

FILE COPY

DEATH AND BLINDNESS AS A RESULT OF POISONING BY METHYL, OR WOOD, ALCOHOL AND ITS VARI- OUS PREPARATIONS

BY CASEY A. WOOD, M.D., D.C.L.

Professor of Clinical Ophthalmology in the University of Illinois, Chicago

ALTHOUGH the toxic effects of preparations of methyl, or wood, alcohol are vaguely referred to in the older works on toxicology, it is only quite recently that the medical profession has had an opportunity of studying the action of this poison. The United State Dispensary informs us that methyl alcohol was discovered in 1812, and was subsequently examined by Liebig, Kane, and others. It was (and is now) obtained by the destructive distillation of wood that also yields a number of other products, including acetic acid and tar. About 1 per cent. of this distilled product consists of an inflammable, volatile liquid which, when separated and purified, constitutes what is known as pyroxylic spirit. It is from this spirit that methyl alcohol—also known as wood spirit, wood alcohol, and wood naphtha—is obtained. Purified methyl alcohol is a mobile, colorless liquid, possessing a hot pungent taste and a peculiar aromatic smell. It mixes in all proportions with water, grain alcohol, and ether, and burns exactly like ethyl alcohol although with a less luminous flame. It has many close affinities with grain alcohol, dissolving practically the same bodies that ethyl alcohol does.

The Dispensary of 1889 states that methyl alcohol was used in a limited way as a therapeutic agent, but it makes no reference whatever to its poisonous properties. It asserts that any effect which it may have is probably due to the impurities and not to the methyl hydrate in the mixture.

Wood 1906
Philadelphia.

Twenty years ago, as now, it was used in commerce by hatters and varnish-makers for dissolving resins and gums, as well as by chemists and others for burning in lamps as a substitute for ordinary alcohol. It was found to be more economical for the latter purpose than ethyl alcohol, giving out more heat for equal weights of the two liquids.

The older Dispensatory remarks that "in Great Britain grain alcohol is subjected to a heavy duty, which, until lately, prevented it from being used in many manufactures; because the products of its use can be more cheaply obtained from abroad. The British parliament, wishing to encourage the use of alcohol in the arts, but not as a beverage, passed an act in 1885, allowing it to be used duty-free, provided it be mixed with at least one-ninth of its bulk of pyroxylic spirits, which renders it unfit for drinking, but does not spoil it for use in the arts. This mixture is called 'methylated spirits,' and is now employed extensively in Great Britain by hatters, brass founders, and cabinet-makers for dissolving shell-lac and other resinous substances, and by manufacturing chemists for making ether, chloroform, and sweet spirit of nitre. From the purification of pyroxylic spirit already referred to, so as to deprive it of offensive taste, it has been supposed that the intended operation of the British revenue laws might be evaded; but, in opposition to this idea, it is asserted that the purifying process is too expensive, on a large scale, to render it available for the purpose. The use of this spirit, however purified, would be unjustifiable in medical preparations, unless officially recognized."

At this early date it never occurred to anyone to drink wood naphtha because of its nauseous taste and vile odor. Indeed, not more than three cases of serious poisoning from methylated preparations had, until June, 1904, been known anywhere. One of these occurred in France during 1877, the other two in Germany in 1899.

In recent years, however, the wood alcohol of commerce has undergone a complete change of character. Since 1896 the vile smelling, greenish liquid known as methylated spirit has been converted, especially in the United States, into a much more attractive fluid. Deodorized and deprived of its disagreeable taste, it now appears on the market in new forms and highly recommended as

a substitute for grain alcohol. These more attractive varieties of "deodorized" wood spirit can with difficulty be distinguished from ethyl alcohol. It has the same vinous odor, agreeable, warm taste, and some of the intoxicating qualities of ordinary alcohol, for which it is now so often substituted. Not only is it highly recommended as a suitable alcohol for "bathing and sponging the sick, making liniments, rubbing for rheumatism," but we know from sad experience that it has been and is now used as a substitute for grain alcohol to adulterate whiskey, "high balls," "punch," "hot drops," "witch hazel," "bay rum," "Florida water," "Eau de cologne," "Jamaica ginger," "extract of lemon," essences of all sorts, not to mention various "liniments," patent medicines, proprietary and domestic remedies, etc. This poisonous agent appears in the market under many fanciful names. It is now employed both in this country and abroad in enormous quantities, not only for legitimate purposes, but as an adulterant of numerous mixtures supposed to be made of pure ethyl alcohol. In the same way, we find on sale in many American drug stores and other shops "deodorized" methyl alcohol sold as Colonial Spirits, Union Spirits, Eagle Spirits, *Lion d'Or*, Greenwood Spirits and Standard Wood Spirits. This is how a refinery of wood spirit in Boston describes the particular "deodorized" product of their factory: "*Lion d'Or* is a 98 per cent. pure methyl alcohol, the remaining 2 per cent. being water. It is a methyl alcohol of exceptional and remarkable purity, manufactured on a commercial scale as a substitute for the best quality grain alcohol, or cologne spirits, as used externally in the arts and manufactures. *Lion d'Or* is readily miscible in all proportions with water, chloroform, ether, glycerine, and, in fact, in this respect is identical in behavior with the best known varieties of alcohol. Unlike other alcohols, *Lion d'Or* undergoes no deteriorating change with time, but after standing for years, will invariably open as pure and sweet as when first made. *Lion d'Or* is clear and limpid, of purest water whiteness, and such odor as it may possess may be described as faintly spiritous; the sweet, sickening odor of the grain alcohol of commerce, and the empyreumatic and tar-like odors of wood alcohol are quite lacking. This almost total absence of odor constitutes, we may say, the most conclusive proof of the purity of our product. *Lion*

d'Or may be, and is being, used in the preparation of the finest perfumes, and the most delicate scents are brought out to an advantage hardly possible even with the use of the best French spirits."

In other words, with the exception of the claim that this form of methyl alcohol can be drunk with impunity, there is, in the opinion of the manufacturers, practically no purpose to which "*Lion d'Or*" can be put in which it is inferior to ordinary grain alcohol.

The communications of Buller and myself,¹ and of myself² alone, furnish a record of at least 314 serious examples of methyl alcohol intoxication. Of these, 158 were well authenticated examples of blindness, while in 156 instances death followed. The great majority of these were the result of drinking some form of methylated spirits, generally the ingestion of some mixture into which "deodorized" wood alcohol entered as an adulteration.

A second important source of poisoning was shown to be inhalation. That blindness may be produced by absorption of the fumes of methylated alcohol through the lungs or skin, or both, has been denied by some observers. They bring forward as evidence of their contention that wood alcohol is innocuous so far as the inhalation of its fumes is concerned, the fact that in hat and whip factories, where the workmen are exposed to the odors of columbian spirits and other wood alcohol preparations, and where the atmosphere is laden with the evaporated fluid, no cases of death or blindness occur. I have already referred to a communication from a physician residing in a factory town where methylated spirit is largely used. "It is well known," says he, "that in the filling rooms of our factories many of the men, especially green hands, are affected with giddiness and act and talk as if intoxicated after working in these rooms. This intoxication, however, they attribute to the fumes of turpentine, benzine, and allied liquids that are largely used along with the wood alcohol. I believe the

¹ "Cases of Death and Blindness from Columbian Spirits and other Methylated Preparations." *Journal of American Medical Association*, October 1-29, 1904.

² "Poisoning by Wood or Methyl Alcohol and its Preparations as a Cause of Death and Blindness; a Supplementary Report." *New York Medical Journal*, January 7, 1905.

symptoms to be due to the fumes of wood alcohol and mean to investigate the subject a bit. I have just called up on the telephone the superintendent of one of our largest factories, who states that the poisonous character of wood alcohol is well known among the employes, and they had a very practical demonstration of it some years ago in the death of several men who drank it."

The truth is that when the fumes of wood alcohol are diluted with a sufficient quantity of pure air—conditions found in any properly ventilated factory—the inhalation is not dangerous to life or to the eyesight. Still I much doubt whether work in any wood alcohol, varnish, whip, or hat factory can properly be regarded as a healthy occupation. Experience has proved that it is work *carried on in a confined space filled with wood alcohol fumes and rebreathed air* that constitutes the chief danger to eyesight and to the general health. The varnishing of closets or small rooms with closed doors and windows, of beer vats, or the evaporation or burning of wood alcohol in a confined space have been responsible for a number of cases of blindness.

That the above truths may be further brought home to those interested in this subject, I quote a few previously published examples of death from the ingestion of some form of methylated alcohol.

"Sheridan Knowles, of Bridgeport, Conn., aged 45 years, a private in the United States Coast Artillery, stationed at Fort Terry, Plum Island, New York, died yesterday afternoon after drinking a quantity of wood alcohol. Knowles had been drinking heavily of late and made visits to New London, Conn., at every opportunity during the week. Each time he imbibed freely, and finally returned to the island for the first time Thursday. He was finishing his spree, and could not stop entirely from drinking liquor, so that the temptation to drink the wood alcohol was more than he could resist, although he knew well the deadly effects of the poison. He was the barber of the fort, and so had no difficulty in getting what he wished from the barber shop. He drank the wood alcohol, and inside of an hour was dead. This is the seventh case of wood alcohol poisoning at Fort Terry within a few months." ³

"On the evening of Wednesday, August 31, an unknown

³ Jour. Am. Med. Assoc., October 22, 1904.

number of Indians of the Turtle Mountain Reservation went on a spree, and being unable to obtain the ordinary alcoholic beverages, secured a large number of bottles of 'Florida water,' and, it is reported in the papers, 'lemon extract,' and drank freely of them. Nine Indians died, most of them Friday morning, September 2, and a survivor is known to have become blind. Empty 'Florida water' bottles were found in the Indian encampment after the debauch. All who partook of the spirits complained of burning in the stomach and bowels, pain in the head, and slow pulse (as low as 43); the finger-nails and lips were blue and they finally died comatose. Investigation showed the fluids to be largely methyl alcohol."⁴

Cases of death and blindness from the drinking of fluids adulterated with methyl alcohol are not, however, confined to semi-civilized tribes. Well known examples of wholesale poisoning have occurred in New York City (where seventeen cases of death and blindness occurred as the result of a single debauch), Chicago, and other large towns. One of the most recent of these took place among some Southern boatmen, a number of whom died from the use of wood alcohol as a beverage during a spree.

Stromberg⁵ has told the story of the Dorpat holocaust which I have elsewhere⁶ translated and reviewed. In June, 1904, an unknown number of men and women celebrated the mobilization of the Russian troops in Jurjew by drinking what in Livonia is known as Kuntzen's Balsam, a popular domestic remedy composed of such fragrant herbs as rosemary, lavender, peppermint, etc., concocted with water and about 50 per cent. of grain alcohol. It is employed in Russia like some of our own domestic "liniments" for both internal and external use. It is on occasions also drunk in Russia just as some people in America, who, unable to obtain more legitimate beverages, drink all sorts of alcoholic mixtures, such as patent medicines, bay rum, cologne water, lemon extract, etc., that are notoriously concocted with more or less pure alcohol. Of course, when these fluids are made from ethyl alcohol a simple intoxication is the consequence, but when adulterated with "deodor-

⁴ Jour. Am. Med. Assoc., *loc. cit.*

⁵ Sechszehn Vergiftungsfälle mit Methylalkohol. St. Petersburg Med. Woch., October 8 and 15, 1904.

⁶ New York Med. Jour., *loc. cit.*

ized " wood alcohol, columbian spirits, union spirits, colonial spirits, or some other methylated product, death or blindness is the result in a large percentage of cases.

The amount of wood alcohol drunk by the Dorpat (Jurjew) victims was small. Probably the "balsam" was made up with columbian spirits imported from America. At any rate thirteen people died, mostly from the same symptoms, and at least three others (probably more) lived but became blind. The symptoms, to quote from the article in the N. Y. Medical Journal, in these cases correspond exactly with what we know from a wide experience in America of this poison to be characteristic of the toxic effects from imbibed deodorized wood alcohol in any of its forms. After the ingestion of the methylated balsam a nauseating, burning, bitter taste was experienced. This extended from the throat, along the esophagus to the stomach; the dose was not followed by the warm, comfortable sensation in the abdomen that follows the drinking of ethyl alcohol. The patients complained of depression, weakness, and of severe pains in the extremities (8 cases), headache (9 cases), and vertigo (8 cases). Although unsteadiness of gait occurred in most of the patients, seven of them did not present this symptom. The heat and discomfort behind the sternum increased, in 8 cases, to severe and even agonizing pain, in the stomach and breast. Shortly (generally in a few hours) after taking the poison a feeling of general weakness (12 cases), and drowsiness (6 cases) with chills (6 cases) were noticed. In the milder cases these symptoms were delayed, but as a rule they appeared at once or at the latest the day after drinking the poison. The patients were quite ill and could no longer go about their usual work. A sensation of chilliness came on and increased until a decided rigor resulted. In one case this symptom was succeeded by fever and sweating. The weakness and chilliness lasted several days and the languid sensation generally deepened into semi-unconsciousness. The patients soon betook themselves to bed and sank into a stupor from which they were, now and then, aroused by attacks of abdominal distress and vomiting (in 13 cases). In nine instances they complained of nausea, pains in the abdomen (12 cases), and difficulty of breathing. They almost constantly threw themselves from one side of the bed to the other in the vain hope of getting relief.

About this time the eyesight was affected, usually in the shape of a cloud before the eyes. This important diagnostic symptom was elicited in an unusually large percentage of the Dorpat cases, 12 in all. In two instances it deepened into complete blindness after forty-eight hours, without any preliminary clouding of sight. In two other cases the blindness gradually increased for five or six days. Complete amaurosis lasted from several days to a week. The ability to distinguish colors continued relatively late in the illness and either returned to normal or was entirely lost. The pupils did not react normally to light, but were in no case dilated *ad maximum*. Nevertheless, in two cases only were there undilated pupils. Twelve patients complained of severe pains and tenderness in the abdomen without diarrhea; the others experienced most pain in the lower extremities, alternating with cramps of the leg muscles. Pains in the eyes were infrequent, occurring in two cases only. The face, generally red with cyanotic areas, sometimes bore a suffering, sometimes an apathetic, appearance. In all cases there was no appetite, but generally much thirst.

Disturbance of breathing (10 cases) was far more noticeable than an abnormal pulse rate. It is likely that this early sign of methyl intoxication was due to pulmonary hyperemia. Although at first breathing was rather labored, the sense of oppression was not marked. However, it soon became difficult, irregular, and superficial; shallow breaths alternated with deep inspirations. Before long there was rattling in the throat, followed by coughing and expectoration of much fluid, foam-like sputum. Finally, there was general cyanosis (5 cases), the extremities exhibited a lowered temperature, and the whole body was covered with cold sweat. In some cases (5) complete unconsciousness set in half an hour to three hours before death; others (4) exhibited only stupor. Some patients were quite conscious at the time of death. Eight victims died within twenty-four hours after drinking the methylated balsam; two others were dead within forty-eight hours.

Cases of blindness from the absorption of methylated preparations chiefly by the lungs, are naturally not so numerous as those that are the outcome of its absorption through the stomach, but they are sufficiently well authenticated. In the investigations by Buller and myself in these instances of blindness we are able

to obtain histories of nine hitherto unpublished examples of amaurosis from inhaling the impure fumes of wood alcohol. The following is a case in point:

S. E. S.,⁷ aged 44 years, April 12, 1902, worked a whole day varnishing tanks in a brewery, using varnish which had been mixed with wood alcohol. In the evening when he left his work,—according to the statement of his physician, Dr. Brock, of Waynesburg,—he acted like an intoxicated man, and two hours later went into a comatose condition, which lasted twenty-four hours. When aroused the sight of the right eye was somewhat impaired and that of the left eye was entirely gone. His vision since then has improved considerably. The pupils on both sides are small (2 mm.) and sluggish. Tension is normal. Vision in the right eye= $\frac{15}{80}$. No glass helps. Field of right eye shows moderate concentric limitation; that of left a more decided contraction, and also a small complete central scotoma. The ophthalmoscope showed right disc hazy, left swollen and blurred at margins and vessels tortuous. Advised iodide of potassium, salicylate of sodium and nux vomica. June 24, 1904.—Did not see the man subsequently, but Dr. Brock, in reply to a recent note, states that the vision of the left eye in time failed entirely. He also states that soon after the poisoning he was taken with left-sided pneumonia, from which recovery was never complete. About six months ago tubercular trouble developed and ended in death June 8, 1904.

Another patient, A. H. S., a German, aged 35 years, strong and healthy, weighed 190 pounds. He was employed as a beer vat shellacer. During the winter of 1900-1901 he was engaged in his employment of varnishing the interior of ill-ventilated vats with shellac dissolved in wood alcohol. He began to suffer from loss of eyesight, and when seen by Dr. North his vision was $\frac{10}{200}$ and there was every indication of optic atrophy, the discs being very white. Abstinence from work and long-continued treatment brought about some amelioration of vision, but improvement of central sight did not extend beyond $\frac{20}{50}$.

The treatment of methyl alcohol poisoning and the blindness which sometimes accompanies it is very unsatisfactory. When one remembers the usual course of the symptoms and the alterations

⁷ Jour. Amer. Med. Assoc., *loc. cit.*

in the background of the eye that are responsible for the blindness, it is not to be wondered at that treatment is of little avail. As already indicated, the vision is often good for several days after recovery from the intoxication, then without warning even total blindness may set in. This is almost always followed after a few days or even weeks of blindness by more or less complete return of vision. Sometimes the improvement is very marked and sight may be found to be as good as ever. After a time, in spite of this apparent improvement (which is often attributed to the treatment followed) blindness once more returns, and this time it is as a rule permanent. The field of vision is nearly always contracted and absolute central scotomata can generally be found. The pupils are then widely dilated and do not respond to light or accommodation.

The organic lesion is an optic neuritis which is characterized in the early stages of wood alcohol poisoning and shows itself, as it does in other forms of this disease, in blurring of the outlines of the optic disc, slight swelling of the nerve-head, and congestion of the central vessels of the retina. The first onset of the optic neuritis generally coincides with the first attack of blindness. Coincident with the disappearance, or partial disappearance, of the optic neuritis we have the improvement in sight just referred to, but this amelioration gives place shortly afterward to more or less complete loss of vision, in correspondence with the setting in of a post-neuritic atrophy. Then the congestion of the optic papilla and vessels disappears and complete atrophy, as shown by a white or grayish nerve-head with contracted retinal vessels, is easily made out with the ophthalmoscope.

It can thus be readily understood why therapeutic measures in these cases are so very unsatisfactory. Some authorities claim that the use of pilocarpin sweats with potassium iodide is indicated in the early stages of optic neuritis and that, later on, strychnin in full dose hypodermatically has been of use.

The treatment of the general poisoning is early elimination of the methylated mixture by careful irrigation of the stomach, followed by continued stimulating and supportive treatment for several weeks. As a rule, however, the cases are seen too late to afford help of any value.

PREVENTION OF WOOD ALCOHOL POISONING

As I have on several occasions pointed out this is a subject that may well attract and hold the attention of the profession. In spite of labeling methylated products "Poison" (with the familiar skull and cross-bones), cases of blindness and death continued to result from the wide-spread employment of columbian spirits and other forms of deodorized wood alcohol. In my judgment, either the sale and manufacture of "deodorized" or "purified" wood alcohol should be absolutely prohibited, or, as in Germany and Great Britain (countries that are entirely free of poisoning from these preparations) an untaxed ethyl alcohol, or one rendered undrinkable by the addition of mineral oil, wood spirit, naphthalin, or some other nauseous compound or compounds, should be allowed for use in the arts. In the countries mentioned millions of gallons of grain alcohol, that can be manufactured for less than 20 cents a gallon, are annually employed for commercial purposes. The Internal Revenue receipts have not suffered, either in Germany or the British Isles, from the use of untaxed alcohol, and there is no reason why we in America should continue to have hundreds of cases of blindness and death from the employment of an agent that possesses no advantages over the British "methylated spirits," or the commercial *Brennspritus* of Germany. Most of the manufacturers in this country are in favor of ethyl alcohol for commercial purposes, and it is believed that a considerable impetus would be given to a number of worthy manufacturers if it were possible to obtain alcohol at the same price as the deodorized methylated product. The retail price of "purified," untaxed, wood alcohol is 50 cents a gallon, while the same amount of ethyl alcohol is \$2.60 a gallon. Yet ethyl alcohol sufficiently pure for all commercial purposes, could be sold at a considerable profit, if untaxed, for about 30 cents a gallon. Until Congress realizes the wisdom of giving her citizens commercial, untaxed alcohol at a reasonable rate, every medical man should insist upon the poisonous character of all "deodorized" alcohols, which, under fanciful names are so extensively employed to intoxicate the people of this country.