-linseed oil, at 240-340°, has been measured. Comparison of the gelation preventing effects of various fatty oils, e.g., castor, sardine, hempseed, at 270° and 280° showed drying oils to be the least effective. For tung oil alone t decreases with rise in temp., but it reaches a min., e.g., at 330°, with 20% of linseed oil, and then increases." From Brit. Chem. Abstracts.

Tatimori, M.
POLYMERIZATION OF TUNG OIL. I.
Bull. Chem. Soc. Japan, 13, 142-151 (1938)*; Brit. Chem. Abstracts 1938, B, 544.

"Polymerization of tung oil at 206-245° has been followed by measurements of its d, I val., relative η, and n_D^{20}. The reaction follows a second-order equation and has a heat of activation of about 24,000 g.-cal." From Brit. Chem. Abstracts.

Tatimori, M.

GELATION OF TUNG OIL. III. EFFECTS OF VARIOUS FREE FATTY ACIDS.
J. Soc. Chem. Ind. Japan 42, Suppl. binding 162-3 (1939); C.A. 33, 8426 (1939).

"A linear relation exists between the reciprocals of gelation time (1/t) and the percentage (X) of the oleic acid added to the oil, up to X = 15, when the line becomes curved. X_{oo} can be calcd. from the initial slope of the line; it becomes greater with increase in the degree of unsatn. of the added acid. Values of X_{oo} at 270° for 7 fat acids range from 32 (oleic) to 42 (fat acids of tung oil)." From C.A.

Tatimori, M.

GELATION OF TUNG OIL. IV. EFFECTS OF SEVERAL ORGANIC SUBSTANCES.
J. Soc. Chem. Ind. Japan 43, Suppl. binding 102-4 (1940); C.A. 34, 6106 (1940).

"Among neutral substances hydrocarbons (paraffin wax, mobile oil), Bu stearate, triacetin, tritolyl phosphate, α-naphthylamine, hydroquinone, β-naphthol have mostly weak retarding effects on gelation; in these cases the relation between I/t and t is linear; benzoic, cinnamic and malic acids are active retarders, their values for x = 5 being, resp., 18, 25 and 19% at 270°. Succinic and citric acids have little or no retarding effect. Tartaric and tannic acids and pyrogallol accelerate gelation. α-Naphthol accelerates gelation in amts. up to 10%; beyond that it acts as a retarder." From C.A.

Tatimori, M.

GELATION OF TUNG OIL. V. EFFECT OF BITUMENS.
J. Soc. Chem. Ind. Japan 43, 136-139B (1940); Brit. Chem. Abstracts 1940, B, 680.

"V. Straight or blown asphalts, gilsonite, petroleum pitch, mineral rubber, or coal-tar pitch, in amounts of 10-15%, accelerate, but in larger amounts retard, the gelation of tung oil. Petroleum asphalt with a lower softening point has a greater retarding effect. The EtOH-sol. and -insol. components of 15°-blown asphalt and the asphaltene from 5°-blown asphalt show a similar inversion, but with the petroleum, 1/t (t = gelation time) bears a linear relation to the amount added." From Brit. Chem. Abstracts.

Tatimori, M.

GELATION OF TUNG OIL. VII. EFFECT OF VARIOUSLY TREATED FATTY OILS.
J. Soc. Chem. Ind. Japan 43, 161-163B (1940) ; Brit. Chem. Abstracts 1940, B, 873.

"VII. The effectiveness of added linseed oil in checking the gelation of heated tung oil decreases as the linseed oil is itself polymerized prior to admixture, and still more if it is oxidized (at 100°). Brominated fatty oils and brominated fatty acids have a strong gelation-retarding effect, which may be due to isomerization of the conjugated linkings of tung oil by the HBr liberated during heating." From Brit. Chem. Abstracts.

Tatimori, M.

STUDIES ON GELATION OF TUNG OIL. IX. MOLECULAR WEIGHT OF TUNG OIL AND ITS POLYMERIDES.
J. Soc. Chem. Ind. Japan 43, Suppl. binding 257-60 (1940); C.A. 35, 2015 (1941).

"The mol. wts. of polymerized tung oil were measured cryoscopically in C_6H_6, camphor, $PhNO_2$, $CHBr_3$ and ethylene bromide solns. In camphor reasonable mol. wts. were obtained; in C_6H_6 the mol. wt. decreased rapidly with increasing concn. In $PhNO_2$, ethylene bromide and $CHBr_3$, the mol. wt. behaved as linear function of concn. and the rate of decrease in mol. wt. with increasing concn. was not so pronounced as in C_6H_6. On the contrary, in cyclohexane the mol. wt. increased with increasing concn. and reasonable values were obtained by interpolation. The abnormality of the behavior in C_6H_6 can be considered as solvation action." /Polymerization of the raw oil at 220° C. gave oils of the following molecular weights (camphor method); raw oil, 893; 0 min., 1110; 20 min., 1220; 40 min., 1380; 50 min., 1550/ From C.A.

Tatimori, M.

STUDIES ON GELATION OF TUNG OIL. X. COMPARISON OF GELATION PHENOMENA OF TUNG OIL AND OITICICA OIL.

J. Soc. Chem. Ind. Japan 43, Suppl. binding 260-2 (1940); C.A. 35, 2015 (1941).

"The general tendency of the gelation phenomena of oiticica oil is similar to that of tung oil. The gelation time is prolonged by the addn. of fatty oils and the relations between the reciprocals of the gelation times and the percentage of added fatty oils are linear. The gelation-preventing action of stearic acid and cetyl alcohol is very strong as compared to that of fatty oils. /Japanese tung, tung, linseed, soya bean, and camellia/. The dependence of the gelation time of oiticica oil upon temp. is similar to that of tung oil." From C.A. Similar to "Polymerization of Tung Oil. IX."

Tatimori, M.

GELATION OF TUNG OIL. XII. EFFECTS OF VARIOUS INORGANIC SUBSTANCES.

J. Soc. Chem. Ind. Japan 43, 339B (1940); Brit. Chem. Abstracts 1941, B, II, 155.

"Effects of inorg. substances (10 wt.-%) on the gelation time of tung oil at 273° are examined. Many compounds, e.g., $Ba(NO_3)_2$, KNO_3, NH_4Cl, KI, have little no effect whilst others, e.g., $K_2Cr_2O_7$, $HgSO_4$, $KClO_3$, $Bi(NO_3)_3$, have an accelerating effect, and LiCl, $Ca(NO_3)_2$, $SbCl_3$, $KmnO_4$, etc. have a retarding effect. Numerous other inorg. compounds are examined. Generally, basic substances show a strong gelation-retarding action." From Brit. Chem. Abstracts.

Tatimori, M.

GELATION OF TUNG OIL. XIII. GELATION BY CATALYTIC ACTION OF IODINE IN CHLOROFORM, ACETIC ACID, AND BENZENE SOLUTIONA.

J. Soc. Chem. Ind. Japan. 43, 437-440B (1940); Brit. Chem. Abstracts 1941, B, II, 191.

"The time of gelation (t = interval between the appearance of the first flocks of ppt. and the solidification of the mass on the stirrer) when mixtures of tung oil (I), I, and $CHCl_3$ are stirred follows the relation $\log t = ax + b'/zx$, where x = vol. of (I), 30 - x = vol. of solvent, z = wt. of I in g., and a and b' are consts. Mixtures of (I) and soya-bean oil (II) follow the same relation, a and b' increasing with increase in the % of (II). In glacial AcOh the general tendency is the same as in $CHCl_3$. The linear relation between log t and 1/z is maintained in C_6H_6, but the min. val. of t could not be observed in these experiments. The effect of temp. on t has been studied. (Cf. B., II, 155, 1941)." From Brit. Chem. Abstracts.

Tatimori, M.

POLYMERIZATION OF TUNG OIL. III. MOL. WTS. OF TUNG OIL AND ITS POLYMERIDES.

Bull. Chem. Soc. Japan 15, 474-480 (1940); Brit. Chem. Abstracts 1941, B, II, 349.

"The mol. wt. of tung oil heated at 220° for up to 1 hr., determined cryoscopically (camphor), shows a decrease with increasing concn. of the solute. In C_6H_6 the apparent mol. wt. diminishes rapidly with increasing concn.; extrapolated to zero concn. is impossible. In $PhNO_2$, $(CH_2Br)_2$, and $CHBr_3$ the mol. wt. is a linear function of the concn., decreasing with increase in concn. In cyclohexane the linear relation is preserved but the mol. wt. increases with increasing concn." J.L.D. From Brit. Chem. Abstracts.

Tatimori, M.

GELATION OF TUNG OIL. XVI. EFFECT OF SULPHUR AND SELENIUM.

J. Soc. Chem. Ind. Japan 44 62-64B (1941)*; Brit. Chem. Abstracts 1941, B, II, 228.

"Addition of S prolongs the gelling time at 270° of tung oil (I) and its mixtures with soya-bean oil; the effect increased with the duration of contact. After 30 min. contact log t increased linearly with (S) (0.005-0.030%). Se has a much greater retarding action on the gelation than S. S and Se also promote isomeride formation of (I) when irradiated by ultra-violet light, but I is much more active." From Brit. Chem. Abstracts.

Tatimori, M.

POLYMERIZATION OF TUNG OIL. IV. EFFECTS OF VARIOUS NATURAL FATTY OILS ON THE GELATION OF TUNG OIL.

Paint Varnish Production Mgr. 21, 98, 100-2 (1941); Bull. Chem. Soc. Japan 16 (1), 16-22 (1941); C. A. 35, 4616 (1941).

"1. The gelation time of the system of tung oil and linseed oil was measured at 240 - 310° C. In the range of 240 - 280° C. the lines of 1/t-x converge on one point. [t = gelation time; x = % of linseed oil]. 2. The relation between gelation time and the amount of addition of any fatty oil is expressed by $1/t = 1/t_0 - ax$, and the value of x at t = ∞ is considered as a characteristic constant of [the] added fatty oil. [t = gelation time of tung oil; a = a constant]. 3. Gelation preventing effects of various natural fatty oils were measured at 270 and 280° C. Drying oils are less effective than non-drying oils due to their tendency of polymerization. 4. The temperature dependance of gelation time was discussed." Summary from article.

Tatimori, M.

POLYMERIZATION OF TUNG OIL. V. EFFECTS OF TREATED FATTY OILS ON THE GELATION OF TUNG OIL.

Bull. Chem. Soc. Japan 16, 45-50 (1941)*; C. A. 35, 4977 (1941).

"The gelation time (t) at 270° was detd. for tung oil (I) with admixts of varying amts. (x) of heat-treated linseed oil (II) and perilla oil (III). 1/t was plotted against x and the value of x, called x_{∞}, required for the prevention of gelling, that is, for 1/t = 0, was estd. by extrapolation. x for II increased as the I no. decreased and, at the same I no., was higher for oil oxidized in O_2 at 100° than for oil bodied at 287° in CO_2. For III oxidized at 300°, a plot of x and 1/t gave a straight line, but for III oxidized at 100 to 200°, a curved line was obtained, presumably because of the presence in the low-temp. oil of active peroxides, whose accelerating effect upon gelling is superimposed upon the retarding effect of the oil itself. Bz_2O_2 (5 and 10%) added to III had a similar effect upon I. Brominated soybean oil and brominated oleic acid strongly retarded the gelling of I ($x_{\infty} < 4\%$) presumably because of the liberation of HBr." From C.A.

Tatimori, M.

POLYMERIZATION OF TUNG OIL. VI. EFFECTS OF FAT ACIDS, FATTY ALCOHOLS AND SEVERAL ORGANIC SUBSTANCES UPON THE GELATION OF TUNG OIL.

Bull. Chem. Soc. Japan 16, 51-9 (1941); C. A. 35, 6472 (1941) (No abstract).

Gelation is retarded by stearic, oleic, and linoleic acids and by the mixed acids derived from tung, linseed, soya, and sesame oils. These acids were more effective than the fatty oils. The relation between the reciprocal of the gelation time and the concentration of added acid is linear below 15% of additive, non-linear above 15%. The effectiveness of acids decreases with increase in unsaturation. Glycerine and the monoglyceride of oleic acid strongly delayed gelation, perhaps due to the exchange of glycerine radicals. Cetyl and oleyl alcohols and the monoglycol of oleic acid were also effective. Other gelation inhibitors include paraffin, mobile oil, butyl stearate, tricresyl phosphate, triacetin, Sepalin AOM, α-naphthylamine, hydroquinone, β-naphthol, benzoic and malic acids and phthalic anhydride. Tannic, tartaric, and gallic acids and pyrogallol have accelerating actions. α-naphthol accelerates gelation when less than 10% is added to the oil; more than 10% retards gelation.

Tatimori, M.

POLYMERIZATION OF TUNG OIL. VII. EFFECTS OF VARIOUS INORGANIC SUBSTANCES UPON THE GELATION OF TUNG OIL.

Bull. Chem. Soc. Japan 16, 75-81 (1941)*; C. A. 35, 6472 (1941) (no abstract).

Numerous inorganic substances were tested for their effect on the rate of gelation of tung oil at 273° C. These included elements (16), halides (28), nitrates (18), sulfates (23), oxides (17), and others (29). Halides, Na and acidic substances in general accelerate gelation. Compounds of Mg and of Mn, elemental S and Se and basic substances in general retard it. Se has the strongest retarding action, but .05% of S permanently delays gelation. S, Se and I_2 isomerize oil irradiated with UV light at room temperature. Coagulation time of tung oil increas with the lapse of time after additions of S, indicating a relationship between isomerization and inhibition of gelation. The relationship between the amount of S added and the logarithm of the gelation time is shown to be linear. Use of Se or of blends of tung with soya oils give other linear relationships.

Tatimori, M.

POLYMERIZATION OF TUNG OIL. VIII. EFFECT OF VARIOUS BITUMENS AND RESINS UPON THE GELATION OF TUNG OIL.

Bull. Chem. Soc. Japan 16, 82-90 (1941); C. A. 35, 6472 (1941) (no abstract).

Studies of the effects of asphalts and pitches on the gelation time of tung oil indicate that gelation is favored by bitumen additions below 10-15% and inhibited by larger amounts. Soft petroleum asphalts exhibit more inhibition than do harder ones. Alcohol-soluble, alcohol-insoluble, and asphalten fractions of blown asphalts exhibit the inversion mentioned. Many resins were shown to retard coagulation. A linear relation was shown between the reciprocal of the gelation time and the concentration added for copal, dammar, amber, coumarone resin, as well as the petroleum fraction of 5°-blown asphalt. Non-linear relations were shown for mastic, leuchtol, phthalate resin, ester rosin, sandarac, tamanol, and rosin.

Tatimori, M.

POLYMERIZATION OF TUNG OIL. IX. COMPARISON OF GELATION PHENOMENA OF TUNG OIL AND OITICICA OIL.

Bull. Chem. Soc. Japan 16, 114-7 (1941); C. A. 35, 6472 (1941).

Essentially the same as "Studies on Gelation of Tung Oil. X."

Tatimori, M.

POLYMERIZATION OF TUNG OIL. X. GELATION OF TUNG OIL AT HIGH TEMPERATURE. (SUMMARIZED REPORT).

Bull. Chem. Soc. Japan 16, 118-124 (1941); C. A. 35, 6472 (1941) (No abstract).

There are presented summarized conclusions on the influence on the gelation time (t) of tung oil caused by various concentrations (x) of additions described in previous papers. The various types of relation of 1/t to the concentration of the added substances are grouped into 8 classes with examples given. From polymerizatien theory T. develops the equation $1/t = 1/t_0 - ax$, where t_0 is the gelation time for pure tung oil and a represents a group of constants. From Carother's theory of polyfunctionality he calculates that 60% of neutral substance must be added to prevent gelation. This agrees with experimental data.

Tatimori, M.

THE GELATION OF TUNG OIL. XXI, DEGREE OF POLYMERIZATION WHEN PROCESSING TEMPERATURE CHANGES EXPONENTIALLY WITH TIME.

J. Soc. Chem. Ind. Japan 47, 598-601 (1944)*; C. A. 43, 5204 (1949).

"The case of temp. changing exponentially with time so that $T = T_0e^{-at}$ or $T = T_0 - (T_0 - T_1)e^{-at}$ and the case when t is expressed as $t = m_0 + m_1 T^2 + m_2 T + m_3 T^3$ were treated. The consts. were detd. from the exptl. values of t and T. A table was constructed from exptl. results giving the amount of resinification taking place while the oil was heated and cooled with T changing linearly with t." From C.A.

Tatimori, M. and Ito, K.
THE GELATION OF TUNG OIL. XVIII. EFFECT OF VARIOUS SARDINE OILS.
J. Soc. Chem. Ind. Japan 45, 825-7 (1942)*; C.A. 43, 5204 (1949).
"The effect of raw and concd. sardine oils upon the gelation of tung oil was studied. Results are tabulated. The gelation tendency is greater than that of perilla oil." From C.A.

Tatimori, M. and Ito, K.
THE GELATION OF TUNG OIL. XIX. EFFECT OF MALEIC ANHYDRIDE AND GLYCEROL.
J. Soc. Chem. Ind. Japan 45, 827-8 (1942)*; C. A. 43, 5204 (1949).
"Maleic anhydride or glycerol alone was effective in preventing the gelation of tung oil. A mixt. of glycerol (1/3 mol.) and maleic anhydride (1/2 mol.) greatly accelerated the gelation. Results are tabulated." From C.A.

Tatimori, M. and Ito, K.
THE GELATION OF TUNG OIL. XX. DEGREE OF POLYMERIZATION WHEN TEMPERATURE INCREASES LINEARLY WITH TIME.
J. Soc. Chem. Ind. Japan 47, 484-6 (1944)*; C. A. 43, 5204 (1949).
"When tung oil is heated at a const. rate of temp. increase from temp. T_1 to T_2, the ratio or τ (the time required at T_2 to produce the same amt. of thermal polymerization as is produced in time t when the oil is heated from T_1 to T_2) to t as calcd. according to Sherman's formula (C. A. 30, 6628) is $\tau/t = A1^{a/T_2}[\overline{H}(r_2) - H(r_1)] - 2.303 (T_2 - T_1)$; $r = \overline{2.303}\ T/a$." From C.A.

Tchang, H. L. and Wang, Y. C.
THE DEODORIZATION OF TUNG OIL.
Contrib. Inst. Chem., Natl. Acad. Peiping 2, 23-9 (1936)*; C.A. 31, 4141 (1937).
"The peculiar odor of Chinese tung oil, usually present in products from this oil, is an objectionable feature. Attempts to remove this odor by chem. treatments have failed, but fair results are obtained with appropriate phys. treatments. Superheated steam, CO_2 or air under reduced pressure is lead through the hot oil. With steam as the deodorizing agent, the oil becomes slightly greenish after the treatment, the objectionable odor comes back after 2-3 days' contact with air, and is more intense than the odor of the original oil. Similar results are obtained when wet CO_2 is used in place of steam. By using dry CO_2 or air, the deodorized oil retains its original straw-yellow color and the odor comes back only after a week's standing, and is less intense than the original odor. Moisture is the chief factor in the production of this odor, sunlight and air accelerate the action, although they have little effect by themselves. The odor in the com. oil comes probably from the fact that moisture is not excluded (and even purposely added) during the manuf. of the oil." From C.A.

Tersand, R.

CHINA WOOD OIL.

Mat. grasses 27, 10399-401, 10427-9, 10510-13 (1935); C. A. 29, 6079 (1935).

"A review of the treatment of China wood oil for its utilization in oil paints and varnishes, and of its use in conjunction with synthetic resins (more particularly glyptals and similar resins)." From C.A.

Ulrich, H.

CRYSTALLIZATION, FROSTING, AND GELATION OF TUNG OIL.

Peintures pigments vernis 21, 96, 113-115 (1935); Brit. Chem. Abstracts 1935, B, 732.

"Crystallization of the β-isomeride from liquid tung oil is more rapid in oil rich in elaeostearin (I); hence stand oils, in which (I) is more or less polymerized, are less susceptible. Low-temp. stand oils are more susceptible than high temp. oils. Heating with glycerol and a catalyst, e.g., CaO, reduces risk of gelation and frosting. Admixture of ≮70% of linseed oil prevents gelation of tung oil occurring during the cooking process." From Brit. Chem. Abstracts.

Ulzer, F.

ATTEMPTS TO DEODORIZE CHINESE WOOD OIL.

Chem. Rev. Fett-u. Harz-Ind. 8 (1), 7-9 (1901)*; J. Soc. Chem. Ind. 20, 261 (1901).

"The use of this oil for varnishes has not been general in Europe on account of its unpleasant odor. The author has made several experiments with the object of removing this. Treatment with Alcohol - The oil was repeatedly shaken with dilute alcohol (20 and 40 percent) with the object of possibly extracting the malodorous constituent, the oily layer separated, and the alcohol expelled by heating for a short time in a current of carbon dioxide. This treatment only caused a slight diminution in the unpleasant odor. Treatment with Sodium Bisulphite - The oil was boiled for six hours under a reflux condenser with twice its volume of bisulphite solution (10° B.), and then washed with distilled water. The odor had not perceptibly decreased. Treatment with Animal Charcoal and with Magnesium Silicate - These also failed to give satisfactory results. Treatment with Superheated Steam - In the first experiment, steam at 130° C. was blown through the oil for eight hours. This caused a considerable decrease in the odor, but the oil partially solidified when completely cold. By the use of steam at 165° C. there was a notable decrease in the odor after five hours, and it was quite different from the odor of the original oil, recalling rather that of linseed oil. After standing for 12 hours, however, this deodorized oil gave a crystalline deposit, and again acquired the characteristic odor of the original oil, though this was less pronounced than at first. This restoration of the odor did not occur so rapidly when air was excluded, from which fact the author considers it probable that the malodorous substance is produced by atmospheric oxidation." From J. Soc. Chem. Ind.

Ware, E. E. and Schumann, C. L.

THE CONSTITUTION OF CHINESE WOOD OIL VARNISHES.

J.Ind. Eng. Chem. 7, 571-3 (1915); C. A. 9, 2459 (1915).

"A review of the polymerization of the oil is given. W. and S. believe with Wolff that the solidification is due to the formation of a colloidal gel. The effect of rosin in preventing solidification is due to the solvent action of the rosin on the gel. The method of W. and S. for the sepn. of Chinese wood oil from other oils was found to be satisfactory for the analysis of heated mixts. of Chinese wood oil and rosin. The Na soaps of both raw and heated Chinese wood oils are insol. in abs. EtOH. The fatty acids from these soaps may be dissolved in 80% EtOH and the oleomargaric acid crystd. by cooling. Expts. showed that rosin has no inhibiting effect on the polymerization of Chinese wood oil." From C.A.

Waterman, H. I., Cordia, J. P., and Pennekamp, B.

FORMATION OF CYCLIC COMPOUNDS IN POLYMERIZATION OF METHYL ESTERS OF FATTY ACIDS FROM LINSEED OIL AND OTHER DRYING OILS.

Research (London) 2, 483-5 (1949); C. A. 44, 2766 (1950); J. Am. Oil Chemists'Soc.27, 288 (1950).

"Linseed oil was simultaneously transesterified and polymerized by heating at 300°-310° under CO_2 with methyl alcohol and KOH. The esters were freed of triglycerides by molecular distillation, fractionated into monomers and residual polymers by distillation at 20 mm. and the polymers were separated into two fractions by molecular distillation. The distillate from the latter step was hydrogenated and further treated to remove oxygenated groups, and examination by ultimate analysis, molecular weight determination, density and refractive index after the method of Vlugter indicated the presence of 3 rings per molecule. By this method treated linseed oil was found to have 0 rings, the monomer from polymerized linseed oil 1 ring, tung oil polymers, 2.8, tung oil monomers, 1, and poppyseed oil polymers, 1.7." From J. Am. Oil Chem. Soc.

Wolff, H.

GELATINIZATION OF CHINA WOOD OIL.

Farben-Ztg. 18, 1171-3 (1913); C. A. 7, 2125 (1913).

"From a series of carefully controlled expts. on the wood oil "gel" formation W. concludes that so-called "polymerization" at 200° and above is really not a polymerization but is probably due to the formation of small quantities of several diff. reaction products (including unsatd. fatty acids of relatively low mol. wt.) which dissolve in an excess of the oil, and form a typical colloidal soln., which then changes to a solid jelly. At the initial solidification point, the gel appears quite sol. in ether, C_6H_6 and $CHCl_3$ and constants (n_D, d, I nos., sapon. nos.) of the sol. portions are practically identical with those of the original oil samples. The gelatinization may be analogous to the "bodying up" and gel formations in the case of colloidal oil solns. of ocher, clays, etc. (W.'s views regarding solubility of gel, etc., are different from those of previous investigators. Cf. Lewkowitsch, Oils, Fats and Waxes, II, 62 - Abstr.)." From C.A.

Wolff, H.

POLYMERIZATION OF OILS.
Kolloid-Z. 27, 183-8 (1920); C. A. 15, 444 (1921).

"The polymerization of oils by heating is usually accompanied by chem. changes. In some cases the new compds. formed have been isolated. The phenomenon has not been fundamentally studied except in the case of wood and linseed oils. The polymerization of the latter on heating out of contact with the air proceeds with appreciable rapidity only after the temp. has reached 160°. During the process the viscosity and sp. gr. of all oils increase, while the iodine number becomes less. The coeff. of refraction also increases with the exception of wood oil. The latter gelatinizes much more easily than the others when subjected to the treatment." From C.A.

Wolff, H.

THE SO-CALLED POLYMERIZATION OF THE DRYING OILS.
Z. angew. Chem. 37, 729-32 (1924); C. A. 18, 3729 (1924).

"The various theories in explanation of the process of polymerization of the drying oils are reviewed and discussed. None of these theories fully fits in with the observed conditions. A decrease in Br. no. and an increase in viscosity are the most marked changes accompanying the so-called polymerization of oils on heating; but the curves representing these changes detd. on samples of linseed and of tung oil, withdrawn at various stages of the heating process, show that the increase in viscosity does not at all conform with the decrease in Br. no. As long as the latter decreases, the former increases only slightly, and shows a max. increase only after the Br. no. and n have reached a min. The form of the viscosity curve is typical for colloids. The thickening of oils, therefore, is not due to an inherent property of the polymerization product, but to its colloidal character. If the Br. no. of the heated oil is to be taken as a measure of the degree of polymerization, with the assumption that this consists of the joining of 2 oil mols. at one of the double linkages, then a decrease from 105 to 83 would indicate the presence of 50% polymerization product. This would require very noticeable increase in the mol. wts. of the oils, such as have been measured by Eibner, Friend (C.A. 11, 1755), and others Marcusson (C.A. 15, 318) and Wolff (C.A. 7, 2125), however, have found that polymerized tung oil contains large quantities, up to 80% of unchanged oil; this is not shown by the observed mol. wts. detd. by f. p. methods in C_6H_6, $CHCl_3$, etc., so that association of the oil in these solvents must have occurred. Detn. of mol. wts. with camphor by the method of Rast (C.A. 16, 2061; 17, 667) showed no increase for thickened oils or their fatty acids. Results are tabulated: tung oil, 300; soybean oil, 290; linseed oil, 285. The fatty acids from the insol. residue of completely extd. tung oil gel showed the same mol. wt. as the raw oil. Genuine polymerization therefore does not occur, and except that thickening is due to formation of colloidal solns., no explanation can be given. The decrease in Br. no. could possibly be caused by colloid-chem. changes, such as an aggregation of the oil mols. in a manner to prevent addn. of the Br.; and does not necessarily require a chem. change. That the drying of tung oil, while primarily an oxidation process, is essentially a colloidal phys. process, has recently been shown (C.A. 18, 2614)." From C.A.

Wolff, H.

THE POLYMERIZATION OF FATTY OILS.
Farben-Ztg. 30, 1263-4 (1925); Z. angew. Chem. 38, 489-90 (1925); C. A. 19, 2277 (1925).

"The colloidal theory of the thickening of tung oil on heating is reviewed, and defended against published criticism." From C.A.

Wolff, H.

CHINESE WOOD OIL.
Chem. Umschau Fette, Oele, Wachse. u. Harze 33, 70-2 (1926); C. A. 20, 2910 (1926).

"The gelatinizing phenomenon of wood oil is considered more as a colloidal than a chem. reaction, because (1) the viscosity curve runs asymptotically toward the ordinate; (2) the increased mol. wt. may be caused by the degree of dispersion rather than the size of the mol.; (3) gelatinizing by a few drops of $FeCl_3$ or by HCl or SO_2 changes the I no. very little when compared with the considerable decrease of I no. by heat." From C.A.

Wolff, H.

THE POLYMERIZATION OF WOOD OILS.
Z. angew. Chem. 39, 767-70 (1926); C.A. 20, 3092 (1926).

"The thickening of wood oil by heat is generally considered to be a colloidal reaction. This change in physical properties is brought about mainly by a polymerization, and partially by an exchange of radicals (Umesterungen), a transformation of α-eleostearic into the β acid, and by a mol. decompn. By treating the oil with extremely small amts. of aq. HCl, the same physical changes are brought about as occur upon heating, but at the same time there is only a slight decrease of the I no. of oil." From C.A.

Wolff, H., and Zeidler, G.

STAND OIL.
Farben-Ztg. 37, 269-71, 305-7 (1931); C. A. 26, 858 (1932).

"No relation exists between the apparent I no. and viscosity of stand oils prepd. at different temps. For equal viscosities, the higher the temp., the higher the I no. and for equal I nos., the higher the temp. the higher the viscosity. The true I no. (van Loon) is, however, but slightly affected during the prepn. of stand oils. While this indicates assocn., viscosity detns. (cf. C.A. 24, 5717) of xylene solns. yield no positive proof ot it." From C.A.

Wornum, W. E.

COLLOIDAL BEHAVIOR IN PAINT AND VARNISH SYSTEMS. I.
J. Oil & Colour Chemists' Assoc. 16, 231-48 (1933)*; C.A. 27, 4694-5 (1933).

"The stages of dispersion from the mol. through micelle and secondary flocculates, or swarm, to coagulum, or gel, are reversible if the forces are confined to secondary valences. Any stage becomes irreversible if primary valences must be ruptured to permit dispersion. A resin liquifiable by heat or dispersible in a solvent is a reversible gel. A heat- or element-convertible resin is an irreversible gel. If low-temp. esterification of an alkyd is stopped prior to heat gelation, the resin is a reversible one. At high temp., the gelation is rapid and irreversible, but the difference is a change in colloidal complexity rather than in the size, shape or structure as suggested by Kienle (C.A. 24, 3661). At low temp., the β-OH group is not reactive so that only a 2,2 reaction occurs. At high temps., increased activity of the β-group results in a 2,3 reaction involving cross linkages through primary valence forces. The rapid increase in the speed of gelation of tung oil above 270 suggests a resemblance to alkyds. The acid in the β-position in the tung oil mol. remains inactive during low-temp. cooking. It functions as unpolymerized oil and may therefore be responsible for the webbing of tung oil films. Linseed oil requires a high temp. for gelation because of the satd. compds. present." From C.A.

Yakubovich, S., and Terekhov, K.
FILM-FORMING SUBSTANCES.
Trudui Nauch.-Issledovatel. Inst. Lakov i Krasok. No. 1, 40-51 (1935)*; C.A. 30, 8655 (1936).

"The expts. were carried out with Russian linseed and Chinese tung oils. Lacquers.--The oxidized and polymerized tung oils are more resistant than linseed oils. Lacquers prepd. from mixts. of oils treated individually are more resistant than those treated in mixts. An increase in the proportion of tung oils in the mixts. improves the stability of lacquers. The properties are not improved by mixing oxidized and polymerized oils. Enamels.--The tung oils are more resistant than linseed oils to oxidation and polymerization. The oxidized oils are more stable than the polymerized oils. Enamels prepd. from separately treated ingredients differ little from those prepd. from mixts. treated after mixing. A higher proportion of tung oil improves the stability of enamels. The mixing of oxidized and polymerized oils does not yield favorable results, although a mixt. of linseed oils is better than that of tung oils. It is concluded that the method of prepn. and the degree of condensation have a great influence on the resistance of enamels toward the effects of the atm. The expts. are described." From C.A.

Yieh, Y. F., and Fu. Y.
INFLUENCE OF GASES ON THE POLYMERIZATION OF WOOD OIL.
J. Chinese Chem. Soc. 10, 90 (1943)*; C. A. 38, 4821 (1944).

"Oxygen is not necessary for the polymerization of wood oil. The rate of polymerization is the same in either H, CO_2 or air. The energy of activation of wood oil is 14,600 cal." From C.A.