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WELLCOME
WOOD ALCOHOL:
RESEARCH LABORATORY.

A Report on the Chemistry, Technology and Pharmacology of and the Legislation Pertaining to Methyl Alcohol

Methyl alcohol

By CHARLES BASKERVILLE, Ph.D., F. C. S.

Professor of Chemistry and Director of the Laboratory in the College of the City of New York

Reprint of Appendix VI to Second Report of the New York State
Factory Investigating Commission, submitted to the
Legislature January 15, 1913

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APPENDIX VI

WOOD ALCOHOL:

A REPORT ON THE CHEMISTRY, TECHNOLOGY AND
PHARMACOLOGY OF AND THE LEGISLATION
PERTAINING TO METHYL ALCOHOL,

BY

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PREFACE

Nearly a thousand cases of poisoning attributed to wood alcohol have been reported in the literature since 1899. That time marked the advent of such preparations as "Columbian spirits," "Colonial spirits," etc., that is to say, methyl alcohol of a high grade of purity. In 1906, due to a general agitation for a tax-free denatured ethyl alcohol, hearings were held before the Ways and Means and Finance Committees of the Federal Congress. The deleterious action of wood alcohol on the general health and eyesight of the working people handling it in the industries was strongly emphasized by manufacturers, working people and experts at these hearings. The actual number of cases of poisoning by wood alcohol and the extent of the poisoning will probably never be known, as the practitioner, having a clearly defined case, no doubt notes the fact in his private records, but, unless it presents some novel features of scientific interest, makes no publication of the fact. However, even since 1906, there has been a steadily increasing number of cases of poisoning by methyl alcohol reported in the scientific journals. The recognition of this fact alone warranted an investigation of the conditions in the State of New York, a work independently begun by several organizations, among them the Committee for the Prevention of Blindness in the Association for the Blind. An inspection of works where wood alcohol is made or used in the arts by Dr. George M. Price and Dr. F. E. Breithut, whom I assigned as chemical advisor to the inspectors, emphasized the necessity for providing precautionary measures to abate the evil. A study of the whole problem, especially the legislation concerned therewith, made by me, substantiated the need of further legislation.

In making the recommendations given in Chapter VII. of the report, I held constantly in mind two basic principles: first, progress in civilization has involved the multiplication of dangers and devising means to safeguard them; and, second, legitimate manufacturing has some rights which should be respected. Makers and users of chemicals, especially the former, are ready to co-operate in any reasonable way for the welfare of the com-

munity, even if it entail some financial outlay. The changes proposed in the present laws are reasonable. They involve, first, ample ventilation; second, proper labelling; and, third, removal of the ambiguity of the present law.

The sum of \$600 was placed at my disposal for the preparation of this report. Two hundred dollars were paid Dr. F. E. Breithut for services referred to above, and the balance was paid my private assistants, Messrs. W. A. Hamor and Jacob Feldbaum, for bibliographic work. The typewriting was done by my secretary, provided by the College of the City of New York, and my own services have been gratuitous.

CHAS. BASKERVILLE.

COLLEGE OF THE CITY OF NEW YORK,

December 2, 1912.

CHAPTER I

WOOD ALCOHOL: WHAT IT IS.

Early History.

Although methyl alcohol was discovered by Robert Boyle (1) in 1661, Philip Taylor (2) is regarded by most authorities as the discoverer of the compound. In 1812, Taylor obtained it in attempting to purify pyroligneous acid by a new process; he thought it was a new variety of ether and called it "pyroligneous aether." The constitution of methyl alcohol and its analogy to ethyl alcohol was established by Dumas and Peligot (3) in 1835; they named the compound methyl alcohol, from $\mu\acute{\epsilon}\theta\upsilon$, wine; $\alpha\lambda\eta$, wood.

*Wood Spirit is a Complex Mixture.**Deodorized Wood Alcohol.*

That "wood-spirit" is not a simple compound, but contains different bodies was suggested by Berzelius (4) in 1839. This supposition was soon confirmed by Scanlin (5), Gmelin (6), Weidmann and Schweizer (7), and Cahours (8). Later, Dancer (9) and Grodski and Kraemer (10) determined the impurities in commercial wood alcohol, and devised methods for their elimination. Methods for the preparation of pure methyl alcohol were also devised by Regnault and Villejean (11), Wohler (12) and Lieben (13). Nevertheless, the commercial wood alcohol on the market in 1896 (14) was the same vile-smelling, greenish yellow, nauseous liquid as in 1850, and only quite recently was the deodorized product (15) placed upon the market.

(1) "Opera," 3, 385.

Boyle speaks of a "natural" or "adiophorous" spirit obtained by distilling the liquor afforded by wood.

(2) Phil. Mag., 60, 315 (1822).

(3) J. prakt. Chem., 3, 7, 369; Pharm. Centr., 6, 279.

(4) Ann., 73, 213.

(5) Jahresber., 15, 378 (1837).

(6) Ann., 19, 288 (1837).

(7) Idem, 25, 47 (1838).

(8) Pogg. Ann. 43, 593 (1838).

(9) Compt. rend., 30, 319 (1850).

(10) Ann., 132, 240.

(11) Idem, 1870, 317.

(12) Ber., 7, 1492; 9, 1920 (1874).

(13) Ann., 81, 376.

(14) See Wood, N. Y. Med. J., Jan. 7, 1905, 5.

(15) Sold as "Columbian spirits," "Eagle spirits," "Colonial spirits," "Manhattan spirits," "Union spirits," "Lion d'or," "green wood spirits," "Standard wood spirits," and the newest variety (1912) "pro spirit."

Methyl Alcohol Occurs in the Distillate from Plants.

It is doubtful whether methyl alcohol occurs in the free state in nature, although the methyl salts are contained in a variety of plants. Thus, methyl alcohol is contained in the *steam distillate* from meadow grass (16), in the distillation water from oil of cloves (17), from oil of caraway (18), from vetivier oil (19), from the oil of the fruit of *Heracleum giganteum* (20), and from the oil of tea from leaves of *Thea Chinesis* (21).

Methyl alcohol occurs also in the water distillate from the unripe fruit of *Anthriscus cerefolium* (22), from the oil obtained by distilling the leaves of *Indigofera galegoides* (23), from the oil of bay (24), and in the steam distillate from the root of *Acorus calamus* (25). According to Wolff (26), methyl alcohol is also found in the fermented juice of fruit, such as currants, plums, apples, cherries, grapes, etc.

Esters of Methyl Alcohol Occur in Volatile Plant Oils.

Methyl esters occur very frequently in volatile plant oils. Thus, methyl salicylate occurs in many plants, notably in oil of wintergreen from *Gaultheria procumbens* (27), etc. Methyl esters of the fatty acids occur in the fruits of various plants (28), and the methyl ester of anthranilic acid occurs in neroli oil from the flowers of the bitter orange and from the peel of the sweet orange (29). Methyl cinnamate occurs in the oil from the root, stems and leaves of various plants (30). The methyl ester of methyl-anthranilic acid occurs in mandarin oil and possibly in the oil of rue (31). The following acids have been found to be methyl esters: atraric acid, a product of the decomposition of

-
- (16) Lieben, Monatsh., 19, 333.
 - (17) Schimmel's Ber., Oct., 1896.
 - (18) *Idem*, Oct., 1899.
 - (19) *Idem*, April, 1900. From the roots of *Andropogon muricatus*.
 - (20) Zincke and Franchimont, Ber., 4, 822.
 - (21) Von Romburg, Schimmel's Ber., April, 1897; April, 1898.
 - (22) Gutzeit, Ann., 177, 382.
 - (23) Von Romburg, Schimmel's Ber., Oct., 1894, April, 1896.
 - (24) Schimmel's Ber., April, 1901.
 - (25) Schnedermann, Ann., 41, 384.
 - (26) Compt. rend., 131, 1323.
 - (27) For a complete list of plants containing methyl salicylate, see Cahours, Ann., 48, 60; Schimmel's Ber., April, 1900.
 - (28) Gutzeit, Ann., 177, 344; Tiemann and Kruger, Ber., 26, 2675.
 - (29) Schimmel's Ber., April, 1900; April, 1899.
 - (30) *Idem*, April, 1899.
 - (31) Walbaum, J. prakt. Chem., (2), 62, 135; Charabot, Compt. rend., 135, 580; Schimmel's Ber., Oct., 1901.

antranorin (32), rangiformic acid (33), lecidic acid (34), parelic acid (35), thamnolic acid (36), vulpic acid (37), etc.

Methyl Alcohol Occurs as a Product of Fermentation.

Methyl alcohol is also among the products of the fermentation of glycerol by *Bacillus boocapricus* (38), of the bacterial fermentation of calcium glycerate (39), and of the fermentation of the juice of the sugar cane by a special (wild) yeast (40).

These occurrences might acquire more than passing significance in chemically proving the origin of wood alcohol in a matter at law, especially in connection with a question as to the presence of methyl alcohol in flavoring extracts and medicines intended for internal use.

Properties of Methyl Alcohol.

Methyl alcohol ("Wood Alcohol," "Wood Spirit," "Wood Naphtha," Carbinol, Methanol, Methyl Hydroxide, Methyl or Methylic Hydrate, Methylic Alcohol), when in the pure state, is a colorless, mobile liquid, having a pure vinous odor (41), similar to that of ethyl alcohol, and possesses a burning taste. The boiling point, as given by different observers, varies from 55° to 66.5° C. (42), and the specific gravity from 0.8098 to 0.8612 at 0° C. (43), and 0.7973 to 0.810 at 15° C. (44). Methyl alcohol burns with a pale blue flame; it is miscible in all proportions with water, ethyl alcohol and ethyl ether. In its solvent properties (45) and chemical reactions it presents close analogies to ethyl alcohol (46).

- (32) For occurrence see: Hesse, Ber., 30, 359; J. prakt. Chem., (2), 57, 287, 422.
 (33) Paterno, Gazz. chim. Ital., 12, 259.
 (34) Hesse, J. prakt. Chem., (2), 58, 508.
 (35) Schunck, Ann., 54, 274.
 (36) Zopf, Chem.-Centr., 1893, ii, 54.
 (37) Bolley, Jahresber., 1864, 554.
 (38) Emmerling, Ber., 29, 2727.
 (39) Fitz, Ber., 13, 1312.
 (40) Marciano, Compt. rend., 108, 955.
 (41) The empyreumatic odor of common "wood spirits" is due to impurities.
 (42) Regnault, 66.78° (Beilstein, 1, 220); Perkin, 65.9° (J. Chem. Soc., 45, 465); Vincent, Delachnal, 64.8° (Bull. Soc. Chim., 33, 469); Grodzki, Kramer, 65.75°—66.25° (Beilstein, 1, 220); R. Schiff, 64.8° (Ann., 220, 1100); Dittmarr and Stewart give 55.1° for the perfectly anhydrous compound (Chem. News, 33, 35).
 (43) Pierre [Ann. chim. phys., (3), 15, 25] obtained 0.82704 at 0°; Kopp (Pogg. Ann., 72, 53) gives 0.81796 at 0°; Kopp (Ann., 94, 257) gives 0.8142 at 0°; Vincent, Delachnal (Jahresber., 1880, 396) give 0.8098 at 0°; Zander (Ann., 224, 88) obtained the sp. gr. 0.8111 at 0°; Pagliani, Battelli (Beitr. Ann. Phys. Chem., 10, 222) give 0.8612 at 0°.
 (44) At 15° the following numbers are given: Mendeleeff (Jahresber., 13, 7) gives 0.8065; Graham (Clarke's "Constants of Nature," p. 187) obtained 0.7973; Duclaux [Ann. chim. phys., (5), 13, 86] gives 0.7995; Grodzki and Kramer (Z. anal. Chem., 14, 103) give 0.7997; they also (Ber., 9, 1929) obtained 0.7984; Regnault and Villejean (Compt. rend., 39, 82) obtained 0.810.
 (45) Methyl alcohol is a good solvent for fats, volatile oils, camphor, resins, gums, alkalies, and various salts.
 (46) For differences in the chemical behavior of methyl and ethyl alcohols, see O. A. Lobry de Bruin, Ber., 26, 268 (1893).

Different Names Under Which Purified Wood Alcohol Appears in Commerce.

Pure methyl alcohol (47) is sold in the United States under various names, viz.:—“Columbian Spirits,” “Colonial Spirits,” “Manhattan Spirits,” “Hastings Spirits,” “Alcolene,” “Eagle Spirits,” “Union Spirits,” and “Lion d’or;” in Canada it appears under the names of “green wood spirits” and “standard wood spirits;” in Germany the newest variety is “pro spirit” (48).

Impure Wood Alcohol.

The names wood spirit, wood naphtha, and pyroxylic spirit are applied to the impure methyl alcohol of commerce. It is a complex liquid, containing variable proportions of methyl alcohol, acetone, methyl acetate and formate, dimethyl acetal, allyl alcohol, aldehyde, methylamine, oil, water, etc. (49). The “tailings” contain furfural, methyl-ethyl ketone, and allyl acetate, with small quantities of paroxanthine (50). The best commercial wood spirit contains about 95 per cent. of real methyl alcohol, the common varieties from 75 to 90 per cent., while some samples may contain only 35 to 40 per cent. (51).

Properties of Wood Spirit.

Wood Spirit is a greenish yellow fluid possessing a characteristic odor and a nauseous taste. It is a good solvent and its miscibility with water depends upon the amount of acetone present. The crude spirit is usually sold at a specific gravity of from 0.980 to 0.850 at 60° F. (52).

Denatured Alcohol.

Denatured alcohol is ethyl alcohol to which has been added some substance or substances which may or may not be of a poisonous character. The intention is to so treat the alcohol as to

(47) Pure methyl alcohol is of 100 per cent. strength as it leaves the works, but it soon absorbs water on exposure so as to reduce its strength to 98 or 97 per cent.

(48) A. Hellingel (Apoth.-Ztg., 27, 567) reports that, due to the notorious Scharnaek catastrophe (1911), whereby many persons were fatally poisoned from the use of methyl alcohol, as well as recent stringent regulations relative to the use of this substance, a Luxemburg firm is attempting to exploit under the name of “Pro Spirit” an alcoholic substitute recommended for external use, pharmaceutical preparations and cosmetics. It consists of “pure acetone-free aromatized methyl alcohol.”

(49) Wladesco, Bull. Soc. Chim., (3), 3, 498 (1890); Regnault and Villejean, Compt. rend., 99, 82; Wiley, N. Y. Med. J., 80, 1009 (1904); Dittmar and Fawsitt, Trans. Roy. Soc. Edinb., 1837, 509; J. Soc. Chem. Ind., 22, 685 (1903); Klar, Chem. Ind., 20, 152, 176 (1897).

(50) Allen, “Commercial Organic Analysis,” 1, 72 (1908).

(51) Fawsitt, J. Soc. Chem. Ind., 22, 685 (1903). See also Allen, “Commercial Organic Analysis,” 1, 72 (1908).

(52) See Fawsitt, loc. cit.

prevent its being drunk, but to admit of the use of such alcohol for industrial purposes.

The principal substances used as denaturants are commercial wood alcohol, pyridine partially rectified, bone oil which contains large amounts of pyridine, benzine and benzol; and, for special purposes, ether, castor oil, spirits of turpentine, caustic soda, distilled grease from sheeps' wool, and so forth.

Federal Law as to Denaturing Alcohol.

The enactment of legislation by the United States Congress, June 7, 1906, (53) permits the use of a tax-free domestic alcohol in the arts and industries, and for fuel, light and power, provided said alcohol shall have been mixed in the presence and under the direction of an authorized government officer with *methyl alcohol or other denaturing material or materials or admixtures of the same* which will destroy its character as a beverage and render it unfit for liquid medicinal purposes (54).

(53) "Law for Denatured Alcohol in the U. S." (Public Act No. 201).

(54) For United States Regulations, see Methyl Alcohol as a Denaturant, Chapter III., p. 937.

CHAPTER II

MANUFACTURE OF WOOD ALCOHOL.

Methods of and Materials Used in Manufacture.

The destructive distillation of wood is almost the only method of obtaining methyl alcohol in the United States possessed of practical interest, although in Europe it has been proposed to manufacture it by the destructive distillation of peat (55) and it has been obtained as a by-product from vinasse (56). Methyl alcohol may also be prepared by a variety of synthetical reactions (57), and recently a process has been developed for obtaining it as a by-product in the manufacture of wood-pulp by a soluble sulphite process (58).

The production from peat, vinasse and wood-pulp is inconsiderable, and more or less incidental; and the synthetical methods are at present too expensive to be practised on a commercial scale. The commercial demand for methyl alcohol is therefore

(55) For description of process, see W. A. G. von Heidenstam, English Patent 2292, Feb. 5, 1900.

(56) Vinasse is the residue remaining after the distillation of fermented beet-root molasses.

(57) The chief methods proposed are:—

A. From methane.

(1) By chlorination in reflected sunlight (Berthelot, *Compt. rend.*, 45, 916).

(2) Incomplete oxidation (Maumene, *Bull. soc. chim.*, (2), 19, 243).

(3) Oxidation with ozone at ordinary temperatures [Otto, *Ann. chim. phys.*, (7), 13, 77].

(4) By passing methane and air over finely divided copper (Glock, *Ger. Pat.* 109014 of 1898; Coquillon, *Z. Spiritusind.*, 23, 182).

(5) By oxidation with hydrogen peroxide, ferrous sulphate, monopersulphuric acid, combined or alone (Lance and Elworthy, *Eng. Pat.* 7297, March 26, 1906).

(6) By oxidation at 30-50° C., using tan bark as a contact substance (Haugmann & Co., *Ger. Pat.* 214155, Sept. 26, 1906).

B. By the dry distillation of calcium formate [Lieben and Rossi, *Gazz. chim. Ital.*, 1871, 164; Lieben and Paterno, *Ann.*, 167, 293; Friedel and Silva, *Bull. soc. chim.*, (2), 19, 481].

C. By the electrolysis of an organic salt.

(1) From potassium malonate (Peterson, *Z. physikal. Chem.*, 33, 714).

(2) From potassium acetate (Hoefer & Moest, *Z. Elektrochem.*, 10, 833).

(3) From sodium acetate, perchlorate, sulphate, and potassium carbonate and bicarbonate (Moest, *Chem.-Centr.*, 74, i, 370).

D. From formaldehyde.

(1) By the action of potassium hydroxide (Lieben, *Monatsh.*, 22, 302).

(2) By the action of light on a mixture of it with water (Inghilleri, *Z. physiol. Chem.*, 73, 144).

E. From glycerine and glycerates.

(1) By distillation of glycerine with soda [Fernbach, *Bull. soc. chim.*, (2), 34, 143].

(2) By the action of carbon dioxide on sodium glycerate at 180° C. (Loebisch and Looss, *Wien. Anz.*, 1881, 252).

F. From prussic acid (Linnemann and Siersch, *Chem. Centr.*, 39, 390).

G. From acetone by saturation with hydriodic acid or hydrochloric acid (Friedel, *Compt. rend.*, 46, 1165).

H. By the action of a zinc salt [$\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2$] upon monochlor-ether (Henry, *Chem. Cent.*, 62, ii, 680).

(58) See Meyer, U. S. Pat. 407442, July 23, 1889; Stora Kopparbergs Bergslags Aktiebolag, French Pat. 402331, April 23, 1909; Bergstrom, *Papierfabrikant*, 8, 970.

essentially met by submitting wood to destructive distillation, the methyl alcohol, together with many other products, being obtained from the vapors evolved. The residue from the distillation is charcoal, which finds employment as a domestic fuel and in the smelting of various ores (59).

Stages in Manufacture and Refining.

The manufacture of methyl alcohol in the United States on a commercial scale may be conveniently considered under the following heads, a detailed account being unnecessary:—

A. The manufacture of the crude product.

- (1) The raw materials and their preparation.
- (2) The process of destructive distillation of the wood.
- (3) The separation and distillation of the crude product.

B. The refining of the crude product; purification and rectification, especially the separation of the acetone.

Raw Materials Used.

Hard wood, preferably birch, beech, maple, oak, elm, and alder, is best for the purpose, and recently processes have been developed for the destructive distillation of sawdust and wood-waste (60).

Preliminary Treatment.

The wood used is thoroughly seasoned for $1\frac{1}{2}$ to $2\frac{1}{2}$ years and cut in 50-inch lengths (61), or, in the case of saw-dust and chips, it is converted by pressure into briquettes or blocks. If it is not thoroughly dry, it is placed in the kilns, where the remaining sap and moisture are removed.

Process of Distillation.

The destructive distillation is carried on in large iron retorts at a temperature of 400 to 500° F. (62). These retorts are

(59) Chiefly iron ores, for the production of Swedish pig-iron.

(60) See Bergman, U. S. Pat. 504264, Aug. 29, 1893; Fischer, Z. angew. Chem., 1900, 192; Orejavacer, Chem. Fabrik. Muller, French Patent 357432, Sept. 2, 1905; Walker, J. Soc. Chem. Ind., 30, 934; Norton, U. S. Consular Rept., Nov., 1911; Chem. Eng., 16, 1.

(61) In most distillation plants, the wood is divested of its bark.

(62) No decomposition occurs below 160° C. Between 160-275° C., the pyroligneous acid is formed; about 275° C., the yield of gaseous products becomes marked; between 350-450° C., liquid and solid hydrocarbons are formed; and above 450° C. little change occurs.

usually made of steel of varying dimensions, and are provided with a large, tightly-fitting door or doors, one of which is provided with an outlet pipe about 15 inches in diameter; or the gasified products may be taken out through several delivery tubes on the side of each oven. The retorts are set in pairs in brick-work, and batteries of from 6 to 16 pairs are common. The cord wood is fed through the door and carefully stacked so as to completely fill the retort, or steel cars are loaded with the wood and run into the retort. In the larger works the retorts are constructed of brick and are of 50 cords capacity. They are provided with heavy iron doors which may be sealed after closing. The doors are tightly closed, and the retorts are heated from below by burning wood, coal, or charcoal, supplemented by the tar, red oil, and gas which are by-products in the industry; or the ovens may be heated by burning natural gas.

The gasified products of the distillation are run through condensers, which are usually tall closed wooden tanks, each enclosing a number of vertical copper pipes (2 inches in diameter), through which cold water flows. The non-condensed gaseous products are returned and burned under the retorts.

Treatment of Distillate.

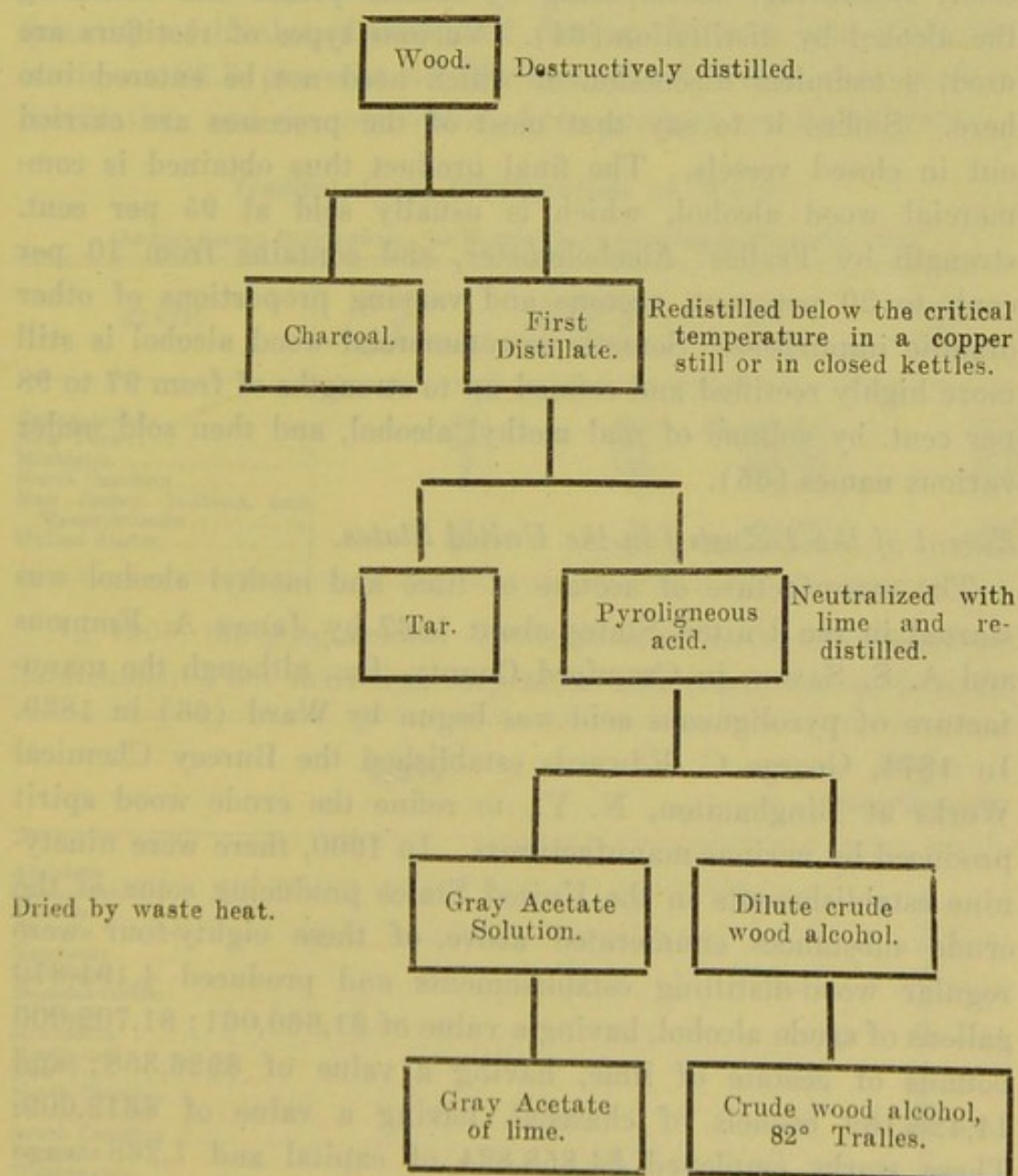
The products condensed are run into tanks, and the tar is allowed to settle to the bottom; the pyroligneous acid, containing acetic acid, methyl alcohol, acetone, allyl alcohol, phenols, etc., remains on top. The pyroligneous acid is a dark red-brown liquid, having a strong acid reaction and a peculiar empyreumatic odor; its density varies from 1.02 to 1.05 (63). It is used to a limited extent in the manufacture of an impure acetate of iron, known as "black iron liquor" or "pyrolignite of iron," but is usually treated to separate the methyl alcohol (of which it contains 15 per cent.), acetone, and acetic acid. This is done by fractional distillation. The acetic acid is recovered by passing the vapors through milk of lime, whereby "gray acetate of lime" is obtained, or the pyroligneous acid is neutralized with lime before distilling off the alcohol, which latter process is technically called "making a tub." Usually three stills of about 2,500 gal-

(63) Munroe and Chatard, 12th Census of U. S., "Manufactures," Part IV, 557.

lons each are employed, and from them are obtained distillates containing 15, 42 and 82 per cent. wood alcohol, respectively. It is a closed process, but not necessarily a continuous one. The commercial product thus obtained is of 82 per cent. strength by the Tralles alcoholometer, and contains varying amounts of acetone and other substances.

Graphic Presentment.

A graphic presentment of the process will, perhaps, make this clearer and is given below.



Purification and Rectification.

This crude material is usually shipped to a centrally located refinery in tank cars, iron drums, or in barrels for purification and rectification. This is accomplished by further distillation from lime or caustic alkalies. The acetone can not be removed by simple distillation and various methods for its separation have been proposed, *viz.*: conversion into chloracetones of high boiling points; conversion into chloroform and volatilizing by distilling the mixture with chloride of lime; crystallizing the methyl alcohol with calcium chloride and separating; forming the methyl ester, separating, decomposing by caustic potash and obtaining the alcohol by distillation (64). Various types of rectifiers are used, a technical discussion of which need not be entered into here. Suffice it to say that most of the processes are carried out in closed vessels. The final product thus obtained is commercial wood alcohol, which is usually sold at 95 per cent. strength by Tralles' Alcoholometer, and contains from 10 per cent. to 20 per cent. acetone and varying proportions of other organic impurities. Sometimes commercial wood alcohol is still more highly rectified and refined up to strengths of from 97 to 98 per cent. by volume of real methyl alcohol, and then sold under various names (65).

Extent of the Industry in the United States.

The manufacture of acetate of lime and methyl alcohol was started in the United States about 1867 by James A. Emmons and A. S. Saxon, in Crawford County, Pa., although the manufacture of pyroligneous acid was begun by Ward (66) in 1830. In 1874, George C. Edwards established the Burcey Chemical Works at Binghamton, N. Y., to refine the crude wood spirit produced by various manufacturers. In 1900, there were ninety-nine establishments in the United States producing some of the crude substances enumerated above, of these eighty-four were regular wood-distilling establishments and produced 4,191,379 gallons of crude alcohol, having a value of \$1,660,061; 81,702,000 pounds of acetate of lime, having a value of \$926,358; and 14,428,182 bushels of charcoal, having a value of \$612,009. These works employed \$4,858,824 of capital and 1,268 wage

(64) See Allen, "Commercial Organic Analysis," I, p. 70 (1908).

(65) For list of names, see page 926.

(66) At North Adams, Mass.

earners. There were nine establishments reporting the production of the crude material and the refining of the alcohol in the same factory; and these establishments produced 637,856 gallons of refined alcohol, having a value of \$370,513; 5,134,000 pounds of acetate of lime, having a value of \$54,928; and 2,726,120 bushels of charcoal, having a value of \$114,663. They employed \$760,156 of capital and 254 wage earners. During the years 1909-1910 there were 147 establishments engaged in wood distillation in the United States, employing 3,039 wage-earners and \$13,017,000 of capital. Of these, 117 were engaged in dry distillation of hardwoods, chiefly birch, beech and maple. The quantity of hardwood consumed during the year was 1,257,997 cords, or 86.7 per cent of the total of all woods consumed in distillation, and the total value of the product was \$9,737,000

Geographical Distribution of Works.

GEOGRAPHICAL DISTRIBUTION OF WORKS PRODUCING CRUDE PRODUCTS, 1900.

STATE.	Number of establishments.	Average number of wage earners.	Value of products.	Per cent. of total.
Pennsylvania.....	58	878	\$2,339,536	61.3
New York.....	24	354	786,252	20.3
Michigan.....	5	169	505,069	13.2
North Carolina.....	3	12	18,409	0.4
New Jersey, Indiana, and Massachusetts.....	3	74	184,000	4.8
United States.....	93	1,487	\$3,833,266	100.0

In 1905, the geographical distribution of wood distillation establishments, not including turpentine and rosin, was as follows:

STATE.	Number of establishments.
Alabama.....	1
Connecticut.....	1
Florida.....	4
Georgia.....	9
Kentucky.....	1
Louisiana.....	2
Massachusetts.....	2
Michigan.....	9
Minnesota.....	1
Mississippi.....	1
New York.....	32
North Carolina.....	7
Pennsylvania.....	63
South Carolina.....	5
Vermont.....	2
Washington.....	1

Production.

CRUDE MATERIALS PRODUCED, 1880 to 1910.

YEAR.	Number of establishments.	WOOD ALCOHOL.		ACETATE OF LIME.		CHARCOAL.	
		Gallons.	Value.	Pounds.	Value.	Bushels.	Value.
1880.....	17	.....	\$86,274	6,593,009	\$156,892	.....	\$31,770
1890.....	53	1,116,075	688,764	26,778,415	315,430	.....	.....
1900.....	93	4,945,963	1,976,986	86,826,000	981,286	17,154,302	726,672
1910.....	147	8,468,083	2,082,253	.....	.....	.....	.....

PRODUCTION OF REFINED ALCOHOL, 1890 AND 1900.

YEAR.	Number of Establishments.	Gallons.	Value.
1890.....	4	166,342	.....
1900.....	18	3,038,140	\$2,296,898

Exports.

EXPORTATION OF WOOD ALCOHOL, 1900 TO 1911.

YEAR.	Gallons.	Value.
1900.....	540,799	\$320,306
1904.....	1,194,436	585,359
1905.....	1,097,451	603,385
1906.....	780,222	460,467
1907.....	2,150,311	862,819
1908.....	1,958,630	819,753
1909.....	1,100,495	383,788
1910.....	1,691,000	760,000
1911.....	2,040,000	898,000

The larger part of the export of wood alcohol for the past six years went to Germany, the United Kingdom and Belgium.

Imports into the United States.

During 1910, wood alcohol valued at \$5,696 was imported into the United States.

Statistics Relating to the Industry in Europe.

Among the European nations, Austria-Hungary and Sweden are large producers of crude wood spirit, while Germany is the principal marketer of purified wood spirit.

The crude wood spirit imported into Germany in 1911 amounted to 8,759,300 kg., valued at 5,694,000 marks; 4,168,700 kg. came from Austria-Hungary, 268,700 kg. from Sweden, and 4,318,800 kg. from the United States. In 1910, 8,726,900 kg. of crude wood spirit were imported. In 1911, Germany exported 1,739,200 kg. of purified wood spirit, valued at 1,267,000 marks. France took 919,300 kg.; Italy, 138,700 kg.; Holland, 236,300 kg.; and Switzerland, 170,500 kg. In 1910, 1,782,400 kg. of purified wood spirit were exported by Germany. In 1910, France imported methyl alcohol valued at 1,819,006 francs, while the exportations for the same year were valued at 106,480 francs.

In 1911, 291,600 kg. of methyl alcohol, valued at 379,080 lira, were imported by Italy, while but 500 kg., valued at 650 lira, were exported.

CHAPTER III

THE USES OF METHYL ALCOHOL.

A. *For Denaturing Ethyl Alcohol.*

B. *In the Chemical Industries.* Methyl alcohol is used in the manufacture of coal tar colors and dyes (methylene blue, green, violet, etc.); perfumes ("Yara-yara," "Eau de Cologne," "Florida Water," etc.); transparent soap; smokeless powder and other explosives; varnish, finish, lacquers, stains, etc.; fulminate of mercury; inks; celluloid, xylonite, and similar products; oil cloth, leather clothes, pegamoid, and similar materials; photographic materials; formaldehyde; organic compounds (synthetic oil of wintergreen, etc.); "methylated ether;" and as a reagent in chemical laboratories.

C. *In Pharmaceutical and Medicinal Preparations.* Methyl alcohol is employed in the preparation of synthetic drugs (methylal, methyl esters, etc.); in toilet preparations (bay rum, witch hazel, "Florida Water," etc.); in essences, extracts (extract of lemon, orange, etc.), tinctures (tincture of iodine, etc.), liniments, lotions and embrocations, patent medicines, proprietary and domestic medicines, solid medicinal preparations, surgical dressings, cattle medicines, plant washes, and in capsules and other medicinal appliances.

D. *In the Arts and Crafts.* Methyl alcohol finds application in the manufacture of hats (stiff, silk and straw), electrical apparatus, gas and electric fixtures, furniture, pianos and organs, cabinet work, picture moulding, burial caskets, passenger cars, wagons and other vehicles, boots and shoes, toys, whips, lead pencils, brushes, rattan goods, brass beds, various kinds of metal hardware, incandescent mantles, artificial flowers; in dyeing establishments; in cleaning in laundries, etc.; and in the painting industry.

E. *Unclassified.* Other uses of methyl alcohol are as a fuel and illuminant. It also is employed for a variety of domestic

purposes (cleaning, etc.); its *abuses* are conveniently considered in this connection.

Denatured Alcohol.

A. Methyl Alcohol is a Denaturant for Ethyl Alcohol.

In 1906, the United States, following the example set by England, France, Germany, and other European countries, enacted a law permitting the general use of a tax-free domestic alcohol for industrial purposes and for light, heat and power. In order to prevent alcohol intended for industrial purposes being used as a beverage or for liquid medicinal purposes (*i. e.*, patent or proprietary medicines), the law enacted requires that tax-free alcohol for use in the arts and manufactures shall have first admixed with it certain substances which destroy its suitability as a beverage.

Value of Methyl Alcohol as a Denaturant.

Methyl alcohol, on account of its poisonous properties, cheapness, difficulty of removing from the resulting industrial alcohol, non-interference with most of the industrial purposes for which the denatured alcohol is intended, and various other reasons (67), was chosen by the Commissioner of Internal Revenue as the principal denaturant. The regulations (68) provide that the agents used for denaturing alcohol shall consist of methyl alcohol and benzine or methyl alcohol and pyridine bases in the following proportions:—

U. S. Regulations.

To every 100 parts by volume of ethyl alcohol of the desired proof (not less than 180°), there shall be added ten parts by volume of the approved methyl alcohol (69) and one-half of one

(67) A very important reason was the complaint of the manufacturers of methyl alcohol that the introduction of a tax-free alcohol meant the destruction of their business.

(68) Regulation No. 30, U. S. Internal Revenue, Sec. 26; amended Dec. 10, 1906 (Circular No. 686).

(69) The methyl alcohol must be partially purified and must conform to the following analytical requirements: *Color*.—This shall not be darker than that produced by a freshly prepared solution of 2 cc. of N/10 iodine diluted to 1,000 cc. with distilled water. *Specific Gravity*.—It must have a specific gravity not more than 0.830 at 60° F., corresponding to 91° Tralles' scale. *Boiling Point*.—100 cc. slowly heated in a flask under conditions described (see Circular No. 680) must give a distillate of not less than 90 cc. at a temperature not exceeding 75° C. at 760 mm. pressure. *Miscibility with Water*.—It must give a clear or only slightly opalescent solution when mixed with twice its volume of water. *Acetone Content*.—It must contain not more than 25 or less than 15 grams per 100 cc. of acetone and other substances estimated as acetone when tested by Messinger's method. *Esters*.—It should contain not more than 5 grams of esters per 100 cc. of spirit, calculated as methyl acetate and determined as in Circular No. 680. *Bromine Absorption*.—It must contain a sufficient quantity of impurities derived from the wood, so that no more than 25 cc. or less than 15 cc. shall be required to decolorize a standard solution containing 0.5 gram of bromine (see Circular No. 680). In addition, the methyl alcohol must be of such a character as to render the ethyl alcohol with which it is mixed unfit for use as a beverage.

part by volume of approved benzine, or two parts of methyl alcohol and one-half of one part of pyridine bases (70).

Denatured alcohol is employed in large quantities in the arts and crafts, and in the chemical industries; and in recent years it has displaced wood alcohol to a large extent. It is used as a solvent for shellac in the manufacture of all kinds of wood products, such as passenger cars, carriages, furniture, pianos, organs, billiard tables, burial caskets, toys, whips, trunks, pipes, etc. Shellac is used as a binding material in the manufacture of lead pencils (71) and electric motors and generators (72). It enters intimately into the manufacture of stiff, silk, straw and felt hats, in which cases the shellac is incorporated in the body of the hat by the aid of alcohol. Similarly, it enters into the manufacture of lacquers, enamels, etc., used to enamel the surface of metals such as hardware, iron, brass beds, gas and electrical fixtures, lamps, brass musical instruments, bird cages, clocks, watches, toys, etc.

In the Chemical Industries.

The manufacture of celluloid, xylonite, collodion, artificial silk, etc., are dependent upon the availability of denatured alcohol. It is used in large quantities in the manufacture of smoke-

(70) For example, to every 100 gallons of ethyl alcohol there shall be added 10 gallons of methyl alcohol and one-half gallon of benzine, or 2 gallons of methyl alcohol and one-half gallon of pyridine bases. On the pyridine bases as a denaturant for alcohol, see Kraemer, *Z. Spiritusind.*, 35, 437 (1912).

SPECIAL DENATURING AGENTS.

Reg. No. 30, U. S. Internal Revenue provides:

Section 79. As the agents for use in complete denaturation render the alcohol denatured unfit for use in many industries, special denaturants are authorized by the Commissioner of Internal Revenue.

Section 80. The Commissioner of Internal Revenue will consider any formula for special denaturation that may be submitted by any manufacturer in any art or industry. But one special denaturant will be authorized for the same class of industries, unless it shall be shown that there is good reason for additional special denaturants.

SPECIAL DENATURANTS IN USE.

1. For varnish and similar substances: 20 l. of a shellac solution (1 part of shellac to 2 parts of alcohol, 90°) per 100 l. of spirit.
2. For the production of celluloid and pegamoid: 1 kilogram of camphor or 2 l. of turpentine or $\frac{1}{2}$ l. of benzol.
3. For the production of ether, ethyl chloride, bromide, and iodide, ethyl sulphuric salts, chloral hydrates, etc.: 10 l. of sulphuric ether, or 1 l. of benzol, or $\frac{1}{2}$ l. of turpentine, or 0.025 l. of animal oil, or sulphuric acid, hydrochloric acid and nitric acid.
4. Chloroform: 5-6 kilos. of chloride of lime, or 300 g. of chloroform.
5. Vinegar: Acetic acid in varying proportions and water.
6. Inks, waxes, etc.: 0.5 l. of turpentine, or 0.025 l. of animal oil.
7. Iodoform: 200 g. of iodoform.
8. Soap-making: 1 kilo. of castor oil and 400 cc. of soda solution.
9. For preparing dye substances: Sulphuric ether (10 l.), or coal tar oil (1 l.), or turpentine ($\frac{1}{2}$ l.), in varying proportions, or aniline dyes (25 grams), or camphor ($\frac{1}{2}$ kilo.), and various other special denaturants.

(71) The shellac, dissolved in alcohol, binds together the moulded graphite.

(72) The coils of insulated wire are held in place by this binding shellac.

less powder, fulminate of mercury and other explosives. An important use of industrial alcohol is in the manufacture of ethyl ether, chloroform (73), and ethyl chloride. Another utility of the alcohol is in the production of dyes, where it enters as a solvent, a medium of interaction, or as a chemically active body. There is also the manufacture of fine chemicals, a very important industry, in which alcohol enters.

As an Illuminant and Fuel.

The use of denatured alcohol as an illuminant, fuel and in gas engines is of growing importance. Hundreds of patents have been taken out for all sorts of alcohol lamps, and hundreds of alcohol heating-mechanisms have been put on the market, especially in Europe.

Production.

The withdrawals of alcohol in the United States in the fiscal year 1910-11, for the purpose of denaturing, upon which no taxes were paid, amounted to 11,062,060 proof gallons, and there remained at the end of the year, in bonded warehouses, 2,213,390 proof gallons. In 1910-11, Germany produced 91,765,078 gallons of alcohol, of which 37,141,633 gallons were consumed in the industrial arts; and, in 1910, 3,962,412 gallons of denatured alcohol were made in England. 3,008,514 gallons of industrial methylated spirit were used in manufacturing operations and for other purposes in the United Kingdom in the year ended March 31, 1912. The Swiss importations of denatured spirit amounted to 6,993,900 kg. in 1911; of this quantity, 6,246,500 kg. came from Austria-Hungary, a large producer of methyl alcohol.

B. Uses of Wood Alcohol in the Chemical Industries.

The chief uses of wood alcohol in the chemical industries are as follows:—

1. As a solvent.
2. As an extraction agent.

(73) Chloroform is no longer prepared from denatured alcohol or ethyl alcohol in this country.

3. As a raw material for the production of formaldehyde.
4. In synthetic chemistry for the introduction of the methyl (CH_3) group.
5. As a reagent in chemical laboratories.

Wood Alcohol as a Solvent.

Wood alcohol is a good solvent for fats, volatile oils, camphor, resins, gums, alkalies, and various salts. Because of its cheapness, it is used as a solvent for varnishes, lacquers, stains, finish and shellac. It is also used as a solvent in the manufacture of certain inks, photographic materials, celluloid, xylonite, and similar products, and incidentally in the manufacture of transparent soap. In celluloid, xylonite, etc., the alcohol does not appear in the finished product, while in varnish, shellac, etc., the wood alcohol remains as such and may produce its deleterious effects on workmen employing these in the industries.

As an Extractive.

As an extractive, wood alcohol is used in the manufacture of smokeless powder, fulminate of mercury, nitrocellulose, and other explosives. Thus, dried, pulped military guncotton is freed from lower cellulose nitrates by extraction with wood alcohol (74).

For the Production of Formaldehyde.

Formaldehyde, which has an extensive use, is produced from methyl alcohol by oxidizing with air by the aid of a catalytic agent. It is prepared on a large scale by passing a mixture of methyl alcohol vapor and air over a glowing platinum spiral or heated copper gauze (75). Formaldehyde may also be prepared by the electrolysis of dilute methyl alcohol and when ozone is passed through it.

Commercial formaldehyde is a 40 per cent. water solution, containing from 12-15 per cent. of methyl alcohol.

In Synthetic Chemistry.

Methyl alcohol is used in synthetic chemistry for the introduction of the methyl group (CH_3) into various substances.

(74) Monroe, United States Patent 489684 of 1893; English Patent 580 of 1893.

(75) See LeBlanc and Planchke, Z. Elektrochem., 17, 45 (1911); Glassner, Oesterr. Chem.-Ztg., 5, 337.

In the manufacture of artificial perfumes and flavors, it was discovered that the presence or addition of the methyl group converted certain odorless and tasteless bodies into those possessing strong perfumes or flavors. Thus, methyl benzoate ($C_6H_5COOCH_3$) is prepared by distilling wood spirit with benzoic and sulphuric acids; it is used in perfumery under the names "Essence Niobé" and "Peau d'Espagne." Methyl betanaphtholate ($CH_3O.C_{10}H_7$), known in commerce under the names "Nerolin" and "Yara-yara," is prepared by boiling betanaphthol with methyl alcohol and zinc chloride; it is one of the strongest smelling perfume materials. Methyl cinnamate ($C_6H_5.CH:CH.COOCCH_3$) is prepared by distilling methyl alcohol with sodium cinnamate and sulphuric acid; it is used as a flavoring extract in confectionery and as a perfume. Methyl anthranilate, a very fragrant perfume, is prepared by condensing anthranilic acid with methyl alcohol. Methyl alcohol is also used in the preparation of vanillin, etc. It is used in a similar manner in the manufacture of various aniline dyes, viz., methylene blue, green and violet.

As a Chemical Reagent.

Methyl alcohol is used as a reagent in chemical laboratories for the detection of salicylic acid, the determination of boric acid, in the preparation of grape sugar, and as a substitute for ethyl alcohol for various purposes.

C. Uses of Methyl Alcohol in Pharmacy and Medicine.

Methyl alcohol is used in pharmacy and medicine chiefly as a solvent, a substitute for ethyl alcohol, and as a chemically active body.

As an Extractive.

As an extraction menstruum for the preparation of solid extracts, methyl alcohol gives a better yield than ethyl alcohol for many substances. Thus for belladonna, nux vomica, jalap resin, etc., the former is a much better solvent than the latter (76). Again, another advantage claimed for methyl alcohol for this purpose is its greater volatility. However, the toxic

(76) See Batta, Bull. Soc. Chim. Belg., 23, 7 (1912); Rosenthaler, Pharm.-Ztg., 52, 291.

action of methyl alcohol should preclude its use in any preparation intended for internal use (77).

Substitute for Ethyl Alcohol.

Methyl alcohol is employed in large quantities as a cheap substitute for ethyl alcohol in washes, tinctures, liniments, patent medicines, proprietary and domestic medicines, extracts, essences, cattle medicines and plant washes. A large number of poisoning cases are reported every year from drinking Jamaica ginger, extract of lemon, bay rum, "eau de Cologne," etc. (78).

In Synthetic Drugs.

As a chemically active body, methyl alcohol is used in the manufacture of synthetic drugs. Thus methyl salicylate, artificial (synthetic) oil of wintergreen, used as an antirheumatic and antiseptic, is prepared by distilling methyl alcohol with salicylic and sulphuric acids. The anesthetic methyl chloride (79) is prepared by distilling methyl alcohol with common salt and sulphuric acid. Gallicin (methyl gallate), an antiscatarrhal, is prepared by heating a solution of gallic or tannic acid with concentrated sulphuric acid and methyl alcohol. The sedative and hypnotic methylal (80) is prepared by distilling methyl alcohol with dilute sulphuric acid and manganese dioxide. Methylene blue (81), methylene chloride (82) and other drugs are prepared in a similar manner.

D. *Uses of Wood Alcohol in the Arts and Crafts.*

As a Solvent.

The pure grades of methyl alcohol, sold under the names of "Columbian spirits," "Colonial spirits," etc., find their chief employment in the arts and crafts as solvents for shellac. Thus, shellac "cut" in wood alcohol is used in the manufacture of passenger cars, carriages, furniture, pianos, organs, cabinet

(77) Kobert (Pharm.-Ztg., 51, 518), warns against the use of methyl alcohol in pharmaceutical and medical preparations.

(78) For cases see *Appendix C.*, p. 1004.

(79) This has been used as a local anesthetic for severe neuralgia, pruritus and spinal pains.

(80) Used internally in delirium tremens, gastric and intestinal pains, insomnia, and in strychnine poisoning. Commercial methylal is used in perfumery for extracting odors.

(81) Used in malaria, rheumatism, cystitis, pyelitis, carcinoma, blackwater fever, diabetes, gonorrhea, and neuralgia.

(82) Prepared by treating a mixture of methyl alcohol and chloroform with zinc and hydrochloric acid, and used as a spray to produce local anesthesia in dentistry.

work, picture moulding, hats, electrical apparatus, toys, whips, brushes, lead pencils, rattan goods, etc. It is used as a solvent for lacquers and enamels, for polishing the surface of metals such as brass beds, hardware, gas and electric light fixtures, clocks, watches, etc., and also in the manufacture of boots and shoes. Another important use of wood alcohol is as a cleaning fluid in laundries. Again, it is used by painters for removing old paint, and in shellac, varnish, stains and lacquers.

E. *Unclassified.*

Wood alcohol is used extensively as a liquid fuel, and for such domestic purposes as a cleaning agent. *It is easily purchased and is a common household article.*

ABUSES OF METHYL ALCOHOL.

Methyl Alcohol as an Adulterant.

The data obtainable from the literature indicate that the drinking of liquors containing methyl alcohol is responsible for most of the deaths and blindness attributable to methyl alcohol. The "deodorized" methyl alcohol resembles ethyl alcohol so closely that the ordinary layman can hardly distinguish the difference between the two (83), and, as it costs less than one-fourth as much as grain alcohol, people are tempted to use it as a substitute for ethyl alcohol in adulterating whiskey, essences, extracts, bitters, washes, liniments, balsams, perfumes, etc.

Class of Consumers.

The victims are generally those who indulge in the commoner forms of whiskey, rum and wine: soldiers and sailors who frequent low resorts, men who go on protracted sprees, the low negro population of the country, Indians who are unable to obtain the better grades of whiskey, etc.

Persons not addicted to the use of intoxicating drinks are undoubtedly often affected innocently, from drinking Jamaica ginger, lemon extract, essences of lemon, cinnamon, peppermint, etc., bitters, patent medicines, proprietary medicines, balsams, etc., whose chief menstruum is "deodorized" wood alcohol. Methyl

(83) See *Properties of Methyl Alcohol*, p. 925.

alcohol is also used as a substitute for ethyl alcohol to adulterate witch hazel, bay rum, "eau de Cologne," Florida water, and in liniments. A considerable quantity of "deodorized" methyl alcohol, under the names of "Columbian spirits," "Colonial spirits," etc., is absorbed annually by individuals ignorant of its toxic action, by the poorer negroes, who drink it under the name of "white horse" or "old mule," and by individuals with the craving for alcohol who are unable to obtain ethyl alcohol.

Present Condition of the Adulteration.

The adulteration of alcoholic beverages and extracts with methyl alcohol is still going on. Now and then the daily papers report a few cases of poisoning from drinking whiskey containing methyl alcohol. Sometimes, when an epidemic of such poisoning occurs, it is prominently brought before the public, as when 25 persons were fatally poisoned in New York City in 1905, or when, at the recent Sharnack catastrophe in Berlin, hundreds of persons were fatally poisoned. That the adulteration of whiskey is widely practised was proven by Warren, Pure Food Commissioner of Pennsylvania, who collected 1,000 samples of cheap whiskey from all parts of the State and found 95 per cent. of them to contain varying quantities of methyl alcohol, some as high as 75 per cent. Brooks, State Chemist of New Jersey, reported, in 1903, that from 4-8 samples of paregoric and from 4-11 samples of ginger contained wood alcohol. Scovill (84) found 2 out of 6 commercial liniments to contain wood alcohol. Greenwood (85) found "Columbian spirits" in tinctures obtained in Boston drug stores. Patch (86) found methyl alcohol in 40 out of 225 samples of spirits of camphor. The New York City Board of Health, in 1902, found that 40 out of 215 drug stores were substituting wood alcohol for ethyl alcohol in Jamaica ginger and spirits of ammonia. In 1907, the same department found 12 samples of toilet waters, 5 hair tonics and 2 samples of cologne to contain methyl alcohol; in 1910, wood alcohol was found in 8 samples of whiskey; in 1911, in 7 samples of whiskey; in 1912, in 16 samples of whiskey,

(84) Mass. Pharm. Assn., 1897.

(85) Cited by Buller and Wood, J. Am. Med. Assn., 1904, 972.

(86) Am. Pharm. Assn., 1902.

in 316 samples of vino vermouth, in 9 flavoring extracts, in one bay rum, and in Marsala wines, bitters and various cordials (87). The State Board of Health of Massachusetts has also had some experience with methyl alcohol as an adulterant: In 1903, one sample of tincture of iodine was found to contain methyl alcohol; in 1904, two samples of tincture of iodine examined contained methyl alcohol; in 1905, samples of lemon extract put out by one manufacturer had methyl alcohol therein; in 1911, samples of vanilla, lemon and orange extracts made by one manufacturer were found to contain denatured alcohol containing methyl alcohol; and in 1912, one sample of tincture of iodine examined contained methyl alcohol, while another sample was made with denatured alcohol containing methyl alcohol, acetone, and petroleum (88). The Board of Health of Detroit, Michigan, reports that: "Some eight years ago (*i. e.*, about 1904), we condemned and dumped into the sewer a quantity of lemon flavoring extract made up with wood alcohol, and since then we have not met with it but in one case, where it was used in a whiskey substitute made by the consumers themselves" (89).

(87) I am indebted to the New York Board of Health for this data.

(88) Private communications, dated November 7 and 20, 1912, from the Secretary of the State Board of Health, Boston, Mass.

(89) Private communication, dated November 3, 1912, from the Director of the Laboratory of the Board of Health, Detroit, Mich.

CHAPTER IV

IS METHYL ALCOHOL A POISON?

Widely varying ideas have prevailed at different periods as to the poisonous nature of methyl alcohol. Most of the early investigators considered it even less poisonous than ethyl alcohol, basing this view on the general law, that the toxicity of the alcohols increased with the carbon content and with the boiling point.

According to One Theory, Methyl Alcohol Should Be Less Poisonous than Ethyl Alcohol.

This property of the alcohols was first observed by Richardson (90), in 1864, and was later confirmed by Rabuteau and Cross (91). In 1880, Dujardin (92) modified this law by stating that the toxicity of the monatomic alcohols depended not only upon the number of carbon atoms, but also upon their origin, solubility and oxidation in the body. Again, Wirgin (93) proved that the disinfecting power of the alcohols increased with the molecular weight. Similarly, Baer (94) proved that the strength of the alcohols from $C-C_5$ increased with the number of carbon atoms. In 1908, Iwanoff (95) asserted that the poisonous action of the primary monatomic alcohols of the fatty series increased with the length of the chain. Fuhner (96) stated that the action of equimolecular solutions increased with the number of carbon atoms. Moreover, Francis and Fortescue-Brickdale (97) state that the intensity of the action of the alcohols depends upon the number of carbon atoms present and increases as the homologous series is ascended, although to some extent methyl alcohol is an exception (98).

(90) Trans. Brit. Assn., 1864, 1865, 1866.

(91) Compt. rend., 81, 631.

(92) Polyt. J., 234, 406 (1880).

(93) Z. Hyg., 49, 149.

(94) Cited by Harnack, Deutsch. Med. Wochschr., 38, 538.

(95) Dissertation St. Petersburg, 1907; Bio-Phys. Zentr., 3, 250.

(96) Arch. exp. Pathol. Pharmacol., 51, 1.

(97) "The Chemical Basis of Pharmacology," p. 92 (1908).

(98) Thus in the case of rabbits: Methyl alcohol, 6-12 g., without action. Ethyl alcohol, 7 g., drunkenness; 12 g., sleep. *n*-Propyl alcohol, 12 g. produce sleep in 5 minutes and death in 5 hours. *n*-Butyl alcohol, 3 g. produce drunkenness; 7 g., sleep and death. *iso*-Amyl alcohol, 2 g. produce drowsiness.

According to Francis and Fortescue-Brickdale (99), the ethyl group is stronger than the methyl group. Thus, certain hypnotic properties possessed by the ethyl group are entirely wanting in the corresponding methyl derivatives (100). Harnack (101) states that ethylmorphin is stronger than the corresponding methyl derivative, viz., 3:1.

Toxic Action on Plants and Animal Organisms.

That methyl alcohol is less poisonous than ethyl alcohol on lower plants and infusoria was proved by the experimental work of Wirgin (102) and that of Buchner, Fuchs and Neagle (103). Fuhner (104) stated that ethyl alcohol was three times more poisonous than methyl alcohol on sea urchins' eggs. Schlossberger (105) performed the first experiments on the toxicity of methyl alcohol on the (higher) animal organisms and concluded that its action was similar to that of ethyl alcohol, producing intoxication with small quantities and coma with larger amounts.

In 1869, Richardson (106) proposed the use of methyl alcohol as a general inhalation anesthetic, maintaining that it was less toxic than ethyl alcohol and slower in its action than chloroform.

Comparative Toxicity of Methyl and Ethyl Alcohols.

Quantitative experiments were performed by Joffroy and Servaux (107), who determined the toxic equivalent of methyl alcohol for the dog at 9 cc. (7.2 g.) per kg. body weight; of ethyl alcohol at 8.65 cc. (6.92 g.) per kg. For the rabbit, 10 cc. methyl alcohol and 8.15 cc. ethyl alcohol per kg. body weight were found. These authors stated that the action of methyl alcohol differed

(99) "The Chemical Basis of Pharmacology," p. 49 (1908).

(100) The ethyl-sulphone group possesses marked hypnotic properties, while the methyl derivatives are quite inert; also dulcin has an extremely sweet taste, whereas the corresponding methyl derivative is entirely wanting in this property.

(101) Deutsch. med. Wochschr., 38, 538 (1912).

(102) Z. Hyg., 46, 149.

(103) Arch. Hyg. Munch., 40, 347 (1901).

(104) Arch. exp. Pathol. Pharmacol., 51, 1.

(105) Ann., 73, 213 (1850).

(106) Med. Times and Gaz., 1869, 703; Lond. Med. Rec., 1875, 62, 77, 93. In the Sci. Am. Suppl., 19, 8240, Richardson summarized his work on anesthetics. He stated that from 1½ to 2 ounces of methyl alcohol by volume were required for complete anesthesia. The action was very slow, and with distinct symptoms of alcoholic intoxication. A full hour was required to produce insensibility, which at the deepest was insufficient to destroy reflex irritability. The breathing was stertorous, often with bronchial rale. Recovery was very slow, four to six hours in deep anesthesia. The temperature was reduced 3 degrees F. The danger was practically nil, but, when the inhalation was enforced, death was produced by the simultaneous cessation of the circulation and respiration.

(107) Arch. med. exp., 8, 490; 9, 707.

from ethyl alcohol in that the symptoms (108) were produced more slowly and the intoxication was more prolonged. Georg Baer (109) placed the toxic dose of methyl alcohol for the dog at 9.02 g. per kg. body weight and ethyl alcohol at 7.44 g. per kg., or, the toxicity of methyl alcohol is to that of ethyl alcohol as 0.8:1. Lessier (110) determined the toxic equivalent for the dog, finding methyl alcohol to be 15 g. per kg. body weight and ethyl alcohol 10 g. per kg. For fish, he found 50 g. for methyl and 40 g. for ethyl alcohol per kg. body weight.

The majority of the text-books on toxicology of the nineteenth century considered methyl alcohol no more poisonous than ethyl alcohol.

Kobert (111) stated, in 1893, that methyl alcohol was as poisonous as ethyl alcohol, but no more. This he withdrew in 1906 (112). In 1897, Jaksch (113) stated that methyl alcohol was not poisonous, and that people in England and Ireland used it as a beverage. Kunkel (114) stated that methyl alcohol had a similar effect upon the body to ethyl alcohol. He asserted that a larger dose of it was necessary to produce paralysis, and, as it acted slower upon the body, death might be produced through the paralysis of the respiratory center by increased somnolence for 3-4 days. Vogle and Boranzig (115) report that the action of methyl alcohol is similar to that of ethyl alcohol so far as poisoning is concerned.

Methyl Alcohol is a Distinct Poison.

On the other hand, the majority of the present authorities maintain that methyl alcohol is a severe poison. They explain the difference in the toxicity of methyl and ethyl alcohols by the property of the former to oxidize slowly in the animal body to formaldehyde and formic acid, while the latter oxidizes rapidly into carbon dioxide and water.

(108) The general symptoms are: Increase of body temperature, partial loss of power of temperature regulation, marked changes in the alimentary tract, convulsion, loss of sensation and reflex movements, convulsive movement of eyes, nystagmus with dilation of the pupils, and blindness.

(109) Arch. Anat. Physiol., 304, 283, 289 (1898).

(110) Munch. med. Wochschr., 59, 248.

(111) See Feletar, Press. Med. Chir., 47, 215, 223, 231 (1911).

(112) "Lehrbuch der Intoxikationen," p. 660.

(113) "Klinische Diagnostik," cited by Feletar, Press. Med. Chir., 47, 215, 223, 231.

(114) "Handbook of Toxicology," 1899.

(115) "Lehrbuch der Arzneimitteln," 1900.

Methyl Alcohol Is More Toxic than Ethyl Alcohol.

Even as early as 1875, Taylor (116) observed that methyl alcohol operated as a "narcotic poison," and later (1879) Poincaré (117) proved that methyl alcohol fumes produced marked anatomical and functional disturbances (118) in animals. Also, Dujardin and Beumetz-Audige (119) declared methyl alcohol to be more poisonous than ethyl alcohol; Blumenthal (120) proved methyl alcohol to be more poisonous on the muscle fibre than ethyl alcohol; and Holden (121) stated that methyl alcohol was more poisonous than ethyl alcohol (in his experiments 50 cc. caused death in the case of a 9 kg. dog). Riche (122) determined the toxic equivalent for methyl alcohol to be 0.66 g. per kg. body weight; ethyl alcohol, 2.65 g. per kg. Baudran (123) gave the toxic equivalent as follows: methyl alcohol, 1.44 g. per kg. body weight; ethyl alcohol, 2.65 g. per kg. Atchinson (124) gave the fatal dose for various animals: dog, 6.37-7.2 g. per kg.; rabbit, 7.2 g. per kg. body weight. From a series of experiments, Lewin (125) proved that methyl alcohol was more toxic than ethyl alcohol (126).

Physiological Action of Methyl Alcohol is Specific.

Julius Pohl (127) was the first to recognize the characteristic action of methyl alcohol as a poison. He stated that while he was able to give animals ethyl, iso-butyl, and amyl alcohols, in doses sufficient to cause intoxication for almost a year, without causing marked anatomical or functional disturbances, methyl alcohol, given in small doses every day, was tolerated for but a few weeks; the animals remained comatose for days, did not eat, and died, although the administration of the alcohol was discontinued. Pohl ascribed this difference to the fact that methyl alcohol was oxidized to formic acid in the body, in which form it was sepa-

(116) "Poisons," 659 (1875).

(117) Compt. rend., 87, 782 (1879).

(118) Great increase in size of abdomen, hypertrophy and fatty degeneration of the liver, and an alteration of the constitution of the muscular fibres of the heart, of the epithelial cells, of the uriniferous tubes, and of a large number of the cells of the lungs.

(119) Compt. rend., 80, 1876.

(120) Pflüger's Arch., 62, 513 (1896).

(121) Arch. Augenhk., 40, 351; Arch. Ophth., 38, 129.

(122) Munch. med. Wochschr., 59, 248.

(123) N. Y. Med. J., 5, 127 (1905).

(124) N. Y. State J. Med., 5, 127 (1905).

(125) Berl. Med. Klin., 8, 95 (1912).

(126) On injecting the alcohols in hens' eggs, half as many normals and twice as many monsters were formed by methyl as by ethyl alcohol.

(127) Arch. exp. Path. Pharmacol., 31, 281.

rated in the urine (128). This view was confirmed by Bongers (129), who asserted that after the administration of methyl alcohol to higher animals (dog), considerable quantities of formic acid and methyl alcohol were excreted in the urine. Schotten (130), and Greenhaut and Quinquad (131) state that the volatile fatty acids poor in carbon pass unchanged into the urine in large amounts and that this is especially true for formic acid.

Explanation of Difference in Action Under Different Conditions

Harnack (132) asserted that methyl alcohol on slow oxidation formed formic acid (133), and that on rapid oxidation carbon dioxide and water were formed. Hence, according to him, when methyl alcohol is oxidized rapidly in the body, it is harmless; this explains the varying toxic action of methyl alcohol upon different species of animals and even upon individuals of the same species (134). Harnack maintained that the action of the formic acid thus formed in the animal organism was stronger than that of pure formic acid introduced into the body, as in the latter case the organism attempts to connect it with bases and thus give rise to formates.

Birch-Hirschfeld (135) experienced great difficulty in keeping animals alive for even short periods when small doses of methyl alcohol were administered at close intervals. He concluded that methyl alcohol was a nerve poison, causing pathologic changes in the ganglia cells of the retina and cornea (136), and a degenerative change in the optic nerve (137).

Acute and Chronic Poisoning by Methyl Alcohol.

Reid Hunt (138) states that the action of methyl alcohol differs from that of ethyl alcohol in that the symptoms are produced more slowly and the intoxication is more prolonged. There are

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- (128) The separation of formic acid reaches its maximum 3-4 days after the poisoning.
 (129) Arch. exp. Path. Pharmacol., 35, 426 (1895).
 (130) Z. physiol. Chem., 7; cited by Hammarsten, "Physiological Chemistry," p. 629 (1908).
 (131) Compt. rend., 104; Hammarsten, *loc. cit.*
 (132) Deutsch. med. Wochschr., 38, 358.
 (133) Formic acid is both an acid and aldehyde, viz., $O=C-OH$, acid; $H-C=O$, aldehyde. As an acid, it is more poisonous than the homologues of its series; on account of its aldehyde properties, it acts as a powerful reducing agent.
 (134) Methyl alcohol is an example of idiosyncrasy; some individuals are immune to it so far as permanent damage to the organism is concerned.
 (135) Centr. Ophth., 1901, 263; Arch. Ophth., 54, 68; Centr. Augenhk., 1902, 280.
 (136) As shown by the disappearance of chromatin vacuols in the protoplasm and the contraction of the cells.
 (137) Causing amblyopia and blindness, the symptoms of which are not similar to any other amblyopia symptoms.
 (138) Johns Hopkins Hosp. Bull., 13, 213 (1902); Hyg. Lab. U. S., Bull. 33.

two forms of methyl alcohol poisoning, acute and chronic. In acute poisoning, the relative toxicity of methyl and ethyl alcohols is almost equal (139); but when the use of methyl alcohol is continued for even a short time, it becomes an extremely dangerous poison. The difference in the toxicity of methyl and ethyl alcohols is due to the property of methyl alcohol to oxidize in the body, producing formic acid, while ethyl alcohol oxidizes rapidly into carbon dioxide and water.

Hollander (140) asserted that methyl alcohol was first oxidized in the body to formaldehyde (141) and then to formic acid.

That the toxicity of methyl alcohol is due to the formic acid into which it is oxidized has been denied by Ball (142), as the symptoms are different; and Kobert (143) stated that no cases of death solely by formic acid had been reported up to 1897.

Influence of Impurities on Toxicity.

Certain investigators maintain that the toxicity of methyl alcohol is due to impurities (144) present. Cololian (145) states that the poisonous properties of methyl alcohol are due to the acetone (146) present; Ohlemann (147) maintains that the toxicity of methyl alcohol is due to the furfural; and a prominent manufacturer, in a private communication to the author, asserts that the toxicity of methyl alcohol is due to allyl alcohol. Likewise, Julius Friedenwald (148), from extended experiments on the comparative toxicity of the various alcoholic beverages, concluded that their poisonous properties were not proportional to the percentage of alcoholic content, but rather to other substances which they contained (149); and recently Vandervelde (150) claimed to have proved experimentally that methyl

(139) The experiments performed by Hunt indicate that death is caused more rapidly by one or two large doses of ethyl alcohol than by corresponding doses of pure methyl alcohol.

(140) Munch. med. Wochschr., 57, 82 (1910).

(141) Formaldehyde is 33 times as toxic as methyl alcohol; 0.24 g. formaldehyde per kg. body weight is fatal to rabbits.

(142) Homeop. Eye, Ear and Throat J., N. Y., 2, 325 (1905).

(143) "Practical Toxicology," p. 83 (1897).

(144) The impurities present in commercial methyl alcohol are chiefly acetone, methyl acetate, dimethyl acetate, furfural, allylic alcohol, homologues and condensation products of acetone, together with oily bodies and other compounds.

(145) J. Physiol. Pathol. gen., 3, 535 (1901).

(146) Acetone, when taken internally, causes paralysis, according to Kobert ("Intoxikationen," p. 586) and Jaksch (Klinische Diagnostik, 1896).

(147) Wochschr. Therap. Hyg. Auges., 1902, Nos. 8, 9, 13.

(148) Trans. Assn. Am. Phys., 26, 61 (1911).

(149) Thus, of the various drinks, liquors and rum are the most toxic, wine is more toxic than whiskey, beer and ale are about as toxic as whiskey.

(150) Bull. Soc. Chim. Belg., 23, 104 (1912).

alcohol, free from all impurities, was less toxic than ethyl alcohol. He asserted that the toxicity of the commercial alcohol was largely due to the presence of impurities (151).

Toxic Action Due to Methyl Alcohol Itself.

On the other hand, Pohl (152) contradicted the supposition that the toxic action of methyl alcohol was due to the acetone present, as the urine of dogs fed on large quantities of it contained but insignificant amounts of formic acid. Hunt was able to produce the same symptoms in animals whether he used pure or impure methyl alcohol, and concluded that its toxic action was due to the alcohol *per se*. Wood (153) stated that methyl alcohol exhibited its toxic properties whenever it was introduced into the human system *in whatever form* (154). Foerster (155) argues that the toxicity of methyl alcohol can not be due to furfural, as the amount of this substance in the alcohol is minute — in fact, less than 0.21 g. per liter (156).

Conclusions.

From the preceding we may draw the following conclusions: *Methyl alcohol is less poisonous to lower plants and infusoria (157) than ethyl alcohol, but for higher animals (158), and especially for man (159), it is a severe toxic agent.* Its poisonous properties are doubtless due, first, to a specific action, and then to its oxidation in the body, first to formaldehyde and then to formic acid (160). It is, furthermore, a cumulative poison (161). It produces toxic effects whether it be taken internally or inhaled through the lungs.

(151) By the plasmolytic method, the iso-toxic quantities are 36.00-37.00 for methyl alcohol and 24.44-25.38 for ethyl alcohol; by hemolysis, the iso-toxic quantities are 100 for ethyl alcohol and greater for methyl alcohol.

(152) Arch. exp. Path. Pharmacol., 31, 281.

(153) Expert Evidence at a Hearing before the Ways and Means Committee on Free Alcohol, Feb.-March, 1906.

(154) Wood and Buller (J. Am. Med. Assn., Oct. 1-29, 1904; Internat. Clinic, 1906, 165; N. Y. Med. J., Jan. 7, 1905; Brit. Med. J., 1906, ii, 1855), report 314 serious cases of methyl alcohol poisoning caused by drinking and inhaling "Columbian spirits," Jamaica ginger, bay rum, "Eau de Cologne," liniments, etc.

(155) Munch. med. Wochschr., 59, 248 (1912).

(156) Pohl (Arch. exp. Pathol. Pharmacol., 1893, 40), found that 0.5 g. of acetone was necessary to produce convulsion in a cat, and 3-4 g. in the case of a large dog.

(157) Buchner, Fuchs and Neagle, Arch. Hyg. Munch., 40, 347 (1901).

(158) See Dujardin and Beumetz-Audige; Pohl; Bungers, Harnack; Hollander; Ball; Holden; Riche; Baudranl Birch-Hirschfeld; Hunt; Atchinson; Lewin; and also De Schweinitz, "Toxic Amblyopias," p. 51 (1896).

(159) Buller and Wood, J. Am. Med. Assn., 1904; Holden, Arch. Augenhk., 40, 351.

(160) See Pohl; Bungers; Schotten; Greehaut and Quinquant; Harnack; Hollander.

(161) See Hunt; Buller and Wood; Stadelmann [Med. Press. and Circ., n. s., 93, 194 (1912)].

It is a matter of little practical importance as to whether *chemically pure* methyl alcohol is toxic or not, as economic reasons prohibit its extended use in the arts and manufacturing industries, although, as pointed out, the purest material is used in certain products. The numerous cases of poisoning prove beyond doubt that the methyl alcohol of commerce is decidedly toxic.

IMPORTANCE OF WOOD ALCOHOL AS A POISON.

History of Methyl Alcohol Poisoning.

The importance of methyl alcohol as a poison began with the introduction of the various "deodorized" grades on the market. Simultaneously with the advent of preparations like "Columbian spirits," "Colonial spirits," "Eagle spirits," etc. (162), a large number of poisoning cases began to be reported in the medical press.

First Cases Reported.

The first fatal case of wood-spirit poisoning reported occurred in London in 1869 and was described by Taylor (163), who also mentioned headache, nausea, sickness, etc., from the inhalation of the vapors. Ten years later, Viger and Menjin (164) reported two prisoners who drank wood alcohol; one died, the other became blind. McCoy and Mitchel (165), in 1898, gave the account of a case in this country; a young man became blind on drinking 60 cc. of methyl alcohol.

Number Increasing.

Beginning in 1899, the number of methyl alcohol poisoning cases increased to a great extent. In 1904, Buller and Wood (166), by sending inquiries to various practitioners throughout the United States, collected 314 serious cases of methyl alcohol intoxication (167). The great majority of these were the result of drinking some form of methylated spirits (168), inhalation form-

(162) Containing from 97-98 per cent. methyl alcohol.

(163) "Poisons," p. 659 (1875).

(164) *L'annee med.*, 1877; *Rec. Ophth.*, 1879, 636.

(165) *N. Y. Med. Rec.*, 53, 28 (1898).

(166) *J. Am. Med. Assn.*, 43, 972, 1058, 1117, 1213, 1289 (1904).

(167) Of these, 158 became blind, while in 156 instances death followed.

(168) The alcohol was taken in the forms of methyl alcohol, "Columbian spirits," "Jamaica ginger," essence of lemon and cinnamon, "Cologne spirits," and alcoholic mixtures containing methyl alcohol.

ing a second important source of the poisoning (169). The statistics gathered were far from complete, as Buller and Wood communicated with but a limited number of practitioners.

Toxic Action on Workmen Employing It.

The deleterious effects of methyl alcohol on workingmen employing it in the industries were prominently brought before the public in 1906, when, at a hearing (170) in the United States Congress, affidavits of 75 hat workers as to injury to eyesight and general health from wood alcohol used as a solvent for shellac (171), were submitted.

As an Adulterant.

In recent years the increased use of methyl alcohol as an adulterant in beverages, etc., has resulted in epidemics occurring in certain localities (172), of which the Sharnack (173) catastrophe in Berlin in 1911 was the most serious.

Number of Poisoning Cases.

We were able to collect over 700 cases (174) of methyl alcohol poisoning reported in the various medical periodicals. This is but a small percentage of the total number, as comparatively few practitioners report cases that come under their observation in the scientific press. Moreover, physicians often fail to recognize such industrial or occupational diseases because these often take the form of chronic poisoning, which shows itself in obscure diseases of the digestive apparatus and nervous system, and are attributed by the patients to other causes.

WHEN USED EXTERNALLY.

Channels Through Which the Poison May Enter the Circulation.

Poisons may enter the body by various channels. The mucous membranes of all parts of the body are absorbent, hence poisons

(169) The chief danger here lies in inhaling wood alcohol fumes and rebreathed air in a confined space; but when the fumes are diluted with a sufficient quantity of pure air, the inhalation is not dangerous to life or eyesight.

(170) Hearing before Ways and Means Committee, 59th Congress, 1st Session, Feb.-March, 1906.

(171) Used in the hat stiffening department.

(172) Koller (Med. Rec., 68, 10), reported 25 deaths in New York City in 1905 due to drinking whiskey adulterated with methyl alcohol. Kassas (Novoje Medizinske, 1908, 357) and Sinkowitch (Kasan, Medizinski J., 1908, 399) give an account of 47 wood alcohol poisoning cases in Russia in 1908.

(173) See Stadelmann and Magnus-Levy [Berl. Klin. Wochschr., 48, 193 (1912)] for a complete account.

(174) See pages 1004-07, 1007-1034, 1034-1042.

may operate toxically by contact with the mucous membrane of the nose, eye, vagina or rectum. The channels of entrance enumerated in the order of their importance are: the mouth and into the stomach; the air passages and lungs; the skin and cellular membrane; the blood vessels, including wounds; and the intestines.

When Externally Applied.

In 1875, Taylor (175) stated that poisons may be absorbed by the skin, the process depending upon the nature of the poison and upon the texture of the surface of the part to which they are applied. The following circumstances favor the absorption: removal of the cuticle, abrasions or wounds of the skin, when the substance acts chemically on the skin (176), and the solution of the poison in alcohol, ether, or chloroform. In general, poisoning through the skin is slower in appearing, but resembles poisoning through the stomach (177).

Diffusion of Liquids Through the Skin.

The skin, with its cuticle or epidermis intact, is pervious only to substances which are soluble both in lipoids and water (178); but, according to Lehmann (179), the degree of solubility need not be high, *e. g.*, nitrobenzene, which is sparingly soluble in water, is absorbed by the uninjured skin of the cat. Gallard (180) showed that after the immersion of the arms in 5 per cent. sodium iodide solution for a half-hour daily, the urine of the succeeding 24 hours contained 0.066-3.863 mg. of iodine; and Kahlenberg (181) proved that traces of boric acid appeared in the urine within 5 minutes and estimable quantities within 10 minutes, by immersion of the feet in a saturated solution of boric acid. According to Witthaus and Becker (182), the abraded skin, exposing the very vascular subcutaneous cellular tissue, becomes a very active absorbent surface, and solutions applied to it are, to all intents and purposes, under almost the same conditions as when hypodermically injected.

(175) "Poisons," p. 9 (1875).

(176) So as to soften or dissolve the cuticle and expose the cellular membrane beneath.

(177) For cases of poisoning through the skin, see *Ann. d'Hygiene*, 1830, 2, 437; 1846, 2, 131; 1859, 2, 29; 1867, 2, 194; *Lancet*, 1871, (1), 735, 805; (2), 537.

(178) Schwenkenbecher, *Arch. f. Ann. Physiol. Phys. Abt.*, 1904, 121.

(179) *Beitr. Z. Physiol. Path.*, cited by Hermann, 1908, 130.

(180) *Compt. rend.*, 1900, 858.

(181) *Proc. Am. Soc. Biol. Chem.*, 1, 118 (1908).

(182) "Medical Jurisprudence, Forensic Medicine and Toxicology," 4, p. 86 (1911).

Action of Methyl Alcohol on the Skin.

Some poisons act directly upon the skin, producing dermatitis, which, in a mild form, may be limited to a simple redness or erythema, attended with more or less itching, and going on to the formation of visicles, pustules, or bullæ, and, in extreme cases, even gangrene (183).

Raether (184) asserted that methyl alcohol had an irritative action on the skin, due to its property of absorbing water. Fawcitt (185) observed that when methyl alcohol got on the hands no peculiar sensation was experienced unless afterwards the hands were washed in cold water, when intense pain was felt between the fingers where the skin was tender.

Cases in Illustration.

Von Gall, president of the Hat Manufacturers' Association of Danbury and Bethel, Conn., observed, in the case of the operatives in the stiffening room in hat factories, that the wood alcohol acted upon them externally, but he remarked that the action was slower than when taken internally (186). The testimony of the Federal Hat Co. was submitted at a hearing before the United States Congress (187) that wood alcohol caused injury to the hands of their employees. The R. Dunlap Hat Co. (188) also testified that wood alcohol in shellac caused injury to the hands of their employees who immersed their hands in the poison during the process of stiffening. The *Painters' Magazine* of December, 1905, warned the trade of the dangers of wood alcohol through the absorption by the skin.

PUBLISHED CASES OF POISONING BY THE EXTERNAL
USE OF METHYL ALCOHOL.

Case No. 1 (189). J. J. McDonald, age 33, hat stiffener; employed in hat stiffening, using shellac, dissolved in wood alcohol, for seven years.

Result: Itchy rash on back of hands.

(183) See Witthaus and Becker, *loc. cit.*

(184) Dissertation, Tübingen, 1905.

(185) *J. Soc. Chem. Ind.*, 22, 685.

(186) Hearing before Ways and Means Committee on Free Alcohol, 1906.

(187) *Ibid.*

(188) *Ibid.*

(189) *Ibid.*

Case No. 2 (190). M. E. Connor, age 23, hat stiffener (Kings County Factory); employed at present occupation three years; wood alcohol is used to "cut" the shellac.

Result: Hands inflamed and itch.

Case No. 3 (191). J. W. Schenck, age 35, hat stiffener (Kings County); employed at stiffening for 10 years, using wood alcohol to dissolve the shellac.

Result: Arms and hands irritated.

Case No. 4 (192). A healthy woman, age 58, washed head and face with wood alcohol daily. No history of blindness.

Result: Vision became impaired; V.R.= 8/20; V.L.= 8/20.

Case No. 5 (193). A painter, age 39, used wood alcohol to wash varnish from hands every day after work.

Result: Became totally blind and has remained blind.

Case No. 6 (194). A distributor of paints and alcohol in store-room of paint factory, age 53, spilled a quart of wood alcohol on his feet and floor, and remained in same room for some hours.

Result: Became totally blind.

Case No. 7 (195). A photographer, age 32, cleaned plates with wood alcohol.

Result: Was seized with paralysis of arms and legs, pain in sides and decrease in sight. Died after some time.

(190, 191) Hearing before Ways and Means Committee, 59th Congress, 1st Session, Feb.-March, 1906.

(192) Conboy, J. Michigan Med. Soc., 3, 536.

(193) De Schweinitz, Ophth. Rec., 1901, 349.

(194) Phillips, *Idem*, 15, 538.

(195) Gifford, *Idem*, 15, 274.

CHAPTER V

INVESTIGATIONAL EVIDENCE AND RECOMMENDATIONS.

Hearings Before the United States Congress.

Until recently, the poisoning occurring among workmen in industries wherein wood alcohol is employed had received but meagre attention in this country. In 1906, due to a general agitation for a tax-free denatured alcohol, hearings were held on free alcohol before the Ways and Means and Finance Committees in the United States Congress (196). At these hearings the deleterious action of wood alcohol on the general health and eyesight of workingmen employing it in the industries was prominently brought before the public by the testimony of manufacturers, workingmen and experts. An abstracted account of the proceedings relative to wood alcohol follows.

STATEMENTS OF MANUFACTURERS.

Piano Manufacturers.

H. P. Mehlin, President of the National Piano Manufacturers' Association of America, testified that wood alcohol, as used in shellac and varnish in the manufacturing of pianos, was injurious to the health of the workingmen employing it.

Hat Manufacturers.

The Hat Manufacturers' Association was represented by Charles H. Merritt, Chairman of the Committee of the Fur Hat Manufacturers' Association of Danbury, Conn., who stated that competition forced them to employ wood alcohol in the hat industry, as it was much cheaper than grain alcohol; but its employment caused serious interruption to business on account of affecting the eyes and health of the operatives. In addition, he submitted the following statements from individual manufacturers:—

Crofut & Knapp Co. Wood alcohol is detrimental to the health of our employees. One man was obliged to give up work

(196) Hearing on Free Alcohol before the Ways and Means Committee, 59th Congress, 1st Session, Feb.-March, 1906.

entirely, owing to the effect on his eyes; several laid off temporarily for the same reason.

New Milford Hat Co. The use of wood alcohol has been detrimental to the health of our employees. It affects the eyesight of every man in the department.

It has necessitated the stopping of work by some men for days at a time.

Guyer Hat Co. The use of wood alcohol is detrimental to some extent; one man died from the effects.

Frank Shople Co. It is painful to the eyes of employees and injurious to their health. Our hat stiffeners are not able to work full time.

National Hat Co. It is detrimental to the health of the operatives. The men are obliged to stop work, sometimes for a day and frequently parts of days.

Seth Reed, one of our stiffeners, was disabled from the wood alcohol.

Hawes, Von Gal Co. It is detrimental to the health and eyesight of our employees in the hat stiffening department. Stiffening is stopped on the average one day a week. Dobbs, Maggersuppe, Arnold and Stevens were disabled from wood alcohol vapor.

David Higson Co. It is detrimental to the health and eyesight of our employees, and the men are blinded by fumes. It causes delay and some give up for good.

Bethel Manufacturing Co. It is detrimental to the health and eyesight of our employees. The men are unable to work 1-3 days at a time. Cases of disablement: Megnerey, Slade, Euvrard, and Judson.

Connet Hat Co. The wood alcohol is detrimental to the health and eyesight of our employees. The men are unable to work several days at a time. Specific cases of disablement: Brookes, Collins, Cooper, Keeler, and Neal.

Hoyt, Wolthansen Corporation. The wood alcohol causes blindness and delay of the work.

Federal Hat Co. Stiffeners become blind; the hands are irritated and itch.

Danbury Hat Co.; Millard Hat Co.; S. A. G. Hat Co.; H. M. Lachlan & Co.; John W. Green & Sons. Everyone who works in the room where the alcohol is used has trouble with his eyes.

Beltaire Bros. & Co. It is detrimental to the health of the operatives and causes delay.

Price and Vogt. It is detrimental to the health of our employees. Specific cases: Sherwood, Gustafson and Lane.

Bordt, Untiedt Co. The men were broken down in health; their eyes were almost ruined.

Judd & Dunning Hat Co.; J. Rummel & Co.; John B. Stetson Co. The eyes and stomachs of our employees are affected.

Edwin Short Hat Co.; R. Dunlap & Co. Causes blindness, and injured arms and hands.

James Marshall & Bro. Detrimental; causes delay.

Lee Hat Mfg. Co. Have to discontinue work at times.

S. C. Hollery & Co. All employees using wood alcohol have intense pain in eyes; have to use cocain to relieve pain.

Volk Hat Co. Detrimental; causes delay. Specific case: Andrews.

Judd & Co. It is detrimental to the health of the operatives and causes delay.

W. B. Hubbel. It is detrimental to the health of the employees and causes delay. Lamson and Hubbard had to give up work.

Van Gall, President of the Hat Manufacturers' Association of Danbury and Bethel, Conn., stated that wood alcohol vapors caused injury to the general health and eyesight of the employees. He asserted that wood alcohol acted externally just the same as

internally, only slower. On the other hand, the manufacturers of wood alcohol claimed that this alcohol acted as a poison only when taken internally, and that their employees were not affected by its vapors.

EVIDENCE SUBMITTED BY WORKMEN.

Evidence of Workmen.

The affidavits of 75 hat workers as to injury from wood alcohol, used as a solvent for shellac in hat stiffening, were submitted (197). All of these men complained of inflammation of the eyes, with intense pain, causing them to lay off from work at least one-third of the time. Other complaints were pain in the stomach, nausea, inflammation of the mucous membranes of the throat and nose, catarrh, headache, cough, nervous exhaustion, irritation and itching of the skin of arms and hands, etc. Also, two physicians' statements of injuries from using wood alcohol in the industries were submitted (198). These physicians reported seven cases in which the men were forced to discontinue work in the stiffening department owing to the effects of the wood alcohol on their eyesight and general health; and eight cases where the men were still employed in stiffening hats with shellac "cut" with wood alcohol and showed the deleterious effects of the alcohol. They stated that the action of the wood alcohol is constitutional. None of the above men used stimulants to excess and many used them in moderation.

Louis F. Mignory, a hat worker of Danbury, Conn., stated that wood alcohol fumes made him blind temporarily and that he considered it a crime to require a man to work with it. C. E. White, another hat worker, said that wood alcohol made him blind.

Painters.

Bedell, a painter from Lynn, Mass., testified that he was totally blind from using wood alcohol to clean furniture in a small room. Statements from three other painters who became blind from using wood alcohol were submitted.

(197) See Appendix A, p. 995, for affidavits. *

(198) See Appendix B, p. 998.

EXPERT EVIDENCE.

Expert Evidence of C. A. Wood.

Casey A. Wood, Professor of Ophthalmology in the Chicago Post-Graduate Medical School, testified as to the injurious qualities of wood alcohol; he attributed the poisoning to:—

1. *Drinking the methyl alcohol.*

(a) Employees in factories using “Columbian spirits” and other forms of “deodorized” methyl alcohol are frequently tempted to drink the fluid. First, because the “deodorized” forms of methyl alcohol are hardly distinguishable by the layman from grain alcohol; and, second, methyl alcohol is an example of idiosyncrasy, just as in the case of some other poisons, some individuals being immune to it so far as permanent damage to the organism is concerned. Due to the above, employees become careless and drink the spirit.

(b) Drinking of methyl alcohol by soldiers, sailors, Indians, etc., who are unable to obtain grain alcohol easily.

(c) Adulteration of alcoholic beverages, alcoholic extracts, etc., with methyl alcohol, is still going on (199), and is responsible for more deaths and blindness than is brought about by all the other forms combined.

2. *Inhaling methyl alcohol in a confined, badly ventilated space.*

The chief danger here lies in inhaling wood alcohol fumes and rebreathed air in a confined space. Cases of blindness, etc., from the absorption of methyl alcohol by the lungs and skin are reported by Wood (200). If the wood alcohol fumes are diluted with a sufficient quantity of pure air, the inhalation is not dangerous to life and eyesight.

3. *Using methyl alcohol for external use; washes, liniments, etc.*

It is not always easy to detect some of the evil results of the poison on workers with methyl alcohol. The effects often take the

(199) Methyl alcohol exhibits its toxic properties whenever it is introduced into the human system in whatever form. Wood and Buller reported (Feb., 1908) 314 serious cases of methyl alcohol intoxication; of these, 158 became blind, while in 156 instances death followed. The general majority of these were the result of drinking some form of methylated spirits.

(200) J. Am. Med. Assn., Oct. 1-29, 1904; Internat. Clinic, 1906, 165; N. Y. Med. J., Jan. 7, 1905; Brit. Med. J., 1906, ii, 1855.

form of chronic poisoning, which shows itself in obscure diseases of the digestive organs and nervous system, and are attributed by the patients to other causes.

Wood's Recommendation.

Wood recommended a strict prohibition of the manufacture or sale of "deodorized" wood alcohol, and the substitution of an untaxed methylated spirit, corresponding to that of Great Britain, or the *Breunspiritus* of Germany, or a slightly taxed pure ethyl alcohol for commercial purposes.

As a result of a similar investigation, the following bill was proposed in the Austrian Reichstag in 1910:—

1. Wood alcohol is a poison, must be kept in sealed vessels, and sold by responsible persons. The vessels containing it should bear a label, "Poisonous, not to be used externally."

2. The use of methyl alcohol in foods, beverages, cosmetics, and medicinal preparations, is prohibited.

3. The technical use of methyl alcohol is to be limited so that it shall not be inhaled by workmen or their hands be in contact with it.

4. Wood alcohol should not be used as a denaturing substance for spirit; its place should be taken by a non-toxic preparation which will make the spirit undrinkable (201).

Prussia and Hungary, following the example set by Austria, prohibited the free sale of methyl alcohol in 1911 (202).

INDEPENDENT RECOMMENDATIONS.

Recommendations by Organizations.

At various times, individual experts and societies have recommended the limitation of the sale and use of methyl alcohol.

Thus, in 1906, at a meeting of the New England Ophthalmologic Society, a resolution was made that denatured alcohol should be used instead of wood alcohol, as the latter, on account of its poisonous properties, causes blindness of the workingmen employing it.

(201) Jaksch, *Amstszarz.*, 2, 27 (1910).

(202) *Vide* Chapter VI, p. 989.

The American Medical Association (Section Ophthal., 1905) passed a resolution calling upon the various State and Federal authorities to place wood alcohol preparations on the list of poisons.

Local Union 111 of the Brotherhood of Painters, Decorators and Paperhangers of America, in 1905, voted that the use of wood alcohol in paints, shellac, and varnish be prohibited, and the members were warned against the use of it (203).

Recommendations of Individuals.

H. W. Wiley (204) recommended that laws be passed prohibiting the use of methyl alcohol for internal and external purposes, and providing that labels be pasted on vessels containing it, advising people of its danger.

W. M. Carhart (205) recommended that workers using shellac or wood alcohol be permitted to leave their work at frequent intervals and to have much shorter hours of such work.

F. C. Godbold, President of the Louisiana Pharm. Assn. (1905), recommended the passage of stringent laws to prohibit the use of wood alcohol in Louisiana.

Thomas Tyrer (206) urged the lowering of duty on grain alcohol so that it could be used instead of wood alcohol.

Frank Buller (207) recommended that all wood alcohol preparations be labeled with "*This liquid taken internally is likely to cause blindness.*" He believed that such a statement would be more effective than the skull and cross-bones, as people are more afraid of blindness than of even death.

J. P. Atchinson (208) recommended the passage of a bill prohibiting the use of methyl alcohol for internal or external use as a beverage or medicine.

J. H. Ball (209) recommended that the government should control the production of methyl alcohol, making it obligatory that it be marketed in a form undrinkable and impossible to use in any way as a substitute for ethyl alcohol.

(203) Hawes, Boston Med. Surg. J., 153, 525 (1905).

(204) N. Y. Med. J., 80, 1009 (1904).

(205) Am. Med., 3, 176 (1908); Man. Eye and Ear Hosp. Rep., 10, 67 (1909).

(206) Chem. and Drug., May, 1912; Chem. News, July, 1912.

(207) Montreal Med. J., 33, 29.

(208) N. Y. State J. Med., 5, 127 (1905).

(209) Homeop. Eye, Ear and Throat J., 11, 325 (1905).

S. W. Abbott (210) recommended that a law be passed requiring all vessels containing wood alcohol to be labeled "Poison" and to be sold by licensed pharmacists who should record each sale.

C. Koller (211) recommended that a law be passed forbidding the use of methyl alcohol in "essences" and proprietary medicines which might be the means of poisoning persons not addicted to the use of intoxicating drinks and who were entirely ignorant of the dangers to which they were exposed.

Reid Hunt (212) attributed the large number of methyl alcohol poisoning cases in the last few years to the fact that wood alcohol was frequently used as a substitute for ethyl alcohol, viz., in the arts (as varnishes, etc.), for external use (as bay rum), and in medicinal or flavoring agents ("essence of Jamaica ginger," peppermint, etc.)

Recent Inspection in the State of New York.

Under the authorization of the Factory Investigating Commission of the State of New York, a number of wood distillation plants, refineries, and establishments wherein the processes involved the use of wood alcohol, were inspected by Dr. George M. Price, Dr. F. E. Breithut, who acted as chemical advisor, and Miss Grace Potter. The results of this inspection, which are presented in full in a separate report by Dr. Price, substantiate the main evidence and support the principal recommendations given above.

(210) Boston Med. Surg. J., 1903, 63.

(211) Mt. Sinai Hosp. Rep., 4, 376 (1905).

(212) J. Hopkins Bull., 1902, 13, 213; Ophth. Rec., 1903, 34.

CHAPTER VI

LEGISLATION PERTAINING TO METHYL ALCOHOL

This subject may be conveniently divided as follows:—

1. Legislation in the United States.

(1) Federal Acts and Regulations.

(2) State Laws.

(3) Municipal Ordinances.

2. Legislation in Certain Foreign Countries.

1. LEGISLATION IN THE UNITED STATES.

(1) FEDERAL ACTS AND REGULATIONS.

(a) Concerning the Use of Denatured Alcohol.

The United States Prohibits the Use of Denatured Alcohol as a Beverage or in Liquid Medicinal Preparations.

Section 1. From January 1, 1907, domestic alcohol may be withdrawn from bond without the payment of internal revenue tax, for the use in the arts and industries, and for fuel, light, and power, provided said alcohol shall have been mixed, in the presence of a Government officer, after withdrawal from the distillery warehouse, with *methyl alcohol*, or other denaturing material or materials, which will destroy its character as a beverage and render it unfit for liquid medicinal preparations. (Regulations as to the denaturation are given.)

Section 60. Any one using denatured alcohol for the manufacture of any beverage or liquid medicinal preparation, or who knowingly sells any beverage or liquid medicinal preparation, made in whole or in part from such alcohol, becomes subject to

the penalties prescribed in Section 2 of the Act of June 7, 1906 (*q. v.*).

(*Federal Statutes*, Act of June 7, 1906, Chap. 3047, 34 Stat. L. 217.)

(b) The Adulteration and Misbranding of Foods.

Federal Food Law.

The term "food," as used in the Federal Food and Drugs Act (213), includes all articles used for food, drink, confectionery or condiment by man or other animals, whether simple, mixed or compound. According to the Act, food is deemed to be adulterated if any substance has been mixed with or packed with it so as to reduce or lower or injuriously affect its quality or strength; if any substance has been substituted, wholly or in part, for the article; if any valuable constituent of the article has been wholly or in part abstracted; or if it contain added poisonous or other added deleterious ingredient which may render such article injurious to health.

Food is deemed to be misbranded if it be an imitation of or offered for sale under the distinctive name of another article; if it be labelled or branded so as to deceive or mislead the purchaser, or purport to be a foreign product when not so, or when the contents of the package as originally put up shall have been removed in whole or in part and other contents shall have been placed in such package.

RELEVANT JUDGMENTS UNDER THE ACT.

Methyl Alcohol in Flavors.

Judgment No. 277, Food and Drugs Act, relates to a case of adulteration and misbranding of lemon flavor. It was charged that the product was adulterated within the meaning of the Act, in that it contained an added *poisonous* ingredient, namely, methyl alcohol. (F. & D. No. 909; I. S. No. 10376-a, issued May 6, 1910.)

(213) For further particulars concerning the Federal Food and Drugs Act, see Chapter 3915, Public Acts of the 59th Congress of the United States, p. 768: *United States Statutes at Large*, vol. 34, 1. This Act was approved June 30, 1906, and amended in 1912.

Judgment No. 627, Food and Drugs Act, pertains to a case of adulteration of lemon flavor. It was charged that the product was adulterated, in that it consisted of a highly dilute solution of citral in methyl alcohol, etc. (F. & D. No. 1618; I. S. No. 10398-b, issued November 12, 1910.)

Bitters.

Judgment No. 1284, Food and Drugs Act, pertains to a case of adulteration and misbranding of a bitters, and to a case of misbranding of another bitters. Adulteration was alleged in the information against the first product, because it contained an added *poisonous and deleterious* ingredient which might render such article injurious to health, to-wit, methyl alcohol, which methyl alcohol was not a preservative applied externally in the preparation of the said article for shipment. In the second case misbranding was alleged, because the product was labelled so as to mislead the purchaser, in that . . . said label bore no statement of the quantity or proportion of alcohol contained therein. In these two cases of bitters, the first contained 33.6 per cent. of total alcohol by volume, of which about 2.9 per cent. was methyl alcohol; and the second contained 47.44 per cent. of total alcohol by volume, of which 6.4 per cent. was methyl alcohol. (F. & D. No. 2158; I. S. Nos. 1477-c and 1478-c, issued April 4, 1912.)

Liqueurs.

Judgment No. 1703, Food and Drugs Act, refers to a case of adulteration of a liqueur. The product contained an added *poisonous and deleterious* ingredient, to-wit, wood alcohol, which rendered it injurious to health. (F. & D. No. 3621; S. No. 1330, issued October 17, 1912.)

Judgment No. 1704, Food and Drugs Act, relates to the adulteration of a liqueur. Adulteration was alleged in the libel for the reason that the product contained an added *poisonous and deleterious* ingredient, to-wit, wood alcohol, which rendered it injurious to health. (F. & D. No. 3612, S. No. 1327, issued October 17, 1912. See also F. & D. No. 3640; I. S. No. 18713-d; Judgment No. 1754.)

(c) The Adulteration and Misbranding of Drugs.

Federal Drug Law.

The term "drug," as used in the Act, includes all medicines and preparations recognized in the "United States Pharmacopoeia" or "National Formulary," for internal or external use, and any substance or mixture of substances intended to be used for the cure, mitigation, or prevention of diseases of either man or other animals.

When a drug is sold under or by a name recognized in the "United States Pharmacopoeia" or "National Formulary," it is deemed to be adulterated if it differs from the standard of strength, quality, or purity as determined by the tests laid down in the "United States Pharmacopoeia" or "National Formulary" official at the time of the investigation: Provided, that no drug defined in the "United States Pharmacopoeia" or "National Formulary" shall be deemed to be adulterated under this provision if the standard of strength, quality, or purity be plainly stated upon the bottle, box, or other container thereof, although the standard may differ from that determined by the tests laid down in the "United States Pharmacopoeia" or "National Formulary."

A drug is also deemed to be adulterated if its strength or purity fall below the professed standard or quality under which it is sold.

A drug is deemed to be misbranded if it be in imitation of or offered for sale under the name of another article; if the contents of the package as originally put up shall have been removed, in whole or in part, and other contents shall have been placed in such package; or if the package fail to bear a statement on the label of the quantity of *any alcohol* present therein. To quote from Section 8, Drugs, Second:

A drug shall be deemed to be misbranded, . . . if the package fail to bear a statement on the label of the quantity or proportion of any alcohol . . . or of any derivative or preparation of any such substances contained therein.

(On the standards for drugs, see Section 7 of Regulation 7.)

For cases in point, see *United States v. Knowlton Danderine Co.*, 170 Fed., 449; 175 Fed., 1022; *United States v. American Druggists Syndicate*, 186 Fed., 387.

Meaning of the Term Alcohol.

In the *Federal and Drugs Act*, the term "alcohol" is defined to mean common or ethyl alcohol. No other kind of alcohol is permissible in the manufacture of drugs, except as provided in the "*United States Pharmacopoeia*," or "*National Formulary*" (Regulation 28, a).

RELEVANT JUDGMENTS UNDER THE ACT.

Hair Tonics.

Judgment No. 319, Food and Drugs Act, refers to the misbranding of hair tonics. The hair tonic examined was stated to contain "pure Columbian Spirit;" it was held to be misbranded in that it contained 98.5 per cent of methyl alcohol, and failed to bear a statement of the quantity or proportion of the alcohol contained therein on the label. (F. & D. No. 721; I. S. No. 17580-a, issued May 26, 1910.)

Judgment No. 1673, Food and Drugs Act, pertains to the misbranding of a hair tonic, wherein the allegation was made for the reason that the product failed to bear a statement upon the label as to the quantity of alcohol contained therein. (F. & D. No. 2229; I. S. Nos. 5970-c, 5971-c, issued September 27, 1912.)

On the declaration of the quantity or proportion of alcohol present in drug products, see also F. I. D. Nos. 54, 57, 63, 85, and 94; the above are given merely as typical cases in point.

(2) STATE LAWS.

Special Laws Not Enacted in Some States.

In this sub-section, statutes and State regulations relating to the manufacture, sale and use of methyl alcohol, and of preparations containing methyl alcohol, are given. In general, it may be said that only those statutes are included which differ, wholly or in part, from the Federal Food and Drugs Act; but it should be borne in mind that, speaking broadly, most statutes have been based upon the Federal Act, and that the latter initiated legislation in this direction in the majority of the States.

Federal rules, regulations, and definitions apply in Delaware (*Laws of 1907*, Chapter 160), Nevada (*Laws of 1909*, Chapter 101; *Revised Laws*, 1912), South Dakota, and Texas. In Arkansas, Federal regulations likewise apply, and the Food and

Drugs Act is modeled after the Federal Act (see *Supplement to Kirby's Digest*, 1911); and in California, Missouri, Nebraska, and Rhode Island, the provisions and regulations are similar to the Federal regulations. The laws of these States are not included in the following digest.

Alabama.

Alabama Prohibits the Sale of Any Preparation or Product Containing Methyl Alcohol Intended for Internal or External Consumption.

It shall be unlawful to sell, offer, or expose for sale, or otherwise dispose of or have in possession, any preparation or product intended for the use of man, either for internal or external purposes, which contains methyl alcohol or wood spirits.

[*Code of Alabama (Criminal)*, 1907, Sec. 7554.]

Colorado.

Colorado Prohibits the Use of Wood Alcohol in Preparations for Internal and External Human Use.

The use of the "very poisonous" methyl alcohol (wood alcohol, Colonial or Columbian Spirit), is prohibited in all preparations for internal or external use, as regards the human body. This prohibition includes extracts, beverages, washes, perfumes, cosmetics, etc.

(NOTE: Federal rules and regulations apply to drugs containing wood or methyl alcohol, so far as applicable.)

(The Food and Drugs Act of 1908; Chapter 1, *Session Laws of 1907*; Chapter 1, Sections 1-10, *Revised Statutes of 1908*; Vol. 2, Chapter 1, Sections 1-10, *Annotated Statutes of 1911*.)

Connecticut.

Connecticut Provides that all Vessels Containing Methyl Alcohol be Labelled "Poison." (Exception is made in Case of Practising Physicians, Licensed Pharmacists who sell it Wholesale, and for use in Manufacture or for the Arts).

Be it enacted by the Senate and House of Representatives in General Assembly Convened:

Section 4734 of the *General Statutes* is hereby amended by adding at the end of Schedule A, accompanying said Section, the words

“wood or methylic alcohol under any name or in any mixture,” so that said section as amended shall read as follows: “Every person who shall sell any of the articles named in the schedule accompanying this schedule, marked Schedule A, except when prescribed by a practising physician, or sold at wholesale to licensed pharmacists, or for use in manufacture or for the arts, shall label the bottle, box or wrapper containing any such article with a label upon which shall be plainly written or printed the word ‘poison,’ and any person violating the provisions of this section shall be fined one dollar. *Schedule A:—Acid Carbolic, Ammoniated Mercury, Hydrochloric Acid, Chloroform, Nitric Acid, etc., Wood or Methylic Alcohol under any name or in any mixture.*”

(*Public Acts of Connecticut, 1905, Sec. 4734, p. 298.*)

Connecticut Prohibits the use of Wood Alcohol in Food and Drugs, Except as Specified in the “U. S. Pharmacopoeia” or “National Formulary.”

The term “alcohol” is defined to mean common or ethyl alcohol. No other kind of alcohol is permissible in the manufacture of food products or of drugs, except as specified in the “United States Pharmacopoeia” or “National Formulary.”

(The Food and Drugs Act of 1907; Chapter 255, *Public Acts of 1907*; amended by Chapter 178, *Public Acts of 1909.*)

Florida.

Florida Requires that all Food and Drugs Shall be Labelled Stating the Quantity and Proportion of any Alcohol Contained Therein.

An article of food shall be deemed to be misbranded, . . . if (it) fail to bear a statement on the label in conspicuous letters of the quantity or proportion of any alcohol. . . .

(Section 5, *Food*, Second.)

A drug or food product is misbranded in case it fails to bear a statement on the label in conspicuous letters of the quantity or proportion of any alcohol. . . .

(Regulation 28, c.)

No Alcohol Except Ethyl Alcohol shall be Used in Drugs or Food, Except as Provided in the "U. S. Pharmacopoeia" or "National Formulary."

The term "alcohol" is defined to mean common or ethyl alcohol. No other kind of alcohol is permissible in the manufacture of drugs or foods except as specified in the "United States Pharmacopoeia" or "National Formulary."

(Regulation 28, A.)

(On the Pure Food and Drugs Law of Florida, see Chapter 6122, *Acts of 1911*; modeled after the Federal Law.)

Georgia.

Georgia Prohibits the Sale of Wood or Denatured Alcohol, Except by Licensed Druggists, for use in the Arts, or for Scientific and Mechanical Purposes.

Nothing in the preceding sections of this article shall prohibit the sale, by licensed druggists, of wood or denatured alcohol for art, scientific or mechanical purposes.

(*Code of the State of Georgia*, 1911, Sec. 431, Art. 14.)

Definition of "Alcohol."

The term alcohol is defined to mean ethyl alcohol, of the degree of refinement in the "U. S. Pharmacopoeia."

(Ruling 16, 6, the *Drugs Act*.)

Idaho.

Idaho Deems any Article of Food to be Adulterated if it Contains any Wood Alcohol.

That, for the purpose of this Act, an article shall be deemed to be adulterated:—

In case of Food:

7. If it contains methyl or wood alcohol or any of its forms.

(Bull. No. 9, pp. 5-6, of the Dept. of Foods, Drugs and Hotel Inspection, Boise, Idaho, May, 1911; *Laws of 1911*, Chap. 196; House Bill No. 213, Section 5.)

*Illinois.**Illinois Prohibits the Use of Wood Alcohol in Drinks.*

No person shall, within this State, by himself, his agent, or servant, or as a servant or agent of any other person or corporation, manufacture, brew, distil, have or offer for sale, or sell any spirituous or fermented or malt liquor, containing any drug, substance, or ingredient not healthful or not normally existing in said spirituous, fermented or malt liquor, or which may be deleterious or detrimental to health when liquors are used as a beverage, and the following drugs, substances, or ingredients shall be deemed to be not healthful and shall be deemed to be deleterious or detrimental to health when contained in such liquors, to-wit . . . *methyl alcohol and its derivatives.*

(Section 14, Chapter 127b, *Revised Statutes of 1911.*)

Penalty.

Whoever adulterates, for the purpose of sale, any liquor used or intended for drink with . . . substances which are poisonous or injurious to health; and whoever sells or offers or keeps for sale any such liquor so adulterated, shall be confined in the county jail not exceeding one year, or fined not exceeding one thousand dollars, or both.

(Section 8, Chapter 38, *Revised Statutes of 1911.*)

Illinois Provides That No Food, Drink or Medicine Shall be Mixed With Other Substances Unless they Bear a Notice to This Effect on the Label.

No person shall mix . . . any article of food, drink or medicine, or any article which enters into the composition of food, drink or medicine, with any other ingredient or material, whether injurious to health or not, for the purpose of gain or profit, or sell, or offer the same for sale, or order, or permit any other person to sell or offer for sale any article so mixed . . . , unless the same be so manufactured, used or sold or offered for sale under its true and appropriate name, and notice that the same is mixed or impure is marked, printed or stamped upon each package, roll, parcel or vessel containing the same, so as to be and remain at all times readily visible, or unless the per-

son purchasing the same is fully informed by the seller of the true name and ingredient (if other than such as are known by the common name thereof) of such article of food, drink or medicine, at the time of making sale thereof or offering to sell the same.

(Section 9j, Chapter 38, *Revised Statutes of 1911.*)

Iowa.

Iowa Prohibits the Sale of Any Preparations Containing Wood Alcohol for the Use of Man or Domestic Animals, Internally or Externally.

No person, firm or corporation shall sell, offer or expose for sale, or have in his possession any preparation or product intended for the use of man or domestic animals, either for internal or external use, or for cosmetic purposes, or for inhalation, or for perfumes, which contain methyl (wood) alcohol, crude or refined, or denatured alcohol.

(Sec. 4999-a 36, Chap. 10-b, *Suppl. to Code, 1907.*)

Iowa Excludes Denatured Alcohol from the List of Poisons, Removing it from the Statutes Relating to the Sale and Handling of Poisonous Substances (1909).

That the law as it appears in Section 2593 of the *Supplement to the Code, 1907*, be amended by striking from line nine thereof the words "denatured alcohol."

Denatured alcohol shall not be deemed to be a poison within the meaning of the statutes relating to the sale or handling of poisons.

(*Laws of Iowa*, Chapter 162, Section 1, 1909, 33 C. A.)

Kansas.

Kansas Prohibits the Use of Wood Alcohol in Pharmacy, Except as Provided in the "U. S. Pharmacopoeia" or "National Formulary."

The term "alcohol" is defined to mean common or ethyl alcohol. No other kind of alcohol is permissible in the manufacture of drugs, except as specified in "The United States Pharmacopoeia" or "National Formulary."

(*Pharmacy Law*, 1909, Chap. 8095.)

Kentucky.

Kentucky Prohibits the Use of Wood Alcohol in Drugs, Except as Provided in Reg. 9.

The term "alcohol" is defined to mean ethyl alcohol, of the degree of refinement required in the Pharmacopoeia. No other kind of alcohol is permissible in the manufacture of drugs, except as specified in Regulation 9.

(Regulation 9, *Acts of 1908*, amended by *Acts of 1910*.)

It has been found by the inspector that the dealers have been using what is known as commercial alcohol in the manufacturing of drugs. Commercial alcohol does not meet the requirements of the Pharmacopoeia for freedom from aldehyde and fusel oil, and under the law can not be used. The dealer should insist that the wholesaler or jobber supply him with the United States Pharmacopoeial alcohol. (Bulletin No. 144.)

Louisiana.

Louisiana Prohibits the Use of Wood Alcohol in Drugs, Except as Provided in the "U. S. Pharmacopoeia."

The use of methyl alcohol, refined or otherwise, in the manufacture of drugs, is prohibited, except as provided in the "United States Pharmacopoeia."

(Secretary of the State Board of Health.)

No other kind of alcohol than ethyl alcohol is permissible in the manufacture of drugs, foods, liquors, or waters, except as specified in the "United States Pharmacopoeia" or "National Formulary."

(Act No. 98, *Acts of 1906*.)

Maryland.

Maryland Prohibits the Use of Methyl Alcohol in Flavoring Extracts, Essences and Fluids Used for Flavoring Articles of Food or Drink.

No person, firm or corporation engaged in making, manufacturing, compounding and selling extracts, essences, or other fluids commonly used for the purpose of flavoring articles of food or drink, shall use or employ, or permit to be used or employed

by his, their or its agents or employees, in the making, manufacturing or compounding of such flavoring extracts, essences or fluids any *methyl* or *wood alcohol*; nor shall any person, firm, or corporation, his, their or its agents or employees, sell or offer for sale at wholesale or retail, any flavoring extracts, essence, or other fluid commonly used for flavoring articles of food or drink, when the same contains any *methyl* or *wood alcohol*; and any person, firm or corporation, his, their, or its agents, employees or officers, violating the provisions of this section shall be guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not less than \$100 nor more than \$500, or by not less than three months nor more than twelve months imprisonment, or both, in the discretion of the court.

(*Annotated Code of Maryland*, 1, 1125; Section 159.)

Massachusetts.

Massachusetts Requires the Labeling of All Vessels Containing Wood Alcohol, and Prohibits its Use in Food, Drink, or Drug Intended for Internal Use.

Chap. 541, Sec. 1, Wood Alcohol Act, 1910.—Whoever, himself, or by his servant or agent, or as the servant or agent of any other person, sells, exchanges, or delivers any wood alcohol (*methyl alcohol*), either crude or refined, or denatured alcohol, under or by whatever name or trade mark the same may be called or known, shall affix to the bottle or vessel containing same a label bearing the words "Poison, not for internal use," in red letters of uncondensed Gothic type, not less than one-quarter of an inch in height, and the same words "Poison, not for internal use" in stencilled letters of similar Gothic type of a size not less than three-quarter inch nor more than one and one-half inches in height for use on barrels and kegs. Whoever violates any provision of this section shall pay a fine of not less than \$50 nor more than \$200 for each sale in respect to which the violation occurs.

Sec. 2. Whoever, himself, or by his servant or agent, or as the servant or agent of another person, sells, exchanges, or delivers, or has in his possession with intentions to sell, exchange or deliver, any article of food, or drink, or any drug intended for

internal use, containing any wood alcohol (*methyl alcohol*), either crude or refined, under whatever name or trade mark the same may be called or known, shall be punished by a fine of not less than \$200, or by imprisonment of not more than thirty days, or both such fine and imprisonment.

Sec. 3, Chapter 220 of 1905, relative to wood alcohol is hereby repealed. For information, said chapter is given below.

(*Acts and Resolves of Massachusetts, 1910, p. 494.*)

The Law of 1905.

Chap. 220, Sec. 1, Wood Alcohol Act, 1905.—Whoever, himself, or by his servant or agent, or as the servant or agent of any other person, sells, exchanges, or delivers any wood alcohol, otherwise known as methyl alcohol, shall affix to the vessel containing the same and shall deliver therewith a label bearing the words "Wood Alcohol, Poison" in black letters of uncondensed Gothic type not less than one-quarter inch in height. Whoever violates the provisions of this section shall pay a fine of not less than \$50 nor more than \$200.

Sec. 2. Whoever, by himself, or by his servant or agent or any other person, sells, exchanges or delivers, or has in his possession with intent to sell, exchange or deliver, any article of food or drink, or any drug intended for internal use, containing any wood alcohol, otherwise known as methyl alcohol, shall be punished by a fine of not less than \$200, or by imprisonment for not more than thirty days, or by both such fine and imprisonment.

(*Revised Laws of Massachusetts, 1905, 220, Sec. 1.*)

Michigan.

Michigan. General Regulations as to the Adulteration of Food.

An article of food shall be deemed to be adulterated if it contains any added substances or ingredient which is poisonous or injurious to health: . . . Substantially similar to the Federal Law.

(Section 3, Seventh, Act No. 193, *Public Acts 1895*, amended by Act No. 118, *Public Acts 1897.*)

Statement of the Detroit Board of Health.

The Director of the Laboratory of the Board of Health of Detroit, Michigan, informs the author that the use of methyl alcohol in any food is forbidden in Michigan, and that its employment in the manufacture or preparation of drugs is only permitted where it is stipulated by the Pharmacopoeia or "National Formulary."

*Minnesota.**Minnesota Requires the Labeling of All Vessels Containing Wood Alcohol with the Words "Wood Naphtha," "Poison."*

Section 1780.— 1. No person, by himself, his servant or agent, or as the servant or agent of another person or persons, shall sell, exchange, deliver, or have in his custody or possession with intent to sell, exchange or deliver, or expose or offer for sale, exchange or deliver, any wood alcohol, or substance commonly known as wood alcohol, unless each bottle, package, cask, can or receptacle containing the said wood alcohol shall be plainly marked, stamped, branded or labelled on the outside and face of each package, bottle, cask, can, or receptacle of the capacity less than one gallon, in legible type not smaller than large primer, and over the outside and face of each package, bottle, can or receptacle of the capacity of one gallon or more, in legible letters not less than one inch in length, the letters and words "Wood Naphtha," "Poison."

(Chap. 35, Sec. 1, 1905.)

2. Any person violating the provisions of this act shall be deemed guilty of a misdemeanor and be punished by a fine of not less than \$50 and not more than \$100 for each and every offense, or by imprisonment in the county jail for not less than thirty days or more than ninety days.

(*Revised Laws of Minnesota, 1905, Chap. 35, Sec. 1.*)

Minnesota Prohibits the Use of Wood Alcohol in Drinks.

No person shall make, brew, distil, sell or serve, in any form, any adulterated, spirituous, fermented or distilled liquor, and

any such liquor shall be deemed adulterated if it contains any of the following named substances . . . *methyl alcohol, or derivatives therefrom.*

(Section 1759, Chapter 21, *Revised Laws of 1905.*)

General Regulations as to the Adulteration of Foods, Drugs and Medicines.

Every person who, with intent that the same may be sold as unadulterated or undiluted, shall adulterate or dilute, wine, milk, distilled spirits, malt liquors, or any drug, medicine, food, or drink for man or beast; or shall offer for sale or sell the same as unadulterated or undiluted, or without disclosing to or informing the purchaser that the same has been adulterated or diluted; or shall manufacture, sell, expose, or offer for sale, such article of food, or drink, any substance in imitation thereof, without disclosing the imitation by a suitable and plainly visible mark or brand; or with intent that the same may be used as food, drink, or medicine, shall sell, offer or expose for sale, any article whatsoever which to his knowledge has become spoiled, tainted or for any cause unfit to be used as food, drink, or medicine, where special provision has not otherwise been made by statute for its punishment, shall be guilty of a misdemeanor, and punished by a fine of not less than twenty-five dollars or by imprisonment in the county jail for not less than thirty days.

(Section 4993, Chapter 99, *Revised Laws of 1905.*)

Montana.

Montana Requires the Labeling of Bottles Containing Wood Alcohol.

It shall be unlawful for any person, firm or corporation to retail any of the following named poisons, to-wit: . . . *wood alcohol*; without labeling the box, bottle, or other receptacle in which the said poisons are contained with the name of the article and the word "Poison," and the name and place of business of the seller.

(*Code of Montana, 1907.*)

New Hampshire.

New Hampshire Prohibits the Sale of any Food, Drink or Drug Intended for Internal Use Containing Wood Alcohol, and Requires that All Vessels Containing Wood Alcohol be Labelled with the Words "Poison, not for Internal Use."

Section 1. Whoever, by himself, or by his servant, or agent, or as the servant or agent of another person, sells, exchanges or delivers any wood alcohol, otherwise known as methyl alcohol, either crude or refined, or denatured alcohol which contains methyl alcohol, under whatever name or trade mark the same may be called or known, shall affix to the bottle or vessel containing same, a label bearing the words "Poison, not for internal use" in stencilled letters of a similar Gothic type of a size not less than three-quarter of an inch nor more than one and one-half inches in height for use on barrels and kegs. Whoever violates any provision of this section shall pay a fine of not less than \$50 nor more than \$200 for each sale in respect to which the violation occurs.

Section 2. Whoever, himself, etc., sells, etc., any article of food or drink or any drug intended for internal use, containing any wood alcohol (*methyl alcohol*), either crude or refined, under whatever name or trade mark the same may be called or known, shall be punished by a fine of not less than \$200, or by imprisonment for not more than thirty days, or by both such fine and imprisonment.

(*Laws of New Hampshire*, Feb., 1911, Chapter 16, p. 17.)

New Jersey.

New Jersey Prohibits the Sale of Any Preparation Intended for Internal or External Use Containing Methyl Alcohol. (An Exception is Made in Case of Properly Labelled Veterinary Medicine Containing Methyl Alcohol).

Chapter 286, Wood Alcohol Act, 1912.—No person shall sell, etc., any food, drug, preparation, or mixture of any kind whatsoever, intended for internal use, which contains methyl or wood alcohol. Nor shall any person sell, or offer or expose for sale, or have in his possession, with intent to distribute or sell, or

use upon or apply to the body of another, any drug, hair tonic, bay rum or similar preparation, intended for external use, which contains methyl or wood alcohol, provided, however, that nothing in this section shall apply to veterinary medicines containing methyl or wood alcohol, when such remedies are plainly and distinctly labelled in such a manner as to indicate that they are intended solely for external use on animals.

(*Laws of New Jersey*, April 1, 1912, p. 509.)

New York.

New York Prohibits the Manufacture and Sale of any Substance Containing Methyl Alcohol, or any Methylated Preparations Made from it, for Use in Foods.

Article 8, Agricultural Law 201, 1909.—200. No person, firm, association or corporation shall within this State manufacture, produce, sell, offer or expose for sale any article of food which is misbranded within the meaning of this article.

201. Definition of adulterated or misbranded food:—An article of food shall be deemed to be adulterated if it contains *methyl or wood alcohol*, in any of its forms, or any methylated preparation made from it.

(*Consolidated Laws of the State of New York; Laws of 1909*, Chap. 9, Art. 8.)

Any Drink is Deemed to be Adulterated if it Contains Methyl Alcohol.

An article shall be deemed to be adulterated . . . in the case of spirituous, fermented and malt liquors, if it contain *methyl or wood alcohol* in any of its forms, . . .

(Section 41, Article 4, Chapter 49, *Laws of 1909*.)

A Drug is Deemed to be Adulterated if it Contains Methyl Alcohol, Except Veterinary Medicine for External Use Which Must Bear a Label to that Effect.

A drug is adulterated, (if) it contains *methyl or wood alcohol* when intended for use as a medicine, except when sold as a veterinary liniment for external use only and so labelled.

(Section 237, *Adult.*, 6, Article 11, Chapter 49, *Laws of 1909*; amended Chapter 422, *Laws of 1910*.)

*North Carolina.**North Carolina Prohibits the Sale of Spirituous Liquor to be Used as a Beverage Containing Poisonous Properties.*

Manufacturing and selling spirituous liquor to be used as a beverage containing poisonous properties is a misdemeanor punishable by not less than 5 years and a fine, at the discretion of the court.

(*Pell's Revisal, 1908.*)

An Article of Food is Adulterated if it Contains Wood Alcohol.

An article of food shall be deemed to be adulterated, if it contains any added poisonous or other added deleterious ingredient which may render such article injurious to health. If it contains any of the following substances which are hereby declared deleterious and dangerous to health when added to human food, to-wit:
. . . wood alcohol.

(Section 6, Food and Drugs Act, amended Chapter 900, *Laws of 1909.*)

*North Dakota.**North Dakota Prohibits the Use of Methyl Alcohol, Either for Internal or External Purposes, Including Washes and Perfumes.*

Chap. 196, "Pure Drugs Act."—It shall be unlawful to sell, offer or expose for sale, or to have in possession, any preparation or product intended for the use of man, either for internal or external purposes, including washes and perfumes, which contains methyl alcohol or wood spirits.

(H. B. No. 84—*Treat, 1907, p. 320; Laws of 1907, Chap. 196, Sec. 6.*)

*Ohio.**Ohio Considers any Food, Drink, Confectionery, Condiment, Flavoring Extract, or Drug as Adulterated if it Contains any Methyl Alcohol.*

Chap. 1, Sec. 5777.—A drug is adulterated within the meaning of this chapter (6) if it contains any methyl or wood alcohol.

Section 5778.—Food, drink, confectionery, or condiments are adulterated within the meaning of this chapter (11) if they contain any *methyl or wood alcohol*.

Section 5779.—A flavoring extract is adulterated within the meaning of this chapter (8) if it contains any *methyl or wood alcohol*.

(*General Code of Ohio, 1910.*)

Oklahoma.

Oklahoma Prohibits the Use of Wood Alcohol in Drugs, Except as Specified in the "United States Pharmacopoeia."

The term "alcohol" is defined to mean common or ethyl alcohol. No other kind of alcohol is permissible in the manufacture of drugs, except as specified in the "United States Pharmacopoeia" or in the "National Formulary."

(*Food and Drugs Law, 1909, Chap. 18, Rule 34.*)

Pennsylvania.

Pennsylvania Deems any Drug Adulterated if it Contains Methyl Alcohol. Adulteration of Foods.

Any drug containing *methyl alcohol* (wood alcohol) will be regarded as adulterated within the meaning of this act (Adopted 1910.)

(Rule No. 6, The Drugs Act, *Laws of 1909 and 1911.*)

An article of food shall be deemed to be adulterated, if it contains any added . . . ingredients deleterious to health.

(Section 3, Fifth, Act No. 292, *Laws of 1909.*)

South Carolina.

South Carolina Prohibits the Use of Methyl Alcohol as a Beverage or for Medicinal Purposes.

Section 1. An Act—Making lawful the manufacture within the State of ethyl and methyl alcohol from sawdust, slabs, or any other wood substance.

Section 2.—No alcohol manufactured under the provisions of this act shall ever be used either within or without this State as a beverage or for medicinal purposes. (1910, No. 290, p. 570.)

Section 10.— Nothing in the act prohibiting the sale of alcoholic liquors shall prevent the sale of wood or denatured alcohol.

(*Laws of South Carolina, 1909, No. 42.*)

Virginia.

Virginia Prohibits the Sale of Wood Alcohol as a Beverage.

Nothing in this section shall be construed as licensing any person, firm, or corporation to sell *wood alcohol*, or any mixture hereof, as a beverage; and the sale of such *wood alcohol*, or mixture thereof, as a beverage is hereby prohibited.

(*Virginia Code Annotated, Pollard, 1904; Liquor License, Cl. 141, p. 2262.*)

Virginia Prohibits the Use of Wood Alcohol in Drugs, Except as Specified in the "U. S. Pharmacopoeia" or "National Formulary."

The term "alcohol" is defined to mean common or ethyl alcohol. No other kind of alcohol is permissible in the manufacture of drugs, except as specified in the "United States Pharmacopoeia" or "National Formulary."

(Rules and Regulations of the Virginia Board of Pharmacy, March 14, 1908; Pharmacy & Drugs Act, Chap. 291, *Acts of 1908; Code, Suppl. of 1910, p. 815.*)

Wisconsin.

Wisconsin Prohibits the Use of Wood Alcohol as a Solvent for Shellac, etc., Within any Vat or Tank so as to Injure or Endanger the Life of the Person so Using It.

No person, firm, or corporation shall require or wilfully permit the use of *wood alcohol*, or shellac or other materials dissolved in or mixed with *wood alcohol*, or "Columbian spirits," within any vat or tank, in such manner as to cause injury to or endanger the life or health of the person so using it, or any other person or persons.

Any person who violates any of the provisions in Section 1 of this act shall be punished by a fine of not less than \$25 nor more than \$100 for each such offense.

It shall be the duty of the Commissioner of Labor, the Factory Inspector, or any assistant factory inspector to enforce this act.

(*Offenses Against Lives and Persons*, Section 4398g, Chap. 274, 1905, p. 1327.)

Wisconsin Deems a Drug to be Adulterated if it Contains Wood Alcohol, Except When Intended for External Use and is so Labelled.

A drug shall be deemed to be adulterated if it contains *wood alcohol*, except when intended for external use only and so labelled.

(Section 4601, *Drugs*, *Third Suppl.*, 1906, to *Statutes of 1898*, amended by Chapter 202, *Laws of 1909*.)

(3) MUNICIPAL ORDINANCES.

New York, N. Y.

New York City Prohibits the Use of Wood Alcohol in any Preparation for Internal or External Human Consumption.

No person or corporation shall have, sell or offer for sale any food or drink which contains *methyle alcohol* (commonly known as *wood alcohol*) or any preparation or mixture of any kind whatsoever containing the same, intended either for internal or external use by man; nor shall *methyle* or *wood alcohol* or any preparation or mixture containing the same be used upon or applied to the person or body of another.

(Section 66a, *Sanitary Code of the City of New York*, adopted January 23, 1912.)

San Francisco, Cal.

San Francisco Prohibits the Use of Methyl Alcohol in Drugs for Internal Use of Man.

It shall be unlawful to sell, offer for sale, deliver or cause to be delivered any drug or medicine labelled with the recommendation that the same is for the internal or external use of man which contains *methyle alcohol*.

(Ordinance 76, Section 4, *Sanitary Code of the Department of Public Health of the City and County of San Francisco, Cal.*, 1911, p. 69, adopted October 10, 1906.)

LEGISLATION IN CERTAIN FOREIGN COUNTRIES.

The Dominion of Canada.

Canada Prohibits the Use of Methyl Alcohol in Beverages, Pharmaceutical and Medicinal Preparations Intended for Internal Use. It is Supplied by the Government for Manufacturing Purposes.

Chapter 51, Section 251.—When wood naphtha, wood alcohol, or methylated or other denatured spirit is to be used for manufacturing purposes in Canada, it shall be supplied by the department on such conditions as are determined by the department regulations in that behalf, and the price thereof shall not exceed the actual cost with the addition of fifteen per centum.

(*Revised Statutes of Canada, 1906, 2, p. 968.*)

Section 265.—Every person who deodorizes or clarifies, or attempts to deodorize or clarify, any methylated spirits, whether by distillation, filtration, or any other process, is guilty of an indictable offense, and shall for the first offense be liable to a penalty of \$500, and for each subsequent offense to a penalty of \$1,000.

Section 266.—Every person who uses spirits containing methyl alcohol in any form in any pharmaceutical or medicinal preparation intended for internal use, shall be liable to a penalty of \$500.

Chapter 167, Section 17.—Alcoholic, fermented or other potable liquors sold, or offered or exposed for sale, shall be deemed to have been adulterated in a manner injurious to health if they are found to contain methyl alcohol and its derivatives, etc., etc.

Penalties therefor . . .

(*Revised Statutes of Canada, 1886, 2, p. 1448.*)

England.

England Prohibits the Manufacture and Sale of Methyl Alcohol, Methylated Spirits, or Derivative Thereof to be Used as a Beverage or Internally as a Medicine. (Exception is Made in Case of Sulphuric Ether and Chloroform).

Chapter 24, Section 130, Spirit Act, 1880.—(1) If any person . . .

a) prepares or attempts to prepare any methylated spirits (214) [or methylic alcohol] for use as or for a beverage, or as a mixture with a beverage; or

b) sells any methylated spirits [or methylic alcohol], whether so prepared or not, as or for a beverage, or mixed with a beverage; or

c) uses any methylated spirits (215) [or methylic alcohol], or any derivative thereof in the preparation of any article capable of being used wholly or partially as a beverage, or internally as a medicine; or

d) sells or has in his possession any such article in the preparation of which methylated spirits (216) [or methylic alcohol], or any derivative thereof has been used, he shall for each offense incur a fine of 100 pounds, and the spirits with respect to which the offense is committed shall be forfeited.

(2) Nothing in this section shall apply to the use of methylated spirits (217) [or methylic alcohol] in the preparation of sulphuric ether or chloroform, for use as a medicine, or in any art or manufacture, or prevent the sale or possession of any sulphuric ether or chloroform for such use.

(*Statutes of England*, 14, 43-4 Vict., Chapter 24.)

Chapter 20, Section 2. Revenue Act, 1906.—(5.) Section 130 of the Spirit Act, 1880, shall apply as if it were an offense under that section without the consent in writing of the commissioner or otherwise than in accordance with regulations to purify or attempt to purify methylated spirits or methylic alcohol, or, after methylated spirit or methylic alcohol have been used once, to recover the spirit or alcohol by distillation or condensation, or in any other manner.

(6) This does not apply to sulphuric ether and chloroform. (*Edw. VII*, 6, Chapter 20.)

France.

France Allows Duty-Free Denatured Alcohol in the Arts and Industries.

France allows the sale of tax-free denatured alcohol for:

1. Lighting, heating, and making "finish;"

(214, 215, 216, 217) Words in brackets inserted by 61-62 Vict. C., 46, S. 14.

2. For manufacturing purposes, *viz.*, varnishes, solid extracts, solidified spirits, plastic substances, alkaloids, fulminate of mercury, transparent soap, insecticides.

[The alcohol is denatured with ten liters of wood spirit, 90° (580 p.), containing twenty-five per cent. acetone and twenty-five per cent. "impurities pyrogenes," for 100 liters of spirit.]

Germany.

Germany Allows Duty-Free Denatured Alcohol in the Arts and Industries.

Germany allows the sale of duty-free spirit which is made undrinkable by:

1. Twenty per cent. wood naphtha and 0.5 per cent. of pyridine bases;

2. Five liters of wood spirit per 100 liters of spirit. Freedom from duty includes —

- a) Release from the "consumption" tax and its additions;
- b) The refunding of the "fermenting-vat" tax at the rate of 0.16 mark per liter of pure alcohol;
- c) Return of distilling tax at rate of 0.06 mark per liter of pure alcohol.

The employment of methyl alcohol in wines, whiskies, pharmaceutical and cosmetical preparations is prohibited, according to von Buchka (*Chem-Ztg.*, 1912, 36, No. 134, 1309.)

Prussia.

Prussia Prohibits the Free Sale of Methyl Alcohol.

The free sale of methyl alcohol was prohibited in Prussia in May, 1911.

(Laws of Prussia, Forster, *Münch. med. Wochschr.*, 1912, 248.)

Austria-Hungary.

Austria-Hungary Allows the Use of Duty-Free Denatured Alcohol in the Arts and Industries.

The sale of duty-free denatured alcohol is allowed to be used in hat-making, varnishes, fulminate of mercury, vinegar, etc.

The spirit is denatured with two per cent. of wood naphtha and 0.5 per cent of pyridine bases.

Hungary.

Hungary Prohibits the Free Sale of Methyl Alcohol.

The free sale of methyl alcohol is forbidden in Hungary.

(Laws of Hungary, Forster, *Münch. med. Wochschr.*, 1912, 248.)

Russia.

Russia Allows the Sale of Duty-Free Spirit.

The sale of duty-free spirit is permitted. The Minister of Finance issues permission to persons wishing to use denatured alcohol, limited to one year.

Japan.

Japan Prohibits Manufacture and Sale of Comestibles and Beverages Containing Methyl Alcohol. All Containers of Wood Alcohol Must Be Clearly Labelled. Sales Must Be Entered in Trade Book.

According to the *Chemical World* (1, No. 10, 359), in consequence of the recent cases of poisoning by wood alcohol on the European Continent, which led to strict measures for the regulation of the trade in several countries, the Japanese government issued (1912) new regulations. According to these, the manufacture and sale of comestibles and beverages containing wood alcohol are absolutely prohibited. The sale of any article containing such alcohol is illegal, unless a label on the container clearly indicates the character of the contents. Manufacturers, dealers and importers who handle wood alcohol in any form are required to keep a trade book, and to make entries concerning the amounts manufactured, received, transferred, or sold, to whom sold, object of purchase, and adding date of sale.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS.

Prohibition of Use of Wood Alcohol in Foods, Beverages or Medicines to be Taken Internally.

The data and facts summarized in this report warrant the following conclusions:—

1. (a)—While there may be differences in opinion as to the actual toxicity of absolutely pure methyl alcohol, the preponderating evidence indicates that its physiological action spells injury. The toxicity of the ordinary methyl alcohol of commerce, commonly called wood alcohol, even though it be of a higher grade of purity, is a recognized fact, whether its morbid action be due to the concomitant impurities or not.

The use of methyl or wood alcohol in any food, condiment, flavoring extract, or liquid capable of being used in whole or partially as a beverage, or internally as a medicine, should therefore be prohibited by law. This is covered in part at present by Article 8, Agricultural Law No. 201, State of New York, cited on p. 982.

Injustice Liable in Present Law Through Lack of Control.

(b)—In connection with the law just referred to, I would like to direct your attention to a lack in clarity, and, in consequence, likely injustice from attempts at its execution. The intent of the law is undoubtedly wholesome, but the use of the word "methylated" is ambiguous. In the loose English sense, it means ethyl alcohol which has been denatured with methyl alcohol; but it has an even wider meaning from what might appear as its real intent. One instance will illustrate the point. Methyl salicylate, oil of wintergreen, is a recognized product of manufacture used for flavoring, which is a "methylated" preparation. It is the same as oil of wintergreen made from natural sources. If the synthetic preparation were properly labelled, it would not be a case of misbranding, morally, within the meaning of the section (No. 201, *loc. cit.*), yet a court could very properly hold

that it was, because synthetic oil of wintergreen is a "methylated preparation." The wood alcohol is no longer present as such and the physiological action of the wood alcohol is no longer observed. The above is true of many synthetic perfumes, flavoring extracts (as vanillin), and drugs of recognized medicinal value which are welcomed as legitimate commercial products of the chemist's art.

Prohibition of Use of Wood Alcohol in Fluids to be Applied Externally on the Human Body.

2. As the skin is a membrane through which many liquids readily pass, the application of wood alcohol to the skin serves as a means of introducing it into the circulation. The absorption is instantaneous if there are abrasions. Furthermore, when a liquid containing wood alcohol is applied as a liniment or wash, the air becomes more or less saturated with its vapor. When this vapor is breathed, the wood alcohol exerts its characteristic physiological action. Wood alcohol should, therefore, not be permitted in those preparations such as perfumes, witch hazel, bay rum, "eau de cologne," liniments, washes, etc., which are intended primarily for external use on the human body. It may be remarked that "tippling" with these preparations is not uncommon.

Use of Denatured Alcohol in Liniments, Etc., Meant for External Use Alone.

The question of allowing ethyl alcohol which has been denatured with methyl alcohol to be used for this purpose, namely, in liniments, etc., might appear as one open to argument primarily on the basis of dilution. The denaturing formulas now in effect by Federal consent do not encourage but discourage the use of industrial alcohol for such purposes. In my opinion, it would be better to err on the safe side and to make the restriction only as the occasion arises.

Ample Ventilation in Works Where Wood Alcohol is Made and Refined.

3. In the manufacture of wood alcohol the workmen are liable to come into contact with the vapor only in neutralizing the acetic

liquor with lime and in filling the shipping containers. In case of the former, the common practice now is to carry out the operation in closed vats, which are opened only when lime is dumped in. General requirements for *ample ventilation* should meet these difficulties, which, in fact, do not now exist in the works inspected in New York State.

Laws on Use of Wood Alcohol in the Arts.

4. Wood alcohol is a valuable solvent, used as such extensively in the arts in two important ways.

(a)—It is used as a solvent in the *course of the manufacture* of many substances, but does not appear in the product when the latter is put upon the market. It is not destroyed, but evaporates or is saved in part by condensation. It can exert its deleterious action during the process

(1) by the workmen breathing its fumes.

(2) by the workmen constantly dipping their hands and arms into the liquor, or

(3) by the workmen drinking the wood alcohol.

Ample ventilation will meet the first difficulty. Standards should be determined in each case by the Board of Health or such board with authority, as may be designated.

In the second case, the workmen should be provided with impervious long gloves or the processes should be operated mechanically; and if a closed process be used, the first difficulty is also largely met.

Education only can solve the third problem.

(b)—Wood alcohol serves as a solvent or menstruum of the material which is placed on the market in a liquid form (varnishes), and exerts its action upon the users, depending upon multiform conditions. In works where these materials are used in large quantities and the solvent evaporates, *ample ventilation* should be required. In many cases, however, the workmen are more or less isolated. They may and should be warned of the danger attendant by suitable labels on the vessels containing the liquid they are to apply.

Proper Labels.

5. All bottles or vessels used for transporting or selling products containing wood alcohol should be required to bear a prominent display label stating that it contains a "Poison," and giving advice as to the danger of working with the material without ample ventilation.

RECOMMENDATIONS AS TO LAWS.

My study of the subject warrants recommending the existence of laws as follows:—

Internal Use.

1. A law prohibiting the presence of wood alcohol in any form of material intended for internal use;

External Use.

2. A law prohibiting the presence of wood alcohol in preparations intended for external use on the human body;

Ample Ventilation Where Made or Used.

3. A law requiring *ample ventilation* in works where wood alcohol is made or used in manufacturing products wherein the wood alcohol remains as such; the same law should apply where the products containing wood alcohol are used up, as, for example, in varnishing vats in breweries;

Proper Labels.

4. A law requiring containers in which wood alcohol is marketed to bear suitable display labels of warning; and

Clarifying Present Restrictions.

5. These laws should be so drawn as not to inhibit the use of wood alcohol in manufacturing products in which methyl alcohol supplies a constituent part, but does not remain as wood alcohol therein.

Respectfully submitted,

CHAS. BASKERVILLE,

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APPENDIX A.

AFFIDAVITS OF EMPLOYEES AS TO INJURY FROM WOOD ALCOHOL, USED AS A SOLVENT FOR SHELLAC IN HAT STIFFENING.

Hearing before Ways and Means Committee, 59th Congress—1st Session, Feb.-March, 1906.

NAME—AGE.	Place.	Period of Employment with wood alcohol.	Incapacity to work due to wood alcohol.	Result.
H. H. O'Brien, 55...	Boston.....	10 years	6 years.....	Asthma.
T. Peters, 64.....	Boston.....	10 years	100 days annually.	Pain in eyes; scarcely able to see.
B. Perry, 32.....	Danbury, Ct....	5½ years	60 days annually.	Ill effects to entire system.
Geo. Sherwood, 38..	Danbury, Ct....	2½ years	1½ days, 250 parts of days annually.	Eyes and stomach affected.
J. W. Grimshaw, 46	Danbury, Ct....	32 years	50-60 parts of days annually.	Almost blind; cannot see to read and write.
H. Imagersuppe, 32.	Danbury, Ct....	12 years	50 days and 1 year parts of days annually.	Eyes and lungs affected.
G. Gustafson, 18....	Danbury, Ct....	½ year	100 parts of days annually.	Normal.
A. Williams, 20....	Danbury, Ct....	4 years	30 days annually.	Inflammation of eyes and nostrils; cannot see bright light; loss of appetite.
I. N. H. Harrison, 27	Danbury, Ct....	13 years	300 days annually.	Eyesight affected.
C. Wilkins, 31.....	Danbury, Ct....	13½ years	15 days and 170 parts of days annually.	Eyes painful; dry throat, bad cough.
Wm. Phillips, 47....	Danbury, Ct....	20 years	30 days and 20 parts of days annually.	Eyesight and health impaired; dry throat and cough.
Wm. Williams, 42..	Danbury, Ct....	15 years	½ time each week.	Unable to read or sit in bright light.
I. Wood, 18.....	Danbury, Ct....	1 year	8 days annually.	Bad effect upon eyes and stomach.
Wm. Clark, 25.....	Danbury, Ct....	10 years	200 days annually.	Eyes, stomach and nose affected.
Nelson, 31.....	Danbury, Ct....	12 years	20 parts of days.	Inflammation of eyes and catarrhal headache.
Eyre, 39.....	Danbury, Ct....	13 years	25 days; parts of days annually.	Eyes affected; unable to read for days.
Partrick, 61.....	Danbury, Ct....	20 years	.....	Eyes very weak and inflamed; nausea.
Logan, 36.....	Danbury, Ct....	8 years	60 days annually.	Eyes and stomach affected.
Geo. Birt, 26.....	Danbury, Ct....	9 years	20 days annually.	Loss of appetite; inflammation of eyes.
Halas, 20.....	Danbury, Ct....	1 year	10 days annually.	Inflammation of eyes and intense pain.
G. Williams, 45....	Danbury, Ct....	4 years	½ time off each week.	Unable to read or sit in bright light.
W. Smith, 76.....	Danbury, Ct....	3 years	½ day at time	Dry throat, and nose trouble.
F. Elwell, 37.....	Danbury, Ct....	10 years	—days annually.	
F. Leahry, 19.....	Danbury, Ct....	3 years	24 days annually.	Sick and sometimes a rash.
Booth, 60.....	Danbury, Ct....	15 years	30 parts of days annually.	Eyes strained; unable to read nights; cannot stand ordinary light.
Muchfeld, 34.....	Danbury, Ct....	16 years	36 days annually.	Eye trouble.
F. Patrick, 41.....	Danbury, Ct....	11 years	.....	Eyes weak and generally impaired health.

APPENDIX A.—Continued.

NAME—AGE.	Place.	Period of employment with wood alcohol.	Incapacity to work due to wood alcohol.	Result.
J. Trowbridge, 44...	Danbury, Ct....	12 years	Great many parts.	Inflammation of eyes and nose.
Brown, 34.....	Danbury, Ct....	13 years	10 days annually.	Inflammation of eyes and catarrh.
R. Melzer, 30.....	Danbury, Ct....	10 years	2 days annually.	Inflammation of eyes; was forced to discontinue work 3 months.
S. J. Stickey, 41....	Danbury, Ct....	18 years	5 days and 3 parts of a day.	Effect on eyes and stomach; affects liver and kidneys; cannot read nights.
F. Jackson, 34.....	Danbury, Ct....	6 years	40 days annually.	Temporary blindness; general sickness and disability; weak eyes; dry throat and nose.
A. Stevens, 68.....	Danbury, Ct....	1 year	2 days annually.	Affected eyes, nose, throat and stomach; dry cough.
E. R. Fay, 28.....	Danbury, Ct....	10 years	10-15 days; 15 parts of day.	Dull sickening headache; cannot read after work.
Ch. W. Lee, 35.....	Danbury, Ct....	5 years	15 days; 12-15 parts of days.	Eyes, nose, throat and chest trouble.
J. A. Burke, 24.....	Danbury, Ct....	12 years	12-20 parts of days.	Poor eyesight, throat trouble, kidney trouble and sugar diabetes, swelling legs and feet.
Chas. Sherwood, 34.	Danbury, Ct....	10 years	300 parts of days annually.	Normal.
B. S. Brooks, 49....	Danbury, Ct....	18 years	3 years.....	Eyes affected.
A. Jane, 17.....	Danbury, Ct....	$\frac{1}{2}$ year	12 days; 100 parts of days	Normal.
H. B. Stevens, 20...	Danbury, Ct....	2 years	14 days annually	Eyes and nose affected.
Wm. Griffin, 20.....	Danbury, Ct....	1 year	5 days and 10 parts of days.	Had to give up job.
G. Mongin, 50.....	Danbury, Ct....	15 years	10 days annually	Sore eyes, weak stomach.
F. V. Green, 40.....	Danbury, Ct....	3 years	.....	Whole body poisoned with alcohol; cannot do any kind of work.
G. B. Keeler, 69....	Danbury, Ct....	15 years	25 days; 40 parts of days	Eyes very sensitive; cannot read by artificial light.
A. Collins, 18.....	Danbury, Ct....	4 years	50 days; 100 parts of days	Eyesight affected; cannot read by gas light.
R. Abbott, 29.....	Danbury, Ct....	3 years	20 days annually.	Weak eyes; nose affected, and a blind sty.
Ben Cooper, 60.....	Danbury, Ct....	10 years	50 days; 30-40 parts of days.	Eyes sensitive; cannot stand sunlight or read by gas light.
J. Neal, 48.....	Danbury, Ct....	1 year	30 days; 30 parts of days	Eyes sensitive; cannot read by gas light.
Ch. H. Wood, 34....	Danbury, Ct....	10 years	5 days annually.	Inflamed eyes, nose affected; must stop work frequently.
M. Quinn, 36.....	Danbury, Ct....	12 years	20 days annually.	Temporary blindness, intense pain, general health bad; impossible to read at night; uses an eye wash.
A. von Wil, 37.....	Danbury, Ct....	12 years	25 days annually.	Eyesight and lungs affected.
T. Tucci, 18 $\frac{1}{2}$	Danbury, Ct....	$\frac{1}{2}$ year	12 parts of day.	Inflammation of eyes, with intense pain.
J. Madden, 30.....	Danbury, Ct....	7 years	30 days annually.	Headache and poor sight.

APPENDIX A.—*Concluded.*

NAME—AGE.	Place.	Period of employment with wood alcohol.	Incapacity to work due to wood alcohol.	Result.
J. P. Berry, 36.....	Danbury, Ct....	4 years	.....	Intense pain and inflammation of eyes; was obliged to give up work.
J. Porrotsky, 35.....	Danbury, Ct....	6 years	12 days; 20-30 parts of days.	Unable to read after work; headaches, general effects of cold.
F. E. Wilcox, 48....	N. Y. State.....	12 years	3 months....	Weak eyes, vision of left eye impaired; gave up this branch.
J. J. McDonald, 33..	Kings Co.....	7 years	.....	Itchy rash on back of hands; occasional headache.
I. Osborne, 37.....	Kings Co.....	10 years	.....	Inflamed eyes, occasional headache.
M. E. Connor, 23...	Kings Co.....	3 years	.....	Inflamed eyes and weak, hands itch.
J. V. Schenck, 35...	Kings Co.....	10 years	2 weeks one time.	Arms, hands and eyes occasionally irritated.
F. B. Webb, 38.....	Kings Co.....	10 years	6 days annually	Eyes affected.
J. Wilde, 56.....	Kings Co.....	18 years	.....	Eyes affected.
E. J. Wood, 29.....	Kings Co.....	13 years	.....	Eyes affected.
Wm. H. Stone, 65...	Bethel, Ct.....	13 years	2-3 days a week.	Inflammation of eyes in gas light.
W. J. Stone, 43.....	Danbury, Ct....	3 years	3-5 parts of days annually.	Eyes, head and whole nervous system affected; gave up work.
S. S. Reed, 49.....	Danbury, Ct....	6 years	10-20 parts of days annually.	Eyesight and nervous system affected.
J. W. Booth	Newark, N. J....	15 years	2-5 hours at a time.	Nervous exhaustion and gastritis; confined to house since Jan. 15, 1906.
W. Pilcher, 44.....	Newark, N. J....	5 years	3-4 hours per day able to work.	Eyes smart and tear; cannot stand any light.
F. E. Andrews, 44..	S. Norwalk, Ct..	14 years	40 days; 30 parts of days	Eyes smart and tear; cannot stand any light.
J. W. Coleman, 45..	New Milford, Ct.	15 years	20 days annually.	Improved health after sickness due to the alcohol.
F. Beach, 18.....	New Milford, Ct.	2 years	30 days annually.	Weak eyes, poor eyesight, loss of hair.
M. J. McMahon, 31..	New Milford, Ct.	12 years	20 days annually.	Weak eyes, poor sight.
G. Plumb, 28.....	New Milford, Ct.	5 years	20 days annually.	Weak eyes, poor sight.
H. S. Booth, 45.....	New Milford, Ct.	10 years	20 days annually.	Weak eyes, poor sight.

APPENDIX B.

FREE ALCOHOL.

Hearing Before Ways and Means Committee, Fifty-ninth Congress, First Session, February-March, 1906.

Physicians' statements of injuries from using wood alcohol —
C. A. Stratton, M. D., and D. C. Brown, M. D.

Class A.—Cases who have been forced to discontinue work in the stiffening department of hat factories on account of the effects of wood alcohol.*

Case 1. Benjamin Perry, Danbury, Conn.; age, 32. Worked in wood alcohol $5\frac{1}{2}$ years; began to have trouble at the end of three months, with inflammation of the eyes and nausea. After leaving work was unable to stay in light and had to remain in dark room for an hour or two.

Vision: Right eye, 15/30; left eye, 15/20.

Examination of deeper structures — negative; lungs, normal; liver, normal; kidneys, normal.

Case 2. George Sherwood, 54 Pleasant Street, Danbury, Conn.; age, 38. Worked at stiffening about 8 years ago; in wood alcohol $2\frac{1}{2}$ years. Gave up on account of inflammation of eyes; could not work an entire day because his sight failed him. Trouble with eyes began with tears running down the cheeks and then the nostrils. Some days could work until late in the afternoon, but at other times not more than two hours, when vision failed. Eyesight usually returned within an hour or two after leaving work. While working in the factory was unable to read at all during the evenings; when not working in wood alcohol, had no difficulty about reading in artificial light.

Vision: Left eye, 15/30; right eye, 15/20; conjunctiva, normal; lids slightly thickened; right eye has scotoma or blind spot;

*In these cases, apparently no consideration was given to optic disturbances produced by the use of tobacco. Ophthalmological investigations show that tobaccoism deserves to be considered along with alcoholism.

right disc is cupped at outer side; left eye, normal. Nose, normal; throat, normal; lungs, normal; heart, normal; liver, $3\frac{1}{2}$ inches; functions, normal; kidneys, normal.

Case 3. James Grimshaw, Danbury, Conn.; age, 46. Worked in wood alcohol 32 years, and gave up about October, 1906, on account of failing eyesight. While working in wood alcohol, his eyes were badly inflamed, but eyesight remained fair up to 6 years ago, when it began to fail.

Vision: Is able to distinguish large objects, but is unable to recognize features at a distance of a few feet; vision for reading, totally lost; is able to recognize test card letters 1 $\frac{1}{40}$ with each eye; conjunctiva, normal; lids, not thickened; both optic discs are deeply cupped. Nose, normal; throat, normal; lungs, normal; heart, normal; liver, normal; kidneys, normal.

Case 4. Henry Magersuppe, Danbury, Conn.; age, 32. Worked 12 years in stiffening room with wood alcohol; had to give up four years ago on account of inflammation of eyes. Suffered also from inflammation of nasal passage and cough. During last year had to use wash for eyes.

Vision: Right eye, 15/70; left eye, 15/50. Right eye optic disc congested, veins enlarged and tortuous; left eye, same condition. Is unable to read with but best illumination. Vision has improved since stopping work, but, at that, unable to read at all nights.

Nose, septum deflected toward left; membrane congested; mucous membrane extends abnormally near the rim of nostril. While working with wood alcohol had severe inflammation of nasal mucous membrane. Throat: there is a chronic pharyngitis; rima glottis and epiglottis intensely congested; vocal chords clear; there is no hoarseness. Lungs, normal; heart, normal; liver, normal; kidneys, normal.

Case 5. John P. Berry, 96 Garfield avenue, Danbury, Conn.; age, 36; weight, 200 pounds. Worked in wood alcohol 4 years; began to fall off in work, and discontinued work in 1898, on account of pain in the eyes and dimness of vision. While working in wood alcohol, his eyes would smart and burn so that he could not keep them open; was unable to use eyes in the evening

after working there the day, especially in winter. The eyes usually began to pain him at 9 o'clock and trouble continued for the rest of the day. Drinks beer occasionally, but did not use liquor while working in wood alcohol.

Vision: Right eye, 15/20; left eye, 15/30; conjunctiva not inflamed; lids not swollen or thickened; physiological blind spot only; optic discs not clearly defined; pink edges not clear; blood vessels not normal; eyes easily fatigued and congest quickly. Nose, normal; throat, normal; kidneys, normal; liver, normal; lungs, normal.

Case 6. L. F. Ising, Danbury, Conn.; age, 44; jeweler. Nine years ago worked with blowpipe and alcohol lamp in which he burned wood alcohol an hour or two each day for three weeks. A short time after his eyes began to trouble him with an intense conjunctivitis and ulceration of both cornea, followed by failing vision; has had conjunctivitis ever since, and was forced to give up watchmaking.

Conjunctiva intensely congested in both eyes; lids very much swollen and glued together in the morning. Vision: Right eye, 10/40; left eye, 10/50. Both optic discs are choked, borders scarcely to be made out; veins tortuous, discs quite pink, blind spots normal in position in both eyes, the left increased to double that of right. General physical condition, normal.

Case 7. Gustav Gustavson, Germantown, Danbury, Conn.; age, 18. Worked in wood alcohol six months; had to give up on account of its effect on the eyes; could not stand the burning and could not see nights after finishing work. There was pain in eyes, and excessive flow of tears and discharge from nose. Eyes congested; lids thickened.

Vision: Right eye, 15/20; left eye, 15/20. Neither optic disc has any cupping; nerves show congestion and enlargement of veins. Sensation of tightness in throat, slightly congested. Does not use alcoholic drinks.

Class B.—Working in stiffening department of hat factories and show effects of wood alcohol.

Case 1. Charles Clark, 77 South Street. Danbury, Conn.; age, 28. Worked in stiffening room 14 years. Had been so affected

that he was unable to open his eyes for three days at a time. Is unable to use eyes any evening after working. Conjunctiva strongly congested and lids are much thickened. There is excessive secretion from eyes; both optic discs are strongly congested; vision is dim; is unable to use test type. Nose: nasal membrane congested, has to breathe through mouth; pharynx and upper larynx strongly congested and swollen. Lungs: there are coarse bronchial rales over entire chest.

Case 2. Anson Williams, Rocky Glen, Danbury, Conn.; age, 20. Worked with wood alcohol four years. Began to have trouble with eyes; discharges from nose and cough. Is unable to read at night after work; intolerance to light; conjunctiva congested; lids swollen and congested; optic discs not clear; swelling of both discs brought forward $1\frac{1}{2}$ D. Inferior turbinated bones of nose swollen and meet at septum; unable to breathe through nose at night; larynx and pharynx congested; vocal chords congested and voice husky; no appetite after working; has pain in epigastrium; lost five pounds in two months.

Case 3. William Slade, 10 North Street, Danbury, Conn.; age, 49. Worked in wood alcohol two years. Has to stop several times during the day for one-quarter or one-half hour to recover from the effects of the alcohol on his eyes, so that he can see to continue work. Has to lie down in a dark room for an hour after arriving home. Eyes are always glued together in the morning after working, with sticky discharges. Suffers from dizziness while at work. Has been unable to read for past month. Eyes become red and fiery, with tears constantly running, while at work. Both lids swollen, not acutely congested; left eye, optic nerve pink, cupped on outer side. Right nerve is cupped three-quarter out and one-quarter in. Vision: Right eye, $12/50$; left eye, $12/50$; blind spot in left eye normal, but three times normal size; right eye, normal. General physical condition, normal.

Case 4. John N. Harrison, 25 Town Hill, Danbury, Conn.; age, 27. Worked in stiffening department 13 years. Began to have trouble with eyes on first beginning to work with wood alcohol; dimness of vision, inflammation of eyes; is able to work by using cocain. Lids slightly thickened; optic disc shows excessive

cupping, with dilation of veins; blind spot in position, but three times normal size in each eye. Pharynx and larynx congested, catarrhal condition; otherwise normal.

Case 5. C. Wilkins, 62 Davis Street, Danbury, Conn.; age, 31. Worked 13½ years in wood alcohol; had to use cocain for past ten years to relieve pain and to allow him to continue work. Suffers from catarrh in nose and throat, and a feeling of distension in head. Lids thickened, and swollen optic discs deeply cupped; veins dilated and tortuous; blind spot extends over entire right upper quadrant in right eye. Left eye, normal. Membranes of nose intensely congested, especially on septum. Lungs: coarse bronchial rales over entire chest. Skin of hands worn so that the lower layers crack and bleed easily. Otherwise physically normal.

Case 6. William J. Phillips, Middle River, Danbury, Conn.; age, 47. Worked in stiffening room 16 years until last winter, when he was obliged to use cocain in order to continue work, and finally gave up that branch of hatting entirely. Can not see to read at night. Had irritation of nose and dry cough. Right optic nerve cupped; vision diminished in both eyes. Physical condition, normal.

Case 7. William R. Williams, Danbury, Conn.; age, 42. Worked 15 years in stiffening room. Began to have trouble with eyes at start; they became irritated and inflamed, and was unable to see in bright light or read at night. There is a chronic discharge from nose and dry cough. Conjunctiva inflamed. Vision: left eye, 15/70; right eye, 15/40; optic nerve cupped; veins distended and tortuous in both eyes. Nose: membrane congested and swollen; excessive secretion of mucous. Throat congested; voice clear. Lungs: had moist bronchial rales on both sides; otherwise normal.

Case 8. Harold Wood, 8 Crofut Street, Danbury, Conn.; age, 18. Worked with wood alcohol for one year. Began to have trouble with nose and eyes first week; began to cough after three weeks; had to stop work eight days one time, and many times during day to recover from effect of alcohol upon the eyes. After

work is unable to see, read, and has blur before eyes constantly. Conjunctiva intensely congested and lids swollen. Fundus intensely congested; veins dilated and tortuous; intolerance to light. Nose: right nostril intensely congested. Lungs: moist bronchial rales on both sides of chest; otherwise normal.

SUMMARY.

Of 60 men in the department of stiffening hats examined, all of them were suffering as stated in their affidavits. None of the men ever used stimulants to excess, many have used them in moderation; they state no man can work in wood alcohol and drink at the same time. Physicians were able to recognize the individuals who worked with wood alcohol from their breath. Stratton and Brown believe that the effects of wood alcohol are constitutional.

APPENDIX C.

I. SUMMARY OF CASES OF POISONING BY DRINKING WOOD ALCOHOL AND PREPARATIONS THEREOF.

1. *Ages of Individuals.*

The ages range from 21 years to 56 years; the largest number are of middle life, although a few cases of children from 8 to 17 years of age and of old persons (65 years of age) are reported.

2. *Sex of Individuals.*

Most of the victims are males, from 5 to 7 per cent. are females, and in a large number of cases the sex is not stated.

3. *Habits of Life.*

In more than half of the cases the habits of life are not stated; of those reported, the majority of the victims were moderate drinkers; from 25 to 30 are stated to have been hard drinkers, a few used tobacco to excess, and some are reported to have been total abstainers.

4. *Occupations.*

The victims were of various stations of life; thus, 7 were convicts; about 25 were Indians, who, being unable to obtain good whiskey, went on a spree with Jamaica ginger, lemon extract, etc.; about 20 were negro and white laborers, 17 boatmen, 15 sailors, 14 soldiers, 7 painters; farmers, bricklayers, millworkers, shoemakers, physicians, ranchmen, mechanics, miners, hotel-keepers, blacksmiths, carpenters, housewives, etc., etc. In a large number of cases the occupation is not stated.

5. *Mode of Occurrence.*

By far the largest number of poisoning cases are due to drinking whiskeys, rum, etc., adulterated with wood alcohol; at least 200 such cases are reported. The ingestion of wood alcohol during prolonged drinking bouts and sprees is next in importance; about 40 authentic cases of such a nature are reported. A large number of poisoning cases are also reported of people who drank wood alcohol ignorant of its toxic action. One remarkable case

of methyl alcohol drinking with suicidal intent in San Francisco is reported by Powers.

6. *Form of the Wood Alcohol Partaken.*

About 250 cases of poisoning are reported as due to drinking "deodorized" wood alcohol, 20 from drinking "Columbian spirits," 25 from Jamaica ginger, 6 from ginger essence, 12 from methylated bay rum, 17 from lemon extract, about 70 from Kunzens balsam, 2 from Florida water, 2 from liniments, 1 from essence of cinnamon, 1 from eau de Cologne, 2 from bitters, 1 from "Cologne spirits," 1 from "Union spirits," and 1 from sherry wine. The amounts ingested are from one-half an ounce in some cases to a quart in others.

7. *Symptoms.*

(a) Very serious cases:

Become ill 24-36 hours after partaking. Cyanose, blueness of hands, feet, legs and face, feeling of nausea, vomiting, prostration, deep forced breathing, longing for air, restlessness, groaning, convulsions, twitchings, clonic and tonic convulsions of limbs, pain in head, limbs and body and especially in epigastrium. Pulse not frequent, and good at first, then small and soft. The conditions of eyes most characteristic; pupils dilated and reactionless, accommodation weak but not altogether paralyzed, visual disturbance and blindness. Death comes suddenly after the paralysis of the respiratory organs; breath ceases, while heart beats for some time.

(b) Not so serious:

Same symptoms; patients who are not in a serious condition suddenly become serious. Condition of pupils and dyspnoea always present. On appearance of respiratory disturbances, cases become serious.

(c) Cases of light poisoning:

Visual disturbance, dilative inactive pupils; no disturbances of breathing. Patients do not show alcoholic intoxication; there is no odor of alcohol. Visual disturbances are general, also amnesia. Diarrhoea seldom occurs; usually patients are constipated.

Opisthotonos was observed in serious cases, head back and held rigid on neck; reflexes were maintained, especially optic nerve reflexes, which were very active.

Conditions of excitation and attack of mania 24-36 hours after beginning of poisoning. In vomit, blood is sometimes found, but never in evacuation. Patients complain of dryness in mouth and throat, thirst, inability to breathe, oppression of chest, pain in side, and feeling of constriction.

Urine contains albuminous matter, which disappears on improvement; stomach contains a slimy substance, sometimes made darker by blood present in it.

Temperature of body, normal. Patients feel an antipathy for alcohol.

The illness is changing; sometimes one symptom becomes stronger, sometimes another; death is sudden, following paralysis of respiratory centers and collapse. First symptoms are forced breathing and physical want of air. Light cases may become serious; reactions may set in at any time; after improving, a patient may again become serious.

8. *General Effects and Results.*

The fatality is very great: out of 720 cases, 390 died, 90 became totally blind; in 85 cases, the vision was impaired, 6-10 became blind temporarily, 31 recovered; and, in about 100 cases, the results are not specifically stated. Thus the mortality is about 55 per cent., total blindness 12 per cent., impairment of vision 12 per cent., and recovery about 4 per cent.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
1	Taylor (1875).	"Poisons"	M	....	.....	Drank methyl alcohol.	Died.
2	Viger & Menjin (1879).	Rec. Ophth. J., 636; L'annee med., 1877.	M	....	Convict; drank small amounts of ethyl alcohol 3 months previously.	Washed out a varnish barrel with 2 L. water and drank $\frac{1}{2}$ liter of liquid (methyl alcohol).	Intense headache, vomiting, profuse sweating, dilation of pupils and delirium. Completely blind next day; sight improved, then turned blind again. Two years later: optic discs snowy white.
3	Dr. H. C. Kipp (1888).	Balt. M. J., 19, 448....	M	28	Painter; on a spree occasionally.	Taken a considerable quantity of wood alcohol.	Pupils widely dilated, eyes protruding, respiration slow and labored, pulse weak, unconscious, cyanotic. Died a few hours later.
4	Dr. A. G. Thompson (1897)	Proc. Phila. M. Soc., 1897, 172.	M	32	Sailor.....	Drank 20 ounces Jamaica ginger in 2 days.	Headache, nausea, and vomiting next day. Became completely blind; vision improved, then turned blind again. 3 $\frac{1}{2}$ months later: R. V. = counting fingers at 1 meter; L. V. = 1-100, eccentric.
5	Drs. MacCoy & Mitchell (May, 1898).	Med. Rec., 53.....	M	21	Attendant; habits good	Drank 4 oz. "Columbian Spirits," repeated dose in 2 hours.	Violent emesis, gastric pain, pupils wide and fixed. Vision = 0; vision improved after 14 days, but 12 months later was totally blind, with atrophy of optic nerves.
6	Dr. H. Woods (Feb., 1899).	Ophth. Rec.....	M	32	Bricklayer.....	Drank Jamaica ginger..	Pain in stomach; vision became dim, then improved, and now again failed; vision eccentric, optic nerve atrophied, contracted fields, absolute central scotoma.
7	Dr. H. Woods, Balt., Md. (1899).	Ophth. Rec.....	M	38	Millworker; often drank to excess.	Drank Jamaica ginger..	Vomiting, diarrhoea, gastro-intestinal cramps. Headache; became unconscious and awakened totally blind. V = fingers at 20 feet for right and 10 feet for left; contracted fields, central scotoma.
8	Dr. H. Woods (Feb., 1899).	Ophth. Rec.....	M	47	Stock herder. Heavy smoker; often drank to excess.	Ginger essence, etc., 1 $\frac{1}{2}$ to 2 pints.	Nausea, vomiting, pain in head, sudden blindness; vision improved to counting fingers at 6 inches; fields limited to small area on temporal side; small central scotoma.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
9	Dr. H. Woods (Feb., 1899).	Ophth. Rec.	M	56	Shoemaker; occasionally went on spree.	Ginger essence, etc., 1½ to 2 pints.	48 hours after, giddiness, headache, gastro-intestinal pains, dimness of vision, then total blindness. Five months later optic nerves atrophied. Vision = 0.
10	Dr. H. Woods (Feb., 1899).	Ophth. Rec., 8, 5,	M	32	Physician; habitual inebriate.	Ginger essence, etc., 1½ to 2 pints.	Headache, vomiting, abdominal pain; became and remained totally blind.
11	Dr. R. S. Patillo (1899).	Ophth. Rec., 8, 599,	M	52	Mechanic; periodic drinker and heavy smoker.	Ginger essence, etc., 1½ to 2 pints.	Nausea, headache, abdominal pain; became blind and is still totally blind.
12	H. Gifford,	Ophth. Rec.,	M	45	Not stated,	½ pint of ½ wood alcohol and ½ water.	Vomiting, headache; became totally blind; pupils wide and fixed. Vision improved, then turned totally blind with atrophy of optic nerves, which is his condition at present.
13	H. Gifford (Sept., 1899).	Ophth. Rec.,	M	33	Miner,	Drank pint "Columbian spirits."	Wildly excited; pulse and respiration rapid; became totally blind; died 24 hours later.
14	Dr. Kuhnt (1899),	Z. Augenhk., 1, 42,	M	24	Workman,	Several ounces of methyl alcohol and whiskey.	Nausea, giddiness; fell into deep sleep; became totally blind; vision returned and is normal at present.
15	Dr. J. F. Raub (Nov. 18, 1899).	Ophth. Rec., 8, 619,	M	....	....	½ ounce of methyl alcohol.	Became and remained totally blind.
16	Dr. J. F. Raub (Nov. 18, 1899).	Ophth. Rec., 8, 619,	M	....	Sailor,	Methyl alcohol and benzine.	Became and remained totally blind.
17	Dr. J. F. Raub (Nov. 18, 1899).	Ophth. Rec.,	M	....	Sailor,	Methyl alcohol and benzine.	Died.
18	Dr. H. Moulton, Ft. Smith, Ark. (July, 1899).	Ophth. Rec., 8, 335,	M	33	Painter,	½ pint of wood alcohol.	Became totally blind, but vision improved to: Vision, R = Pl., L fingers at one foot; complete atrophy of nerves.
19	Callan (1899),	Arch. Ophth., 1899, 129	M	....	....	Drank wood alcohol,	Died.
20	Callan (1899),	Arch. Ophth., 1899, 129	M	....	....	Drank wood alcohol,	Became and remained totally blind.
21	Moulton (1899),	Ophth. Rec., 8, 335,	M	....	....	Drank a large quantity of wood alcohol.	Died.
22	Gifford (1899),	Ophth. Rec., 8, 441,	F	....	....	Drank wood alcohol,	Died.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
23	Payne (1902).....	Ophth. Rec., 10, 662. C. Bl. A. 1902, 176	M	...	.....	Drank large quantity of methyl alcohol.	Became totally blind; optic discs milkwhite; blood vessels of cornea contracted; pupils widely dilated. Died.
24	Gifford (1899).....	Ophth. Rec.....	M	...	.....	Drank methyl alcohol...	Gastro-enteritis set in.
25	Kuhnt (1899).....	Z. Augenhk., 1, 38.....	M	...	Workman in wood distillation plant.	Drank wood alcohol....	
26	.....	.....	.....	.....	.....	.....	.....
27	.....	.....	.....	.....	.....	.....	.....
28	.....	.....	.....	.....	.....	.....	.....
29	.....	Baltimore Ev. News, Dec. 13, 1901.	.....	.....	.....	Drank Jamaica ginger.	All seven died.
30	.....	.....	.....	.....	.....	.....	.....
31	.....	.....	.....	.....	.....	.....	.....
32	.....	.....	.....	.....	.....	.....	.....
33	Moulton (1900).....	Proc. Med. Soc. Ark., 1900, 285.	M	33	Painter.....	Drank 8 oz. of wood alcohol.	Became totally blind; vision improved. Five months later, pupils dilated and inactive. L. V. = fingers at 1 ft. R. V. = Pl. Complete atrophy of optic nerves. Total blindness in three hours; recovery to normal since.
34	Stieren (1901).....	J. Am. Med. Assn.....	M	Adt.	.....	Drank Jamaica ginger..	Vision impaired, 5-200 in each eye; improved since to central V. = 6-200.
35	Harlon (Feb., 1901).....	Ophth. Rec., 10, 81.....	M	30	.....	Three bottles of essence of peppermint and part of bottle of essence of lemon.	Unconsciousness 48 hours; became blind; improved since to fingers at 3 feet; field much contracted; optic discs white, vessels small.
36	Jackson (Apr., 1901)....	Medical Times, Denver.	M	30	.....	Drank wood alcohol....	Unconscious three days; became and remained totally blind.
37	Harlon (Feb., 1901).....	Ophth. Rec.....	M	28	.....	14 bottles Jamaica ginger in one day.	Became totally blind.
38	Moulton.....	Centr. Augenhk., 1901, 406.	M	...	.....	Drank bay rum containing wood alcohol.	8 died, 5 became totally blind, 1 nearly blind, 1 blind temporarily, and 4 recovered without any disturbance of vision.
39	H. T. Guss (1901).....	Med. World, 19, 501....	.....	...	.....	19 cases of serious poisoning by wood alcohol.	Became totally blind.
to 58	.....	.....	.....	.....	.....	.....	.....
59	Stieren.....	J. Am. Med. Assn., 1900	M	...	.....	Drank Jamaica ginger..	

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
60	Gifford (1901).....	M. Herald, St. Joseph, 20, 1325.	M	35	.....	8 ounces of wood alcohol.	Became totally blind; vision improved to almost normal.
61	De Bono (1901).....	Arch. di ottalm., Palermo, 1901-02, 9, 130, 142.	M	43	Hotel keeper.....	15 ounces of a "preparation."	Became and remained totally blind.
62	Burnett (1901).....	Therapeutie ejaz.....	M	65	.....	1 ounce of wood spirit.	Vision impaired permanently.
63	Burnett, Dec., (1901).....	Therapeutie ejaz.....	M	64	.....	Jamaica ginger.....	Permanent blindness.
64	Burnett (1901).....	Therapeutie ejaz.....	M	32	.....	2-4 ounces of pure wood alcohol.	Total permanent blindness.
65	Burnett (Mar., 1902).....	Wash. Med. Ann., 1, 76, 1902, 150.	M	....	.....	6 ounces of Jamaica ginger.	Vision permanently impaired. V = 5-15 ft. 5-35 l; central scotoma of 10"; total color blindness.
66	Payne (1902).....	Ophth. Rec., 10, 662....	M	....	.....	Drank wood alcohol....	Died.
67	Von Fleet (1902).....	Med. Rec., N. Y., 61, 91.	F	....	.....	Drank wood alcohol thinking it to be ordinary alcohol.	Became totally blind, but vision has improved since to R. E. = 20-200; L. E. = 3-200.
68	McConachie.....	Am. Med., 3, 96.....	M	34	Sailor.....	Drank Jamaica ginger....	Became totally blind.
69	Burnett (June, 1902).....	Ophth. Rec.....	M	....	.....	3 ounces of Jamaica ginger.....	Within 48 hours foggy vision; improvement as to R. V.: 165°-10-8.05-15; T. V.: 180°-1.0-7.05-35.
70	Ring (July, 1902).....	Trans. Am. Ophth. Soc., 1902.	F	....	Washerwoman.....	4 ounces of wood alcohol.	Dizziness, nausea, vomiting, dim vision; became totally blind. Vision returned to normal since.
71	Ring (July, 1902).....	Trans. Am. Ophth. Soc., 1902.	F	43	Housewife.....	5 ounces of wood alcohol.	Vomiting, coma; sighing, respiration, followed by death.
72	Ring (July, 1902).....	Trans. Am. Ophth. Soc., 1902.	F	....	Housewife.....	3 ounces of wood alcohol.	Died.
73	Ring (July, 1902).....	Trans. Am. Ophth. Soc., 1902.	M	....	Workman.....	5 ounces of wood alcohol.	Remained totally blind.
74	Ring (July, 1902).....	Trans. Am. Ophth. Soc., 1902.	M	....	Workman.....	4½ ounces of wood alcohol.	Vision impaired to 5-200 for right eye, 10-200 for left eye, with restricted fields, but no central scotoma.
75	Bell (July, 1902).....	Trans. N. H. Med. Soc.	M	....	Prisoner.....	Drank wood alcohol....	Vision impaired; partial recovery.
76	Bell (1902).....	Trans. N. H. Med. Soc..	M	....	Carpenter.....	Considerable quantity of wood alcohol.	Epigastric pain, vomiting, great prostration, pupils dilated, vision dim; became delirious, lapsed into coma, and died.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
77	Bell (1902)	Trans. N. H. Med. Soc..	M	....	Woodsman	Unknown quantity of wood alcohol.	Died.
78	Bell (1902)	Trans. N. H. Med. Soc..	M	....	.....	Wood alcohol, quantity not stated.	Nausea, vomiting, headache, feebleness, pain on movement of eyes, vision dim, pupils dilated and sluggish. Recovered except a permanent defect of vision.
79	Bell (1902)	Trans. N. H. Med. Soc..	M	....	Convict, Maine State prison.	Unknown quantity of "Columbian spirits."	Died.
80	Sherer	Phila. M. J., 2, 792	M	32	Farmer	As above	Nausea, vomiting, vertigo, headache, sweats, stiffness of limbs, vision impaired, R. V. 1-60 eccentric fixation, absolute central scotoma, field contracted; L. F. Pl. only, optic nerves atrophied.
81	Sherer	Phila. M. J., 2, 792	M	....	Farmer	As in case 80	Dizzy, nauseated, vomited, headache, vision dim, completely recovered.
82	Hoitt	Bost. M. S. J., 1903, 62	M	48	<i>Underwood Family.</i> Father.	Drank wood alcohol	Died. Wood alcohol found in stomach.
83	Hoitt	Bost. M. S. J., 1903, 62	F	8	Daughter	Drank wood alcohol	Died. Wood alcohol found in stomach.
84	Hoitt	Bost. M. S. J., 1903, 62	F	22	Daughter	Drank wood alcohol	Died. Wood alcohol found in stomach.
85	Hoitt	Bost. M. S. J., 1903, 62	M	....	Grandson	Drank wood alcohol	Died. Wood alcohol found in stomach.
86	Hoitt	Bost. M. S. J., 1903, 62	F	44	Wife	Drank wood alcohol	Died.
87	Abbot (1903)	Bost. M. S. J., 1903, 63	M	....	.....	Drank "Colonial spirits," declared to be wood alcohol by a chemist.	Died.
88	Abbot	Bost. M. S. J., 1903, 63	M	....	.....	Drank "Colonial spirits," declared to be wood alcohol.	Died.
89	Abbot	Bost. M. S. J., 1903, 63	M	....	.....	Drank "Colonial spirits," another name for wood alcohol.	Died.
90	Wilder	Biochem. Zentr., 4, 2203 No. 561.	M	33	Drunkard	Drank methyl alcohol once.	Became totally blind.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
91	Hartshon (May, 1903)...	Charlotte, N. C., M. J. .	M	36	.....	Drank lemon extract...	Vomiting, vertigo, headache, tenderness of eyeballs. Vision impaired but improved since almost to normal. Died after becoming blind.
92	Main (Sept., 1903).....	Am. Med., No. 10.....	M	44	Watchmaker.....	Lemon extract containing methyl alcohol.	Became blind then died.
93	Armstrong (Oct., 1903)...	Maritime M. News, Halifax, N. S.	M	33	Upholsterer and varnishet.	Bay rum, 1 pint and 7 ounces methylated spirits.	Became blind then died.
94	Armstrong (Oct., 1903)...	Maritime M. News, Halifax, N. S.	M	35	Laborer.....	7 ounces of methylated spirit.	Became blind then died.
95	Buller (Jan., 1904).....	Montreal Med. J.	F	34	Dressmaker, temperate.	$\frac{1}{2}$ ounce methyl alcohol.	Became totally blind, vision improved since to fingers at 3 ft. in each eye. V. fields narrowed, absolute scotoma, optic nerves atrophied.
96	Buller (Jan., 1904).....	Montreal Med. J.	M	39	Barber, temperate.....	$\frac{1}{2}$ ounce methyl alcohol.	Became blind, improved since to R. V. = fingers at 8 ft. L. V. fingers at 3 ft; nerves atrophied.
97	Conboy (1904).....	J. Mich. M. Soc., 3, 536	.....	.....	.....	Drank wood alcohol....	Amblyopia set in.
98	Conboy.....	J. Mich. M. Soc., 3, 536	.....	.....	.....	Drank wood alcohol....	Amblyopia set in.
99	Strohmborg.....	Petersb. Med. Wochschr., 1904, No. 39.	.....	.....	.....	Reports of 18 cases of poisoning in Durpot, Russia from Kunzen balsam containing 50% wood spirit.	15 died and 2 became blind.
118	Buller (Jan., 1904).....	Montreal Med. J.	M	42	Carpenter, temperate...	6 ounces of "Columbian spirits."	Headache, dimness of vision, total blindness, improved since to R. V. = 6-22; L. V. = 6-27.
119	Brunner (Feb., 1904)....	Ophth. Rec., Biochem. Zentr., 3, 122, No. 320	M	47	.....	Wood alcohol, quantity not stated.	Prostration and vomiting several days, vision blurred, then totally blind. Improved at end of 6 $\frac{1}{2}$ months to R. V. 1-45; L. V. 2-40, nerves highly atrophic, vessels small, V field reduced.
120	Foucher (Mar., 1904)....	L'Union Medicale du Canada.	M	22	Laborer.....	1 pint of wood alcohol.	Became and remained totally blind.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
121	Wilder (May, 1904)	Ophth. Rec.	M	33	China decorator.	1 pint of wood alcohol.	Right eye totally blind permanently; L. E. fingers at 1 ft. in temporal field; pupils both dilated.
122	Gifford.	Ophth. Rec., 1901. 443.	M	....	.....	Drank Eau de Cologne.	Became totally blind, no improvement in vision since.
123	Cheatham (1904)	Louisville Month. J. M. S., 12, 27.	M	45	Hard drinker.	Drank sherry wine adulterated with wood alcohol.	Became totally blind.
124	Cheatham.	Louisville Month. J. M. S., 12, 27.	M	....	Music teacher.	Drank wood alcohol.	Became totally blind.
125	Cheatham.	Louisville Month. J. M. S., 12, 27.	M	....	.....	Drank essence of cinnamon made up with wood alcohol.	Became totally blind.
126	Stirling.	Ophth. Rev. London, 24, 38.	M	41	.....	Drank 6 ounces wood spirit.	Vision impaired; R. E. = 1-20; L. E. = 1-10. Total color blindness, optic discs chalk white, retinal vessels contracted.

CASES COLLECTED BY BULLER AND WOOD, J. AM. MED. ASSN., 43, 972, 1058, 1117, 1213, 1289 (1904), NOS. 127 TO 301, INCLUSIVE.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
127	Dr. Stillson, Seattle, Wash.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	J. F. (tramp).....	Drank a large quantity of Union Spirits (wood alcohol).	Died.
128	Dr. Brunson, Chicago...	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	40	B. M. (negro woman)...	Drank $\frac{1}{2}$ pint of Columbian spirits.	Died.
129	Dr. Fagan, North Adams, Mass.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	29	Mrs. X.....	Drank Jamaica ginger and Columbian spirits.	Died.
130	Dr. Collins, Duluth, Minn.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Indians, Minnesota Reservation.	Drank freely of essence of peppermint.	All suffered from severe gastrointestinal symptoms and three died from the effects: one of them became blind before death.
133	Dr. W. G. Craig, Hartford, Conn.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	45	J. P. (Polish).....	Drank a mixture of sugar, water and Columbian spirits.	This was followed by nausea, vomiting, repeated convulsions, coma and death in 24 hours.
134 to 137	Dr. Springer, Coroner's Physician, Cook Co., Ill.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	25 to 40	Laborers (negro).....	Drank an unknown quantity of wood spirits.	Four died from the effects of the poison. One recovered.
138	Dr. G. G. Davis, Phila., Pa.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Lumberman.....	Drank wood spirits used in painting.	Was wildly delirious and died in a few hours.
139	Dr. J. F. Dickson, Portland, Me.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	30	Teamster.....	Drank wood alcohol mixed with syrup.	Became unconscious and died.
140	Dr. J. A. Dingman, Spring Valley, N. Y.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	47	A. McK. (servant).....	Drank wood alcohol....	Died.
141	Dr. J. A. Donovan, Butte, Mont.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Indians.....	Drank wood alcohol....	All three died.
144 to 150	Dr. W. E. Driver, Norfolk, Va.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	29	R. N. and 6 companions	Drank freely of essence of lemon.	All seven died from the results of the poison.
151	Dr. Elwood, Menominee, Mich.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	C. H. (cook).....	Went on a spree with 12 bottles of lemon extract.	Died.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
152	Dr. Enfield, Jefferson, Iowa.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	An adult.....	Drank pint of wood alcohol.	Died.
153	Dr. Engle, Neuton, Ia...	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	20	Mrs. N.....	Drank few ounces of diluted Columbian spirits.	Died in 20 hours.
154	Dr. Engle, Neuton, Ia...	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	30 17	A. Baker..... G. McLeish.	Drank wood alcohol...	Baker died; McLeish was in a critical condition.
155	Dr. W. H. Wood, Sulphur, Ind. Ter.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	30 to 40	4 men.....	Went on a spree with bay rum made of wood alcohol.	One died.
156 and 157	Dr. A. Greene, Anniston, Ala.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	McK. and C.....	Drank wood alcohol thinking it to be grain alcohol.	Both died.
158 and 159	Dr. A. Greenwood, Boston, Mass.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	2 painters.....	Drank wood alcohol...	Both died.
160	Dr. G. E. Hartshorn, S. McAlister, Ind. T.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	G. G. (barber).....	Drank pint of bay rum	Died in 12 hours.
161	Dr. Hartshorn.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	16	Ed. W.....	Drank pint wood spirit thinking it to be grain alcohol.	Died in 6 hours.
162	Dr. R. Hunt and Dr. Stansfield, Pub. H. & Marine Hospital.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	4 Italian woodchoppers.	Went on a spree with wood alcohol.	3 died.
163 and 164	Dr. R. Hunt, Pub. Health & Marine Hospital.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	48	A. P. Baer (soldier); J. Washburn (cook).	Both drank wood alcohol.	Both died.
165 and 166	Dr. R. Hunt.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	E. E. (woodsman).....	Drank 6 ounces methylated spirit.	Died.
167	Dr. J. H. Jamor, Elkton, Ind.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	...	Woman tramp.....	Drank "hot drops" containing 95% wood alcohol.	Died.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and result.
169 170 and 171 172	Dr. G. T. Knowles, Mag- nom, Ill.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	35 65	Farmer..... Blacksmith. Farmer.	Drank lemon extract each.	All three died.
173	Dr. J. J. Main, Barry, Ill.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	40	Man	Drank Jamaica ginger..	Died.
174	Dr. J. J. McKinney, Bar- ry, Ill.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	25	G. K. (Painter).....	Drank methylated alco- hol.	Died.
175 176	Dr. Miles, Bridgeport, Conn.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	45	S. Knowles (soldier)....	Drank wood alcohol....	Died one hour later.
177	J. E. Minney, Topeka, Kan.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	9 Poles.....	Drank 2 gallons of wood alcohol.	2 died; the other 7 recovered.
178 179 and 180 181	Newspaper Rep., Down- ers Grov., Ill. (Feb. 1, 1903).	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	P. O. (engineer).....	Drank wood alcohol....	Died.
182	Newspaper Rep., Rock- land, Mass. (Apr., 1903).	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Frank Helms..... T. Helms. Wm. Conn.	Drank wood alcohol....	All three died.
183	Newspaper Rep., Phila. (Oct., 1903).	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	....	Mrs. F. Progin.....	Drank wood alcohol....	Died.
184	Dr. Patton, Stillwell, Ind. Ter.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	65	L. G. (carpenter).....	Drank lemon extract...	Died.
185	Dr. G. H. Powers, San Francisco, Cal.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	26	A. C. G.....	Took a single dose of wood alcohol with suicidal intent.	Died.
186	Dr. E. H. Robb, Newton, Iowa.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	60	G. C. (barber).....	Drank 3 ounce of bay rum made up with wood alcohol.	Died in 36 hours.
187	Drs. Short and Shaw, Hot Springs, Ark.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	W. T.....	Drank wood alcohol....	Died.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
186	Dr. Short and Shaw, Hot Springs, Ark.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	Companion of above. J. A.	Drank wood alcohol....	Died. A third party to the spree vomited, had cramps in stomach, became unconscious but finally recovered.
187	Dr. C. Storz, Toledo, Ohio.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	42	W. (painter).....	Drank a few ounces of wood alcohol.	Died in 2½ hours.
188	Dr. Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	36	R. (Ind. Ter.).....	Drank bitters containing wood spirits.	Died.
189	Dr. C. Storz, Toledo, O..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	40	I. B.....	Drank wood alcohol....	Complained of pain in the abdomen, became unconscious and died.
190 and 191	Dr. J. W. Scales, Pine Bluff, Ark.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	45	J.....	Drank three bottles of Jamaica ginger and two of bay rum each.	Died with all the symptoms of methyl alcohol poisoning.
192	Surgeon Genl. of Army..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	36	J. W. R. (Private U. S. A.).	Drank Florida water and Columbian spirits.	Died.
193	Surgeon Genl. of Army..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	23	T. O'B. (corporal).....	Drank Columbian spirits.	Died.
194	Surgeon Genl. of Army..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	36	M. O'C. (soldier).....	Drank Columbian spirits.	Died.
195	Surgeon Genl. of Army..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	A. (private U. S. A.)...	Drank wood alcohol....	Died from acute poisoning with methyl alcohol.
196	Surgeon Genl. of Army..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	B. (private U. S. A.)...	Drank wood alcohol....	Died.
197	Surgeon Genl. of Army..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	C. (private U. S. A.)...	Drank a punch made from bay rum, witch hazel, vanilla extract, etc.	Died.
198	Surgeon Genl. of Army..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	...	A. (soldier).....	Drank bay rum made with wood alcohol.	Died.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
199 to 207 208	Dr. J. P. Widmeyer, to Roller, N. D.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Indians from Turtle Mountain Reserva- tion.	Drank Florida water and lemon extract mostly wood alcohol.	Nine of the Indians died, one sur- vived but became totally blind.
208	Dr. G. H. Woodward, N. Y. C.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Man.....	Drank essence of lemon and witch hazel.	Died.]
209	Drs. Bach & Schneider, Milwaukee, Wis.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	46	D. McK. of Ashland, Wis. No previous history of blindness; was not a habitual drinker.	Drank Hinkey's bone liniment.	Within 4 days he became totally blind in left eye and partially blind in right eye; 6 months later his vision was 3-40, there was no perception of light.
210	Beaupre, Quebec, Can...	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	42	Went on spree every month.	Drank $\frac{1}{2}$ tumblerful of methyl alcohol.	Within a few hours was nearly blind, vision in either eye was finger counting at 9 inches; two weeks vision of R. eye = 15-40; vision of L. eye = 15-200.
211	Bell, Vicksburg, Miss....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	50	M. B. (white) black- smith.	Drank Jamaica ginger occasionally for 3-4 months.	Became blind suddenly, sight returned for a short time and then he became totally blind again.
212	Bicknel, Omaha, Neb. ...	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	35	G. W. A. (ranchman in good health.	Drank a considerable amount of wood al- cohol.	Became and remained totally blind.
213	Boris, Seattle, Wash. ...	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	27	German, cabinetmaker.	Drank 2 ounces of wood alcohol.	An hour after was in deep stupor, stertorous breathing, body cold, bloody froth from mouth, pupils dilated. Vision and gait affected for several days.
214	Brundage & Ingals, Brooklyn, N. Y.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	35	Mrs. M. Habitually ad- dicted to excessive alcoholic drinks.	Drank $\frac{1}{2}$ pint of wood alcohol	Became unconscious, sweated, nau- seated, vomited, was delirious, pupils dilated, vision became blurred. Died 36 hours after drinking the wood alcohol.
215	Bruno, New Orleans, La.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	50	.....	Drank one ounce of wood alcohol (Col- umbian spirits).	Became blind, sight returned for a short time, but became blind again and remained so.
216	Bruno, loc. cit.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	.....	Drank a highball made up partly of wood alcohol.	Became and remained totally blind.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
217	Bulston, Jackson, Mich..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	48	John C. (convict).....	Drank wood alcohol, 10 ounces one day and 4 on next day.	Vomited, walk unsteady, pupils were dilated and became blind. Seven months later his vision was finger counting 3-4 inches in each eye.
218	Collins, Duluth, Minn. . .	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	46	Used tobacco, went on spree several times yearly, avoided liquor between sprees.	Drank together with companion 12 bottles of Jamaica ginger.	Vomited, vision began to fail at once. A month later his vision was 2-200 in either eye. Bilateral post neuritic optic atrophy.
219	Buller, Montreal, Can. . .	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	28	Coote. Well built, healthy, no previous history of any disease.	Drank a wine glass of methylated Jamaica ginger.	Had headache, 12-14 hours after sight began to grow dim. Took a second dose and became worse. Three months later central vision in both eyes was completely lost.
220 to 222	Collins, Duluth, Min.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Indians.....	3 Indians drank lemon extract, containing wood alcohol.	All three died.
223	Collins, Duluth, Min.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Indians.....	3 Indians drank lemon extract, containing wood alcohol.	Became totally blind, atrophy of both optic nerves.
224	Craig, Hartford, Conn....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	50	.....	Drank 3 ounces of a mixture of water, sugar and Columbian spirits.	Nausea, vomiting and complete loss of vision in 12 hours. A month later vision was 1-8 in each eye, nerve heads chalk white.
225	Cullom, Nashville, Tenn.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Workman, N. Y.....	Drank wood alcohol....	Went into a stupor and became totally blind, pupils widely dilated and no response to light; nerve heads milk white. Died.
226	Dickson, Portland, Ore..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	30	Teamster, strong, healthy.	Drank a mixture of wood alcohol, water and syrup.	Became totally blind and has remained so.
227	Dickson, Portland, Ore..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	30	Teamster, strong, healthy.	Drank less than his companion, only a few mouthfuls.	
228	Edwards, Columbia Tenn.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Lawyer (young).....	Drank a mixture of bay rum and alcohol. The bay rum contained Columbian spirits.	Pain in stomach, nausea, then became totally blind. Diagnosis toxic amblyopia.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
229	Driver, Norfolk, Va.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	25	J. B. (U. S. sailor).....	Drank wood alcohol....	Became totally blind; diagnosis wood alcohol amblyopia.
230 231	Driver, Norfolk, Va.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	U. S. sailors.....	Drank wood alcohol....	Died.
232	Driver, Norfolk, Va.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	25	A. H. S. (white).....	Drank cider from a country store. (The cider contained wood alcohol).	Became blind, vision returned to left eye to 6-200 and he remained blind in right eye.
233	Dudley, Easton, Pa.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	39	R. W. (pedlar).....	Drank 4 ounces wood alcohol diluted with water.	Became blind; 7 months later vision returned to 1-200 in each eye.
234	Engle, Newton, Ia.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	45	J. F.....	Drank ½ pint of Columbian spirits diluted with water.	Died.
235 and 236	Ford, Sulphur, Ind.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	.....	Went on a spree with methylated bay rum.	Two who drank large quantities died
237 and 238	Ford, Sulphur, Ind.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	.....	.....	Companions of the above drank small quantities, had visual disturbances for 12-14 days. After 2 weeks vision returned.
239	Goldsmith, Sprague & North, Hart. Rep. (June, 15, 1904).	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Wm. Sutherland.....	Drank wine glass of methyl alcohol.	Became blind, then died.
240	Gordon & Buller, Montreal, Can.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	40	B. K. Domestic. Alcoholic, had been drinking two days.	Drank 8 ounces of wood alcohol.	Died.
241	Grawn & Scholtes, Mun-sing, Mich.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	37	J. B. (woodsman).....	Drank 2 quarts of wood alcohol with companion. (See below.)	Died 14 hours after.
242	Grawn & Scholtes, Mun-sing, Mich.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	40	L. B. (woodman).....	Drank 2 quarts of wood alcohol with companion. (See below.)	Died 17 hours after.
243	Harlan, Barringer, Thurman.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Storekeeper.....	Drank Jamaica ginger..	Became totally blind.

No.	Ports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
244	Harlan, Barringer, Thurman.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	38	W. H. J. (merchant)...	Drank Gilbert's Jamaica ginger containing 70 per cent wood alcohol.	Became totally blind, vision improved in 10 days. He has marked optic nerve atrophy.
245	Hubbel & Howe, Buffalo, N. Y.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Dr. B. W. S. N. Y. S.	4½ ounces wood alcohol in 3 doses during 3 days.	Vision became dim, in both eyes. V. R. = 5-30 no jaeger; V. L. = perception of light. 3 months later right pupil torpid, arteries small, discs pale; V = 20-50 and Sn 3. field slightly contracted. Left eye same condition; slightly exaggerated disc, decidedly atrophic. V fingers at 6 ft.; Sn 20 at 12 inches. Same condition 6 months after. Vision disturbed R. E. 10-60; L. E. 10-40 which remained permanent.
246	Dr. Hughes, Salt Lake City, Utah.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	40	J. A. (stonemason).....	Drank freely of wood alcohol.	Both had a long period of insensibility and both were blind on regaining their senses; a neuritis followed by rapid atrophy.
247 and 248	E. E. Jack, Boston, Mass.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	71	J. P.	Drank wood alcohol....	Suffered from severe gastro-intestinal irritation, vomiting and impairment of vision, vision improved until on 18th day. V = 4-60. R. and L.
249	E. Jackson, Denver, Colo.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	....	.....	Drank a large quantity of wood alcohol.	His eyesight was greatly affected for the first day or so, but improved in a few days.
250	Dr. Jamar, Elkton, Ind..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	37	A tramp.....	Drank wood alcohol....	Marked contraction of field in both eyes and vision was permanently reduced 20-100; 20-80 R. and L. of 2 friends who drank with him one died and the other suffered amaurosis.
251	Lamb, Owoso, Mich....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	25	J. F.	Considerable quantity of Columbian spirits.	Lost eyesight R. E. V. = 20-200. L. E. V. = 10-200 with narrowing fields. Condition at present but slightly improved. Optic atrophy.
252	Lamb, Owoso, Mich.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	30	J. B.	Columbian spirits.....	

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253 to 255	Lamb, Owosso, Mich.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	3 Swedes.....	Deodorized wood alcohol.	Central vision greatly reduced, visual fields much contracted optic atrophy.
256	Lewis, Dubuque, Iowa..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	38	J. C. (drunkard).....	Wood alcohol.....	Became blind and died soon after
257	Lewis, Dubuque, Iowa..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	49	... F.....	Wood alcohol $\frac{3}{4}$ cup 4 ounces.	Became blind and remained so.
258	Lippincott, Pittsburg Pa.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	47	F. C. (laborer).....	A large quantity of wood alcohol.	Became blind and still has no light perception.
259	Lippincott, Pittsburg Pa.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	31	J. R. (oilwell driller)...	Drank 24 ounces Jamaica ginger.	Became blind and remained blind ever since.
260	Magee, Topeka, Kans...	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	33	Mrs. S. P.....	Medicine glass of wood alcohol diluted with water.	Vision impaired, R. E. = 16-100 L. E. = 4-200.
261	McKinney, Barry, Ill....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	James Ripple (jeweler, drunkard).	Extract of lemon almost composed entirely of wood alcohol.	Became blind and died two days after ward.
262	Minney, Topeka, Kans..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Pole, farmhand.....	A large quantity of wood alcohol.	Became totally blind and has remained so ever since.
263	Moore, Huntington, W. Va.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	36	G. S. (baker).....	Wood alcohol.....	Became blind, present vision R. E. = fingers at 12 inches; L. E. = with lenses 20-40.
264	Moore, Huntington, W. Va.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	45	House painter.....	$\frac{1}{2}$ pint methylated spirits.	Became totally blind, one year later he was still totally blind, both discs were white.
265	Moulton, Ft. Smith, Ark.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	52	S. W. McK.	4 bottles of essence of lemon.	Became totally blind, his vision improved until when last seen. R. E. = 10-100; L. E. = finger counting at 3 feet.
266	Murray, Cedar Rapids, Iowa.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	Male cook in lumber camp	Drank a liniment for external and internal use about 72 ounces.	Vision impaired, pupils widely dilated, skin cool and moist. Vision improved since.

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267 to 269	Oliver, Phila., Pa.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	30	Skilled laborers.	Wood alcohol.	One had his central vision reduced 1-8 of normal, 1 by 1-15 both by reason of large positive scotomata. Became unconscious, then delirious and died.
270	Dr. Oren, Lewiston, Ill. .	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	48	Frank H. (laborer, habitual drunkard).	Drank freely of lemon essence.	Became and remained totally blind.
271	Dr. Patterson, Grand Rapids, Mich.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	17	Mr. H. (habitual drinker).	Drank wood alcohol by mistake.	Became totally blind and died a little after.
272	Patton & Williams, Stillwell, Ind. Ter.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	24	P. F.	6-7 bottles of lemon extract.	Became blind then died.
273	Patton & Williams, Stillwell, Ind. Ter.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	60	W. H. H. (merchant) ..	Lemon extract.	Headache, dimness of vision, vomiting and was entirely blind for 48 hours. He improved slightly under pilocarpin and strychnia.
274	W. T. Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	54	W. from Ind. Ter.	Drank Columbian spirits.	Headache, vomiting, and other gastrointestinal symptoms, followed by blindness, optic atrophy, with narrowing of the retinal vessels. The atrophy remained permanent. Next morning headache, vomiting, dimness of vision. In 48 hours V. R. E. counting fingers at 3 feet; F. E. = 20-200. When last seen vision was almost normal.
275	W. T. Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	43	K. from Ind. Ter.	Jamaica ginger, lemon extract and peruna.	Complained of blindness, dyspnea and pain in the stomach. Died soon after.
276	W. T. Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	24	E. from Ind. Ter.	Drank 1½ pints of bitters.	Became dizzy, vomited, headache, eyeballs sensitive to touch, blind in 3 days, optic neuritis followed by atrophy.
277	W. T. Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	34	S. T.	Lemon extract for 3-4 days.	Headache, tenderness of eyes, gastric disturbances. Blind in 5 days, papillo-macular atrophy.
278	Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	46	H.	Wood alcohol.	
279	Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	19	Miss F.	Drank cologne spirits. .	

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280	Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	63	H.....	Wood alcohol.....	Violent headache, vomiting. Vision reduced R. E.=20-200; L. E.= fingers at 3 feet.
281	Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	29	M. Ind. Ter.....	Drank one pint of Columbian spirits.	Followed by vomiting and headache. Eyes tender on pressure. Result, much diminished vision, central scotoma and contracted fields.
282	Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	34	S.....	Drank 4 bottles of Jamaica ginger.	Became semi-comatose and totally blind. At first improvement occurred but finally optic atrophy set in.
283	Dr. Saunders, Schenectady, N. Y.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	38	McA. (steamfitter).....	Drank wood alcohol.....	Followed by deep, labored breathing, face flush, skin bathed in sweat, restlessness, pain in stomach, pupils dilated. Became totally blind and death followed convulsive spasms. Followed in 20 hours by severe vomiting and total blindness. Remained blind 36 hours after which vision improved. Nine months later R. E.=1-20; L. E.=1-100. Fields greatly contracted, all color perception lost, optic discs white, sluggish reaction to light.
284	Dr. Seales, Pine Bluff, Ark.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	46	H. E. (hard drinker)...	Drank 6 ounces of wood alcohol.	Was seized with violent intestinal irritation and became totally blind. He never recovered his eyesight.
285	Salmon, Okla. City, Okla.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	45	M. O'C. (railroad section boss).	Drank three bottles of Jamaica ginger, some bay rum and Hostetter's bitters.	Became and remained totally blind.
286	Drs. Sneed & McReynolds, Dallas, Tex.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Negro, barber, a chronic alcoholic.	Drank bay rum made up with wood alcohol.	Vision disturbed. Perception of light in R. E.; nerve white, all vessels attenuated. L. E. V.=10-200, nerve waxey white, vessels attenuated.
287	Dr. Smith, Detroit, Mich.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	20	4-5 tumblers of wood alcohol.	

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288 and 289	Surgeon General of the Army.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	A and B.....	Drank wood alcohol diluted with water.	Followed by gastric pain, vomiting, dryness of mouth and throat, pupils dilated, vision dim. Both died soon after.
290	Surgeon General of the Army.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	29	T. H.....	Drank methylated bay rum and Florida water.	Became totally blind, vision improved slightly until he could count fingers at 18 inches. There has been no improvement since.
291	Dr. Toms, Nyack, N. Y..	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	45	A. B. (servant, alcoholic.)	Drank $\frac{1}{2}$ pint of wood alcohol.	Became blind then died.
292	Dr. Van Kirk, Whateon, Wash.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).....	M	38	T. P. (laborer).....	Drank $\frac{1}{2}$ ounce of wood alcohol.	Became totally blind, vision improved slightly. At present vision in L. E. is light perception only; R. E. vision quite useful.
293	Dr. Weeks, N. Y. C.....	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	38	E. V.....	Drank a cupful of wood alcohol.	On following day vision became impaired, since then there has been some improvement. Four months later V. R. E. = 30-40; L. E. = fingers at 8 feet.
294	Dr. Welsh, Grand Rapids Mich.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	15	J. D.....	Drank wood alcohol more than once, also Jamaica ginger.	Became totally blind and remained so.
295	Dr. Welsh, Grand Rapids, Mich.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	14	J. M.	Drank wood alcohol....	Became totally blind but vision improved to 3-200 in either eye.
296	Dr. White, Richmond, Va.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	S. N.....	Drank a large quantity of Jamaica ginger.	Vision became impaired, since then it remained at 20-200 type at four inches. The diagnosis was retro-ocular neuritis, with atrophy of the papillo-macular bundle.
297	Drs. White & Williams, Richmond, Va.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	21	S. W. (clerk).....	Drank 4 bottles of essence of lemon, each containing 2 ounces.	Became totally blind but his sight improved since to 3-20.
298	Drs. Vinton & Dean, Iowa City, Ia.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904)..	M	37	W. H. (printer).....	Drank Jamaica ginger habitually.	Eyesight began to fail; he then became totally blind.

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299	Drs. Vinton & Dean, Iowa City, I.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	36	C. F. (printer)	Drank 1 dozen small bottles essence of lem- on.	Became totally blind, dyspnoic, cyno- tic and extremities very cool. He was seized by convulsion and died soon after.
300	Dr. Widmeyer, Rolla, N. D.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	....	Indian, Turtle Mountain Reservation.	Drank lemon extract and ½ teacupful of Florida water.	Had intestinal pain burning in stom- ach and nausea, vomited, had marked dysuria, and became totally blind. Of his nine companions, all died.
301	Dr. Woods, Baltimore, Md.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	F	40	Laborer's wife	Drank 3-4 tablespoons full Jamaica ginger daily for several years to improve digestion.	Vision impaired.
302	Dr. Boris, Seattle, Wash.	J. Am. Med. Assn., 43, 972, 1058, 1117, 1213, 1289 (1904).	M	32	S. M. (German, painter)	Drank 3 ounces of Co- lumbian spirits used in his shop for dis- solving shellac.	Pulse weak, temperature subnormal, became totally blind. Blindness continued for three weeks when sight was gradually restored.
303 to 327	Sprague (1905)	Dominion Month., 24, 11.	M	....	.....	Drank whiskey contain- ing wood alcohol.	All died.
328	Koller (1905)	Mt. Sinai Hosp. Rep., 4, 376.	M	42	.....	Drank whiskey contain- ing wood alcohol.	Became totally blind, sight improved to R. E. = 15-28; L. E. = 15-30.
329	Stirling (1905)	Ophth. Rev., 24, 38. . .	M	41	.....	Drank 6 ounces wood alcohol.	Became totally blind, vision improved to R. E. = 1-20; L. E. = 1-10, total color blindness.
330	Jelliffe (1905)	Med. News, 86, 387. . .	M	34	Constant drinker.	Drank Columbian spir- its in small quantities for 3 months thinking it to be ordinary al- cohol.	Paralysis of extensions, drop-wrist, ptosis, and partial amblyopia. He recovered in 4 months except a blurring of vision.
331 to 348	Nagel (1905)	J. Am. M. A., 46, 1560.	M	....	.....	Drank wood alcohol. . .	Death followed.
349	Koller (1905)	M. Rec., 68, 10. . . . .	....	....	.....	Drank wood alcohol in some form.	Death followed.
350	Judd (1905)	Rep. Surgeon Gen. U. S. Navy, 1905, p. 195.	M	....	Private marine, habitual drinker.	Drank one quart of wood alcohol.	Died.
	Scudder & Collier	Virchow-Hirsch, Jahres- ber., 1905. 334. 335	....	....	.....	Drank wood alcohol. . .	Became blind in 3 days.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
351	Strohmborg (1906).....	Petersb. Med. Wohnschr., 31, 55.	M	46	Farmer.....	Drank Kuntzen's balsam containing wood alcohol.	Became totally blind, vision.
352	Strohmborg.....	Petersb. Med. Wohnschr., 31, 55.	M	31	Prisoner.....	Drank wood alcohol used to dissolve shellac.	Died.]
353 to 382	Strohmborg.....	Petersb. Med. Wohnschr., 31, 55.	.....	.....	.....	Wood alcohol drinking.	Reports of 30 deaths from wood alcohol drinking at a village wedding in Russia.
383 to 402	Strohmborg.....	Petersb. Med. Wohnschr., 31, 55.	.....	.....	.....	Wood alcohol drinking.	Also of 20 people in another village (Russia) who died from wood alcohol poisoning.
403	Nagel & Krudner (1905)	J. Am. M. Assn., 1905, 18; Biochem. Zentr., 1906, 802.	M	.....	.....	Drank one glass of methyl alcohol.	Became totally blind.
404	A. H. Bogue (1906).....	Vermont Med. Month., 12, 31.	M	70	.....	Drank $\frac{1}{2}$ pint of what was supposed to be ordinary alcohol from Nov. 22 to 23.	Awoke with severe pain in chest, back and shoulders. Violent pain in stomach. Movement of jaws with pain. Finally died, 3 a. m. next day.
405	A. H. Bogue (1906).....	Vermont Med. Month., 12, 31.	M	43	.....	Drank probably $\frac{1}{2}$ pint bottle of liquor.	Severe pain in stomach, chest and jaws 3 hours later (9 p. m.). At 10 he vomited. Died 1:30 a. m. Result of autopsy was negative. Stomach contents—considerable alcohol.
406	A. H. Bogue (1906).....	Vermont Med. Month., 12, 31.	F	25	.....	Drank $\frac{1}{2}$ pint of same brand as above.	Complained of pains just before 10 p. m. Went to sleep. Found dead by her husband at 6 a. m.
407	A. H. Bogue (1906).....	Vermont Med. Month., 12, 31.	M	46	.....	Drank one ounce of wood alcohol mixed with cider.	Complained of inability to see distinctly; 9 p. m. grew worse, until totally blind at 12 p. m. At 12 p. m., suffered from heart failure, irregular and thready pulse, cold and covered with profuse perspiration. Under stimulants as strychnine, whiskey, etc. Almost fully recovered.

No.	Repts and date	Journal	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
408	A. H. Bogue (1906).....	Vermont Med. Month., 12, 31.	M	40	.....	Drank 4 ounces alcohol through 2 days.	Inability to see next day. Weak, irregular pulse. Given hypodermic strychnine 1-50 gr. and spirits of ammonia. Recovered to a certain extent. Saw more clearly. Had headache for 48 hours.
409	A. H. Bogue (1906).....	Vermont Med. Month., 12, 31.	M	47	.....	Drank one pint wood alcohol.	Suffered from prostration. Some indistinctness of vision. Otherwise well. Did not have the usual headache or blindness.
410	A. H. Bogue (1906).....	Vermont Med. Month., 12, 31.	M	42	.....	½ pint of liquor as in 1 and 2.	Inability of co-ordination of movements without slightest sense of intoxication. Pain in stomach and nausea; ate raw eggs and vomited freely. Complained of mist before eyes. Treatment with dose of castor oil every two hours. Died within an hour.
411	C. A. Wood.....	Internatl. Clinic, 1, 68 (1906).	M	45	S. Knowles (private U. S. A., alcoholic).	Drank wood alcohol....	All died.
412 to 421	C. A. Wood.....	Internatl. Clinic, 1, 68 (1906).	.....	.....	Indians.....	Drank Florida water and lemon extract containing wood alcohol.	Seven died; 10 suffered partial blindness.
422 to 438	C. A. Wood.....	Brit. M. J., 2, 1855 (1906).	M	20-50	Crew of a boat.....	Each drank from ¼ pint to 1 pint of wood alcohol.	One died, the other suffered from the effects.
439 to 444	C. A. Wood.....	Brit. M. J., 2, 1855 (1906).	M	.....	Military convicts.....	Drank partially purified wood alcohol.	.....
445 and 446	C. A. Wood.....	Brit. M. J., 2, 1855 (1906).	.....	.....	.....	.....	.....
447	C. A. Wood.....	Brit. M. J., 2, 1855 (1906).	M	41	H. T. (laborer).....	Drank a whiskey glassful of wood alcohol.	Vision became impaired; to right eye = 12-200, left eye = 20-200.
448	C. A. Wood.....	Brit. M. J., 2, 1855 (1906).	.....	.....	H. R. (Dane)..... tea.	Drank ½ cupful of wood alcohol mixed with tea.	Became blind, but vision improved and then became worse again. Four months later his vision was shadow perception in both eyes.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
449 and 450	C. A. Wood.....	Brit. M. J., 2, 1855 (1906).	M	....	Indians.....	Drank cheap whiskey adulterated with wood alcohol.	Both died.
451 and 452	C. A. Wood.....	Brit. M. J., 2, 1855 (1906).	M	....	Two men from Winnipeg, Man.	Drank purified wood alcohol.	Died. Wood alcohol was determined to be the cause of the poisoning at the coroner's inquest.
453	(1906).....	Chem. & Drug. Cir., July, 1906. 257.	M	....	At a drinking bout.....	Drank wood alcohol obtained from a drug-gist.	Died.
454	(1906).....	Chem. & Drug. Cir., July, 1906. 257.	M	....	At a drinking bout.....	Drank wood alcohol obtained from a drug-gist.	Died.
455	(1906).....	Chem. & Drug. Cir., July, 1906. 257.	M	....	At a drinking bout.....	Drank wood alcohol obtained from a drug-gist.	Became seriously ill; recovered.
456	(1906).....	Chem. & Drug. Cir., July, 1906. 257.	M	....	At a drinking bout.....	Drank wood alcohol obtained from a drug-gist.	Became almost totally blind.
457	Stirling (1905).....	Ophth. Rev., 1905, 24, 38.	M	41	.....	Drank 6 oz. of wood spirit.	Became totally blind, but his vision improved since to R. E.=1-20; L. E.=1-10. Pupils widely contracted to light, total color blindness.
458	Krudner (1907).....	Arch. d'Ophth., 716....	....	....	.....	Drank methyl alcohol..	Blindness, in Rigu, Russia, from methyl alcohol poisoning.
459	H. E. Odell (1907).....	U. S. Nav. M. Bull., Wash., 1, 99.	M	....	U. S. Navy.....	Drank bay rum and water made up with wood alcohol.	Died.
460	H. E. Odell (1907).....	U. S. Nav. M. Bull., Wash., 1, 99.	M	....	U. S. Navy.....	Drank bay rum and water made up with wood alcohol.	Died.
461	H. E. Odell (1907).....	U. S. Nav. M. Bull., Wash., 1, 99.	M	....	U. S. Navy.....	Drank bay rum and water made up with wood alcohol.	Died.
462	Montgomery (1907).....	Brit. M. J., 1, 375.....	M	....	.....	Drank large quantity of methyl alcohol.	Became and remained totally blind.
463	Tschernolozow (1907)...	Ophth. Klinik.....	M	....	Sailor.....	Drank two glasses of methylated alcohol.	Two days apathy; vomiting followed, and visual disturbance.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life	Mode of occurrence.	General effects and results.
464.	Tschermolosow (1907)...	Ophth. Klinik.....	M	....	Sailor.....	Drank four glasses of methyl alcohol.	Two days apathy; vomiting followed, and visual disturbance.
465.	Lowenthal (1907).....	Klin. Monatsbl., 235..	M	29	.....	Drank tea mixed with wood alcohol.	Next day he vomited; the day after that blindness; dilated, reactionless pupils, myopia with staph. post, optic nerves pale, vessels pale.
466	Krudner.....	Zeitschr. Aug., 16, Erg. Helt.	....	....	.....	Drank methyl alcohol..	Blindness in Rigu, Russia, from methyl alcohol poisoning.
467	Krudner (1907).....	C. Bl. of A., 216.....	....	....	.....	Drank methyl alcohol..	Blindness in Rigu, Russia, from methyl alcohol poisoning.
468	Sinkowitch (1908).....	Kasanski Medizinski J., 1908, 399.	M	46	.....	Drank two glasses of "Kinder balsam."	Became totally blind; optic nerves atrophied, vessels contracted; no improvement two months later.
469	Sinkowitch (1908).....	Kasanski Medizinski J., 1908, 399.	M	52	.....	Drank 1 lb. of "Kinder balsam."	Totally blind.
470	Sinkowitch (1908).....	Kasanski Medizinski J., 1908, 399.	M	42	Syphilitic.....	Drank 1 lb. "Kinder Balsam."	Vision impaired, R. E. 5cc.; L. E. 9 cc. concentric contraction, neuritic; optic nerve, atrophy, vessels contracted.
471	Sinkowitch (1908).....	Kasanski Medizinski J., 1908, 399.	M	22	.....	Drank 1 lb. "Kinder balsam."	Vision impaired; permanently R. E. 6 cc.; L. E. 5-6 cc. Amaurosis, optic nerves atrophied.
472	Sinkowitch (1908).....	Kasanski Medizinski J., 1908, 399.	M	22	.....	Drank 2 lbs. "Kinder balsam."	Pain in head and breast; vision impaired permanently to R. E.=20 cc.; L. E.=3 cc. neuritic optic nerves; atrophy with contracted vessels.
473	Kassas (1908).....	Nowojen Medizinje, 1908, 357.	F	..	In Russia.....	Drank diluted methyl alcohol.	Became blind.
474	A. H. Pearce (1909).....	Boston M. & S. J., 1909, CIX, 237.	M	50	Employed in factory. Addicted to habit.	Drank Columbian spirits.	Complained of headache, dizziness, vomiting, abdominal pains. That night became totally blind. Death followed later.
475	A. H. Pearce (1909).....	Boston M. & S. J., 1909, CIX, 237.	....	....	.....	Drank 1½ ounces of Colonial spirits.	Became ill; worse next day; complained of epigastric pain, nausea, and great prostration. Next morning became unconscious. Died later.

No.	Reports and adte.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
476	A. Natanson (1909).....	Deutsch Med. Wochensh. Berl., 1909, No. 45, 35, 971.	M	45	.....	Drank $\frac{1}{2}$ glassful of "Kinder balsam."	Vision became permanently impaired.
477 to 502	Kassas (1908).....	Nowoje w. Medizine, 1908, 357.	.....	.....	Reports of 26 persons in Waldimir-Wolynsk, Russia.	Drank methyl alcohol (lack spirit).	14 died.
503 to 517	Kassas (1908).....	Nowoje w. Medizine, 1908, 357.	.....	.....	Reports of 15 wedding guests at a Russian feast.	Drank methyl alcohol....	Four died; one woman became totally blind and one man became totally blind
518	Gruning.....	Festschr. Deutsch. Hosp., 1909.	M	40	.....	Drank $\frac{1}{2}$ bottle of whiskey.	Next morning was blind. 8 days later no improvement. On treatment improved to 1-200 in right and 1-40 in left eye.
519	Bachmann (1909).....	U. S. Nav. Bull., 3, 33.	M	.....	Chief yeoman on U. S. S. St. Louis.	Drank fluid from rubber cement mostly wood alcohol.	Died. Post mortem: Stomach empty, mucosa dark and injected, small hemorrhages into membrane visible over entire surface. Lungs: lower lobes congested and consistency weakened; entire lungs floated.
520	Bachmann (1909).....	U. S. Nav. Bull., 3, 33.	M	.....	Blacksmith on U. S. S. St. Louis.	Drank fluid from rubber cement mostly wood alcohol.	Died. Post mortem: hemorrhagic points over mucosa of stomach; liver and lungs congested.
521	Bachmann (1909).....	U. S. Nav. Bull., 3, 33.	M	.....	Fireman on U. S. S. St. Louis.	Drank fluid from rubber cement mostly wood alcohol.	Died. Post mortem: small hemorrhages part of mucosa of stomach viscid yellow mucous adherent to membrane. Liver and lungs congested.
522	Bachmann (1909).....	U. S. Nav. Bull., 3, 33.	M	.....	Electrician on U. S. S. St. Louis.	Drank fluid from rubber cement mostly wood alcohol.	Vomited, pulse 110, pupils dilated, vision dim. Improved, and at time of discharge pupils were dilated and he could barely distinguish fingers 18 inches from eyes.
523	Gruning (1909).....	Festschr. Deutsch. Hosp.	.....	.....	(Young).....	Drank cheap wine adulterated with methyl alcohol.	Became totally blind but vision improved to R. E. = 1-20; L. Eye. = 1-200.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
524	C. Koller.....	J. Am. Med. Assn., 1910, 1866.	F	....	Mrs. M. D. (temperate habits.)	Drank about one table-spoonful of brandy adulterated with wood alcohol.	1898 29 Vision was impaired 7 weeks after; the vision in each eye was 20-50.
525	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	M	....	Andreas Cs. Infantry soldier. Was drunk at times.	Drank wood alcohol....	Died. Methyl alcohol was found in the urine of the victim.
526	Felletar.....	Pest. Med. Chir. Presse 47, 215, 223, 231 (1911).	M	....	Sigmund K., orderly. Drunk at times.	Drank wood alcohol....	Died. Methyl alcohol was found in the urine of the victim.
527	Felletar.....	Pest. Med. Chir. presse, 47, 215, 223, 231 (1911).	M	24	A man from Miskocz, Austria.	Drank wood alcohol....	Died.
528	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	F	30	.....	Drank wood alcohol....	Died.
529	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	F	56	F. Fest.....	Drank tea with rum 2-3 deciliters. The rum was adulterated with wood alcohol.	Died.
530	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	M	58	F. Fest.....	Drank tea with rum 2-3 deciliters. The rum was adulterated with wood alcohol.	Died.
531	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	F	24	B. Fest.....	Drank tea with rum 2-3 deciliters. The rum was adulterated with wood alcohol.	Died.
532	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	F	30	F. Petrusovics.....	Drank tea with rum 2-3 deciliters. The rum was adulterated with wood alcohol.	Died.
533	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	F	51	K. Flekats.....	Drank tea with rum 2-3 deciliters. The rum was adulterated with wood alcohol.	Died.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
534	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	M	53	I. Namesanski.....	Drank $\frac{1}{2}$ liter of rum together with his friend Mullner. Rum was adulterated with wood alcohol.	Died; became blind before death. Methyl alcohol found in the body and in the urine.
535	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	M	53	F. Mullner.....	Drank $\frac{1}{2}$ liter of rum together with his friend Namesanski. Rum was adulterated with wood alcohol.	Died. Methyl alcohol found in the blood and urine.
536	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	F	....	J. Natter.....	Drank tea with rum adulterated with wood alcohol.	Died.
537	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	M	....	M. Fest.....	Drank tea with rum adulterated with wood alcohol.	Died.
538 to 567	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	....	....	30 people in a town of Torontaler, Komitats, Austria.	Drank adulterated liquors.	13 died.
568 to 580	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	....	....	13 people in Miskolcz, Austria.	Drank adulterated rum	8 died; 5 became blind.
581 to 592	Felletar.....	Pest. Med. Chir. Presse, 47, 215, 223, 231 (1911).	....	....	12 in Groswalden.....	Drank adulterated liquors.	Died.
593 to 722	Stadelmann & Magnus-Levy. (1912).	Berl. Klin. Wochschr., 48, 193.	....	....	A large number of persons in Berlin drank brandy composed of 2-3 methyl alcohol and 1-3 ethyl alcohol.	Drank wood alcohol in brandy.	Out of 130 cases, 58 died; in 42 cases the vision was impaired, and 30 recovered.
723	Pick.....	Berl. Klin. Wochschr., 1912, 888.	M	33	M. Paul (laborer).....	Drank brandy adulterated with wood alcohol.	Impairment of vision due to amaurosis followed by death.
724	Pick.....	Berl. Klin. Wochschr., 1912, 888.	M	32	G. Willy, (skilled workman).	Drank brandy adulterated with wood alcohol.	Died.
725	Pick.....	Berl. Klin. Wochschr., 1912, 888.	M	43	August H. (locksmith).	Drank brandy adulterated with wood alcohol.	Died.

II. SUMMARY OF CASES OF POISONING BY INHALATION OF WOOD ALCOHOL.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
1	H. Gifford, Omaha, Neb., Sept., 1899.	Ophth. Rec., 8, 441....	M	31	Painter, moderate smoker and drinker.	Shellacked beer vats 20x 11. The temperature of vats was 70°F. The shellac was made up with Columbian spirits.	After 2 weeks nausea and headache. Became totally blind but since then sight improved so that R. E. = fingers at 3 ft.; L. E. = fingers at 1 ft. Discs opaque white.
2	Pattilo, Dec., 1899, Chicago.	Ophth. Rec., 8, 539....	M	36	Painter, no drinker....	Shellacked beer vats 20x 11. The temperature of vats was 70°F. The shellac was made up with Columbian spirits.	End of 4 day's dizziness headache, on 6th day became totally blind; vision improved to R. E. = fingers at 3 ft.; disc bluish tint; L. E. = light perception only, disc white, vessels slightly contracted.
3	Pattilo, Dec., 1899, Chicago.	Ophth. Rec., 8, 599....	M	36	Painter, no drinker....	Shellacked beer vats. Shellac was mixed with Columbian spirits. Vats badly ventilated.	Became totally blind, but vision improved to R. E. = fingers at 3 ft.; L. E. = fingers at 1 ft.
4	Wurdemann.....	Ophth. Rec., 2, 995....	M	33	Painter, no drinker....	Shellacked beer vats 6 days using Columbian spirits as a solvent for the shellac.	Became totally blind but sight has improved since.
5	Wurdemann.....	Ophth. Rec., 2, 995....	M	....	Painter.....	Varnished vats with a mixture composed of shellac and Columbian spirits.	Died.
6	Wurdemann.....	Ophth. Rec., 2, 995....	M	....	Painter.....	Varnished vats using Columbian spirits as solvent.	Methyl alcohol amaurosis set in.
7	Hale, 1901.....	Ophth. Rec., 1901, 10, 662.	M	....	Cooper, no drinker....	Inhaled wood alcohol vapors from shellac.	Amblyopia set in.
8	Hale, 1901.....	Ophth. Rec., 1901, 10, 662.	M	....	Cooper, no drinker....	Inhaled wood alcohol vapors from shellac.	Amblyopia set in.
9	Schweinitz, June, 1901.	Ophth. Rec., 1901, 349.	M	39	Painter. Tobacco and alcohol moderate.	Used wood alcohol in varnish and to hands and arms after work.	Chilliness and pain in legs in morning, became totally blind and has remained so.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
10	Herbert, 1902.....	Am. Med., 3, 300.....	M	38	Painter.....	Inhaled methyl alcohol and charcoal fumes.	Had to give up work because of nausea and dizziness. Became totally blind but vision improved to V = 6-V + for distance and for near work + 0.50-D with which he could read the finest type.
11	Stricker.....	Ophth. Rec., 6, 249.....	M	....	Varnisher.....	Inhaled the vapors from shellac which was dissolved in wood alcohol.	Amaurosis set in.
12	Conboy, 1904.....	J. Mich. M. Soc., 3, 536.	M	....	Cleaner.....	Inhaled wood alcohol while cleaning.	Became and remained totally blind.
13	Conboy, 1904.....	J. Mich. M. Soc., 3, 536.	M	....	Cleaner.....	Inhaled wood alcohol while cleaning.	Became and remained totally blind.
14	Conboy, 1904.....	J. Mich. M. Soc., 3, 536.	F	56	Healthy woman. No history of blindness.	Washed head and face with wood alcohol daily.	Vision impaired; V. R. 8-20; V. L. 8-20.
15	Dr. Todd, Minneapolis, Minn.	.....	M	45	H. T. J. (painter). No previous history of disease, drinks one glass of liquor in six months.	Varnished and shellacked in small room. Varnish and shellac was dissolved in Columbian spirits.	Vision became dim but returned to normal in two months.
16	C. Wood & J. Buller....	J. Am. M. Assn., 1904..	M	56	Cleaner and dyer.....	Had been cleaning and dyeing clothes in alcoholic preparation. Did not drink any wood alcohol.	Headache and vomiting. Vision reduced to perception of light in 10 days. Under pilocarpin recovered most of his sight in 61 days.
17	Buller & Wood, 1904, Cincinnati, Ohio.	J. Am. M. Assn.....	M	44	W. E. C. (painter).....	Had been varnishing and shellacking inside of closets in a Cincinnati hotel. The shellac was dissolved in wood alcohol.	Became dizzy while at work, had an intense headache, stopped work and got some fresh air. Returned to work and was again attacked by nausea, vomiting and headache and discontinued work. On 3-4 day his eyesight began to fail and at end of week central vision was 5-100. Had double optic neuritis, followed in a few months by partial atrophy and large central scotoma in both eyes. When last seen was unable to work on account of impairment to sight.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
18	Dr. Driver, Norfolk Va..	J. Am. M. Assn.....	M	54	E. L. (white).....	Shellacked the benches and interiors of several schools. Shellac was dissolved in wood alcohol.	He awoke two mornings later totally blind, he remained blind for two weeks when sight began to improve, especially in the left eye. In last two years vision in left eye improved some.
19	Dr. Gifford, Omaha, Neb.	J. Am. M. Assn.....	F	35	Woman.....	Had been burning a methyl alcohol lamp in her room to warm water for 2-3 months. She never drank any.	Vision impaired 20-200 in each eye. Vision began to improve and rose to 20-200 in R. E. and 20-70, in L. E.
20	Dr. Lippincott, Pittsburgh, Pa.	J. Am. M. Assn.....	M	44	S. E. S. (varnisher).....	Worked a whole day varnishing tanks in a brewery. The varnish was dissolved in wood alcohol.	Two hours after ending work went into a comatose condition, which lasted 24 hours. When he awoke vision was impaired, but improved since. Two years later vision of L. E. failed entirely. Soon after the poisoning he was taken with left-sided pneumonia which developed into tuberculosis of which he died two years later.
21	Dr. North, Brooklyn, N. Y.	J. Am. M. Assn.....	M	48	H. E. W. (varnisher)...	Was employed as a varnisher of beer vats. The varnish was dissolved in wood alcohol. The vats were badly ventilated.	Vision became impaired 20-70 in each eye, optic papillae pale. On prompt treatment vision improved almost to normal in each eye.
22	Dr. North, Brooklyn, N. Y.	J. Am. M. Assn.....	M	35	A. H. S. (shellacker)...	Was employed as beer vat shellacker. The vats were ill ventilated.	Vision became impaired to 10-200 with every indication of optic atrophy, the discs being very white. Long continued treatment brought improvement of vision to 20-50 in each eye.
23	Dr. Solomon, Okla. City, Okla.	J. Am. M. Assn.....	.....	5 mo.	A. J. (infant).....	Had been burning a wood alcohol lamp by the crib in which the infant slept.	Vision became impaired, pupils constricted, optic discs pale, arteries narrow. Vision improved, total recovery.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
24	N. T. Wilson, Elizabeth, N. J.	J. Am. M. Assn.	M	42	O. E. H. (mixer)	Had been mixing shellac with Columbian spirits in cabinet factory.	Vision was reduced to 10-200 discs were pale and vessels very small. He frequently bathed his hands in the alcohol to remove the shellac. He never drank any of it. Became totally blind.
25	.....	Chem. Drug. Circ., Dec., 1905, 449.	M	....	Painter. No drinker, no history of blindness, etc.	Used wood alcohol to clean the floor of a room. Kept doors and windows closed.	
26	.....	Chem. Drug. Circ., Dec., 1905, 449.	M	45	Painter. No drinker...	Used wood alcohol to clean the floor of a room. Kept doors and windows closed.	Became totally blind.
27	.....	Chem. Drug. Circ., Dec., 1905, 449.	M	....	Painter. No drinker...	Used wood alcohol to clean the floor of a room. Kept doors and windows closed.	Became and remained totally blind.
28	Jellife, 1905.....	Med. News, 86, 387....	M	....	Painter.....	Used shellac dissolved in wood alcohol on furniture.	Suffered from hyperesthesia, pares- thesia, pain in back of hands and forearms. Also edema or puffiness.
29	Jellife, 1905.....	Med. News, 86, 387....	M	....	Painter.....	Used shellac dissolved in wood alcohol on furniture.	Suffered from hyperesthesia, pares- thesia, pain in back of hands and forearms. Also edema or puffiness.
30	Hawes, 1905.....	Bost. M. S. J., 153, 525..	M	53	Painter. Did not drink wood alcohol. Sober, did not smoke to excess.	Used wood alcohol to remove paint from furniture and in shellac.	Became and remained totally blind.
31	Stratton & Brown, 1906.	Hearing before Ways & Means Com. on Free Alcohol, 59th Cong. 1st Sess.	M	32	Worked in hat factory stiffening.	Used wood alcohol in stiffening hats for 5½ years.	Had to discontinue work on account of impaired vision due to wood alcohol. Vision when last seen R. E.=15-30; L. E.=15-20.
32	Stratton & Brown, 1906.	Hearing before Ways & Means Com. on Free Alcohol, 59th Cong. 1st Sess.	M	38	Hat stiffener.....	Worked in wood alcohol 2½ years.	Gave up work on account of inflammation of eyes. Vision R. E.=15-20; L. E.=15-20.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
33	Stratton & Brown, 1906	Hearing before Ways & Means Com. on Free Alcohol. 59th Cong. 1st Sess.	M	46	Hat stiffener.	Worked in wood alcohol 32 years.	Discontinued work on account of failing vision. He is still able to distinguish large objects but is unable to recognize features at a distance of a few feet. Vision for reading totally lost; is able to recognize test card letters 1 1-40 with each eye. Became totally blind, sight improved to R. E. counting fingers extrinsically 6 inches; L. E. fingers at 1 ft. Field of R. E. gone, except about one-third of temporal half. L. E. field of temporal half with 10° of center gone. Was seized with paralysis of arms and legs, pain in sides and decrease in sight. Died.
34	Gifford, 1906.	Ophth. Rec., 15, 274. . .	M	46	Jack of all trades.	Used shellac and stain dissolved in wood alcohol in a room where the windows were closed.	
35	Gifford, 1906.	Ophth. Rec., 15, 274. . .	M	32	Photographer.	Cleaned plates with wood alcohol in small, poorly ventilated room. Spilled a quart of wood alcohol on feet and floor and remained in same room for some hours. Worked 13½ years in wood alcohol.	Became dizzy after he left the room sight became dim. Later became totally blind.
36	Phillips, 1906.	Ophth. Rec., 10, 634. . .	M	53	Distributor of paints and alcohols in store-room of paint factory.		
37	Stratton & Brown.	Ways & Means Com., 1906.	M	31	Hat stiffener.		Had to use cocain for past 10 years to relieve pain in eyes in order to work. Suffers from catarrh in nose and throat, membranes of nose intensely congested. Bronchial scales over chest, s in of hands worn so that they crack and bleed easily. Was obliged to use cocain in order to continue work, finally had to give up that branch entirely. Cannot see to read at night, optic nerve cupped, vision diminished in both eyes.
38	Stratton & Brown.	Ways & Means Com., 1906.	M	47	Hat stiffener.	Worked in stiffening room with wood alcohol 16 years.	

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
39	Stratton & Brown.....	Ways & Means Com., 1906.	M	42	Hat stiffener.....	Worked 15 years in hat stiffening department.	Eyes became irritated and inflamed; at start could not see in bright light or read at night. At present vision is R. E.=15-40; L. E.=15-70, optic nerves cupped, veins distended and tortuous; chronic discharge from nose, nose membranes congested and swollen, throat congested. Dry cough, lungs have moist bronchial scales on both sides.
40	Stratton & Brown.....	Ways & Means Com., 1906.	M	28	Hat stiffener.....	Worked in stiffening room 14 years. Using wood alcohol for the stiffening.	Was affected by the wood alcohol so that he was unable to open his eyes for 3 days at a time. Is unable to use eyes any evening after working. Secretion from eyes, vision dim, optic discs congested, is unable to use test type. Nasal membrane congested, pharynx and upper larynx strongly congested. bronchial scales over entire chest.
41	Stratton & Brown.....	Ways & Means Com., 1906.	M	20	Hat stiffener.....	Worked in wood alcohol 4 years.	Trouble with eyes, discharges from nose and cough. Is unable to read at night after work, intolerance to light conjunctiva congested.
43	Stratton & Brown.....	Ways & Means Com., 1906.	M	49	Hat stiffener.....	Worked in wood alcohol two years.	Has to stop $\frac{1}{2}$ to $\frac{1}{4}$ hour several times each day to recover from the effects of the alcohol on his eyes. Has to be in a dark room one hour after work. Eyes are always glued together in the morning. Suffers from dizziness while at work. Eyes are red and fiery, is unable to read. Vision R. E.=12-50; L. eye = 12-50.
44	Stratton & Brown.....	Ways & Means Com., 1906.	M	27	Hat stiffener.....	Worked in hat stiffening department 13 years.	Vision dim, eyes inflamed, is only able to work after using cocaine; lids thickened, optic discs show excessive cupping. Blind spot three times the normal size in each eye. Pharynx and larynx congested.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
45	Stratton & Brown, 1906.	Hearing before Ways & Means Com.	M	32	Hat stiffener.....	Worked with wood alcohol 12 years.	Had to give up work on account of inflammation of eyes and nasal passage, also cough. Vision at present R. E.=15-70; L. E.=15-50. Is not able to read.
46	Stratton & Brown, 1906.	Hearing before Ways & Means Com.	M	36	Hat stiffener. Strong and healthy. No drinker.	Worked with wood alcohol 4 years.	Had to discontinue work on account of pain in eyes and dimness of vision. Vision at present R. eye = 15-20; L. E.=15-30.
47	Stratton & Brown, 1906.	Hearing before Ways & Means Com.	M	44	Jeweler.....	Worked in wood alcohol an hour or two each day for 3 weeks.	Eyes began to trouble him with an intense conjunctivitis and ulceration of both cornea, followed by failing vision. Had to give up watchmaking on account of conjunctivitis.
48	Stratton & Brown, 1906.	Hearing before Ways & Means Com.	M	18	Hat stiffener.....	Worked in wood alcohol six months.	Was obliged to give up work on account of burning in eyes and dimness of vision. Vision R. E. at present = 15-20; L. E.=15-20. Became blind and kidneys were affected.
49	Torry, Lynn, Mass.....	Hearing Ways & Means Com. on Free Alcohol, 1906.	M	....	Painter.....	Did not drink any wood alcohol. Used shellac dissolved in Columbian spirits for polishing.	
50	Burton, Lynn, Mass.....	Hearing Ways & Means Com. on Free Alcohol 1906.	M	....	.....	Did not drink any wood alcohol. Used shellac dissolved in Columbian spirits for polishing.	Had a bad effect on eyes and kidneys.
51	C. A. Wood, 1906.....	Inter. Clinic, I, 68.....	M	....	S. E. S. (varnisher)....	Varnished tanks in a brewery, using varnish mixed with wood alcohol.	Became totally blind.
52	C. A. Wood, 1906.....	Inter. Clinic, I, 68.....	M	35	A. H. S. (varnisher.) healthy, weighed 190 pounds.	Varnished the interior of ill ventilated vats with varnish dissolved in wood alcohol.	Vision was impaired to 10-200 in each eye, central sight to 20-50. The optic nerves became atrophied, discs being white.

No.	Reports and date.	Journal.	Sex.	Age.	Occupation, habits of life.	Mode of occurrence.	General effects and results.
53	C. A. Wood, 1906.....	Brit. M. J., 2, 1855....	M	45	Frank P. (storekeeper in piano factory. Healthy, weighed 210 pounds).	Poured wood alcohol from 5 gallon cans and mixed it with shellac.	.....
54	Stricker.....	Ophth. Yr. Book., 6, 249	....	....	Shellacker.....	Inhaled wood alcohol via or while shellacking Shellacked beer vats....	Methyl alcohol amaurosis set in.
55	Carhart, 1908.....	Am. Med., 1908, 3, 176. Man. Eye & Ear. Hosp. Rep. N. Y.	M	23	Painter.....	.....	Had attack of vertigo and nausea, next day complained of imperfect vision. Then became totally blind. R. E. = to perceive large object. L. E. = 3-200.
56	Carhart, Lancet-Clinic.. 1909.	Jackson, Ophth. Yr. Book, 6, 249.	M	....	.....	Shellacked beer vats....	Vision faint. Light perception in left eye. None in right. Moderate optic neuritis. Vision gradually improved until R. E. could detect moving shadows. L. E. = 3-200. Became and remained totally blind.
57	.....	N. Y. State Dept. Labor Bull. No. 51, 1912.	M	30	Varnisher in brewery...	Varnished vats in a brewery; the varnish was dissolved in wood alcohol.	Died.
58	.....	N. Y. State Dept. Labor Bull. No. 51, 1912.	M	27	Varnisher in brewery...	Varnished vats in a brewery; the varnish was dissolved in wood alcohol.	Became blind.
59	.....	.....	M	19	Type cleaner.....	Used wood alcohol to clean type.	Died.
60	A. S. Mitchell.....	.....	M	....	Varnisher.....	Varnished beer vats with shellac dissolved in wood alcohol.	2 died. The other 2 went blind.
61 to 64	.....	.....	M	....	Varnishers. 4 men.....	Varnished beer vats with shellac dissolved in wood alcohol.	.....

APPENDIX D.*

WOOD ALCOHOL MANUFACTURERS IN THE UNITED STATES.

Barclay Chemical Co.	Laquin, Pa.
Boyne City Chemical Co.	Boyne City, Mich.
Beerston City Acetate Co.	Beerston, N. Y.
John Bartley	Mt. Alton, Pa.
Buckhannon Chemical Co.	Selbyville, W. Va.
Cadillac Chemical Co.	Cadillac, Mich.
Cummer-Diggins Co.	Cadillac, Mich.
Clawson Chemical Co.	Ridgway, Pa.
Custer City Chemical Co.	Custer City, Pa.
Coryville Chemical Co.	Bradford, Pa.
M. J. Corbett & Co.	Binghamton, N. Y.
Corbett & Stuart	Binghamton, N. Y.
Day Chemical Co.	Westline, Pa.
Desmond Charcoal and Chemical Co.	Thompsonville, Mich.
Duck Harbor Lumber and Chemical Co.	Lookout, Pa.
East Jordan Chemical Co.	East Jordan, Mich.
Forest Chemical Co.	Sheffield, Pa.
Gray Chemical Co.	Port Alleghany, Pa.
Genesee Chemical Co.	Genesee, Pa.
Gaffney Wood Products Co.	Galeton, Pa.
Heinemann Chemical Co.	Olean, N. Y.
James Mfg. Co.	Kane, Pa.
Thomas Keery Co.	Hancock, N. Y.
Kinzua Valley Chemical Co.	Williamsport, Pa.
Keelor Chemical Co.	Wetmore, Pa.
Keystone Wood Products Co.	Olean, N. Y.
Lake Superior Iron and Chemical Co.	Detroit, Mich.
Lamont Chemical Co.	Kane, Pa.
Lackawanna Chemical Co.	Olean, N. Y.
Lewis Run Mfg. Co.	Bradford, Pa.
Liberty Wood Products Co.	Port Allegany, Pa.
McKean Chemical Co.	Williamsport, Pa.
Mashek Chemical and Iron Co.	Wells, Mich.
Marvindale Chemical Co.	Bradford, Pa.
Minard Run Chemical Co.	De Golia, Pa.
Maryland Wood Products Co.	Maryland, N. Y.
Mt. Hope Chemical Charcoal Works	Mt. Hope, Pa.
National Chemical Co.	Galeton, Pa.
Newton Chemical Co.	Olean, N. Y.
Nansen Chemical Co.	Kane, Pa.
Nusbaum Chemical Co.	Bradford, Pa.
Oswayo Chemical Co.	Oswayo, Pa.
Otto Chemical Co.	Williamsport, Pa.
Penn Chemical Co.	Ridgway, Pa.
E. D. Penwarden	Carley Brook, Pa.
Riefler & Sons	Honesdale, Pa.
Risley Lumber Co.	Walton, N. Y.
R. G. Roosa	Willowemoc, N. Y.
Russell Chemical Co.	Russell, Pa.
Straight Creek Chemical Co.	Olean, N. Y.
Susquehanna Chemical Co.	Olean, N. Y.
A. B. Smith Chemical Co.	White Bldg., Buffalo, N. Y.
Sullivan Chemical Co.	Acidalia, N. Y.
Scott Chemical Co.	Sherman, Pa.
Stamford Chemical Co.	Stamford, Vt.
Smethport Chemical Co.	East Smethport, Pa.
Starrucca Chemical Co.	Starrucca, Pa.
G. H. Treyz & Co.	Binghamton, N. Y.
Geo. I. Treyz	Cooks Falls, N. Y.
Vandalia Chemical Co.	Olean, N. Y.
Wisconsin Chemical Co.	Hackley, Wis.
Wright Chemical Co.	Ridgway, Pa.
Wyman Chemical Co.	Port Allegany, Pa.

* Courteously revised by Mr. Wm. S. Gray, President of Gray & Co., 76 William Street, New York.

