PART I. THEORETICAL.

1. Introductory.

VERY few investigations have been made of harmful effects of inhalation of methyl alcohol—I am referring to the work of Enlenberg, Poincaré, Tyson and Schoenberg, Loewy and Heide, and Mueller. Of these only Poincaré and Tyson and Schoenberg have studied the histo-pathological changes. But these results,
how are we to explain such paradoxical IhenOrneflofl? Why does a substance, non-lethal in a single dose, become lethal after a few repeated doses, and vice versa? The explanation as given by Pohi is as follows:

Ethyl alcohol is very rapidly oxidized in the animal body, in fact so rapidly that over 90 per cent. of it is converted to carbon dioxide and water, whereas methyl alcohol is oxidized very slowly, with the formation of formaldehyde and then formic acid.

It is formic acid and its cumulative action that is responsible for the Un\textsuperscript{to,vard} effects of methyl alcohol, the placet \textsuperscript{9} constructed the following table showing the difference in the elimination—that is, the rate of elimination of the two substances. In other words, the complete diminution of wood alcohol requires five times as much time as that of ethyl alcohol, and we are dealing here with a cumulative action. In rabbits the elimination of wood alcohol while faster than in dogs is...
Wood alcohol is very readily absorbed into the body from the pulmonary surface. Loewy and Ileide have shown that inhaling the air in which wood alcohol is present in so slight concentration as 1% for two to eight hours leads to its accumulation in the animal body in quantities varying from 0.3 to 0.55 grams per kilogram weight, which means that if a person weighing 60 kilograms about 150 lbs. inhales the air in which wood alcohol is present in the proportion of 0.1% for 5 hours, at the end of this period there will accumulate in this body about 5 grams of wood alcohol, which is a considerable amount hearing in mind the extremely slow oxidation of this substance.
quickly becoming slower and slower until it becomes entirely dependent on the elimination.

PART II. EXPERIMENTAL.

Twelve rabbits, with controls, were used, one half of the animals being subjected to inhalation of Columbian Spirits, and the other to that of commercial wood alcohol both brands were purchased from Eimer and Eoes, New York.

It was of utmost importance to ensure atmospheric conditions as similar to those which prevail in ordinary workshops as possible, and with that purpose in mind a wooden box was built according to the specifications evolved by Tyson and Schoenberg, with suitable openings and mica valves, sufficient draught being allowed to insure a very fair ventilation, the temperature being about 60 F. throughout the entire length of the experiment, with thermometric readings being in virtually about 60 per cent.

The animals were weighed after 15 days, and were placed under the best hygienic and sanitary conditions, thus having a decided advantage over the great majority of workers.

Both wood alcohol and Columbian Spirits were administered as follows: A piece of cotton large enough to soak up 1 ounce of either substance was suspended from a hook in the ceiling of the cage for periods of time varying from 15 minutes to one hour, three times.

In no case was it necessary to increase either the amount of the substances used or the frequency and the duration of exposure to inhalation.

In fact, the first three animals died within 6-10 days after 15 minutes' exposure, three times a day, with one ounce having been used, when it became necessary to decrease the quantity of wood alcohol and Columbian Spirits to one-half of an ounce.

The animals except the three which died within 10 days after the experiment had been begun, were permitted to live months, 4 months, 6 months, 8 and 10 months, respectively.

The most striking observation with the uniformity of lesions practically in every case the same organs, and those only, were involved, the extent of lesions varying with the duration of time exposure, thus the fatty degeneration of the cardiac muscle or destruction of the parenchyma cells of the cerebrum being more extensive in the rabbit which had been exposed for months than in the one which had inhaled wood alcohol or Columbian Spirits for but months.

Another interesting observation was the fact that neither macroscopically nor microscopically could there be detected the slightest difference between the effects of the "ordinary commercial wood alcohol and those of "refined" or Columbian Spirits----in fact, should one be disposed to do so, he could properly maintain that the latter is, if anything, a more violent acting poison than the former, since the two most severe cases of destruction of the cerebral parenchyma were observed in the cases of inhalation of Columbian Spirits.

Of course, one might expect a priori that there would be no difference, since mere masking of the odor and...
Visceral Changes in Wood Alcohol poisoning

pos'4hle removal of certain impurities ran in no way be expected to prevent or mitigate the physiological action of formic acid—the true modus operandi in the cases of poisoning by wood alcohol.

On what some of the manufacturers hac—on their claims that the “refined” product is “quite harmless” is rather uncertain, I should think, unless they are of a very trustful disposition. One might as well try to “deodorize” and “refine’ bromine and proclaim it, eo pso, “quite innocuous.”

Because of the striking uniformity of lesions it is unnecessary to go in each protocol or description of histological picture separately, a general discussion being sufficient, providing one wars in mind that the extent of the various lesions is directly in proportion to the length of exposure.

As noticed in the theoretical part of this study Placet, Loewy and others, the central nervous system—notably the cerebrum—appears to bear the brunt of the attack, it being together with the optic nerve the most frequently as well as the most extensively involved organ. Next in frequency, but not necessarily in extent, of involvement are the kidneys, the liver, and the muscle—the latter again showing a very marked inequality of involvement, the cardiac rius being affected in every case while the striated and the smooth muscle were involved but in 10 per cent. of the cases.

This limitation of lesions to the above organs brings us face to face with another deduction, namely that, so far as distribution of the lesions is concerned, it will presently be shown that this applies to the nature of lesions as well, there appears to he no difference between the effects of wood alcohol when imbibed and when inhaled.

The lesions found in the various parts of the cerebrum, the cerebellum, the medulla and—the pois consisted of different degrees of inflammatory and degenerative processes. Macroscopically the tissues appear yellowish, glistening; the line of demarcation between the gray and the white matter is not as sharp as in the control animals, in the more prolonged cases the gray matter appearing quite thinned—the entire picture being one of a non-specific atrophy.

Microscopically, the neurocytes are diminished, assuming a spindle-like shapes NissUs granules also are di—minished, with brownish pigment scattered here and there.

In the more severe cases the parenchyma cells are greatly reduced ill numbers as well as in size. Thus, for example, the brain of the rabbit which had been exposed to the inhalation If Columbian Spirits showed practically nothing but neuroglia cells and no trace of parenchyma cells, the latter being represented by masses of granular debris and fat droplets, partly taken up by the so-called contractile cells, i.e. leucoeytes, lymphocytes, and according to Bireh-Hirsidifield, endothelial cells.

The different stages of pareuchymatous degeneration of course, on the length of the exposure to which the animal has been subjected—determined front the nuclear change via the wandering of the nucleus to the...
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The impression is that the apparent increase of the connective tissue is due not only to the fact that the parenchyma cells have disappeared, but to the actual proliferation of the fixed tissue cells, as seen by the very marked thickening of the adventitia and the media of the blood-vessels.

The entire microscopical picture corresponds very closely to Adami's "exhaustion" of 

2. The lesions of the liver and the kidney present macroscopically and microscopically, the typical characteristics of albuminous degeneration, the increased size of the organ, softened consistence, the tissue being almost friable, glistening yellowish color, the protoplasm being uniformly dull-gray, the outline of the cells in most cases being altered or lost. The nuclei are much smaller than they normally are, lost in many cases and appearing as vague, shadowy structures in others. The cell bodies are filled with granular, dust-like masses.

In cases of long standing, in addition to the above general appearance, there is also a marked increase of the connective tissue, especially around the blood-vessels.

The muscle cells, especially the heart, present an appearance very similar to that of the liver and the kidney, as well as both fragmentation and segmentation, in some of the cases.

The lung shows in many patches of broncho-pneumonia, but however, are not uniform either in distribution or in extent.

PART III. Conclusions.

1. Wood methyl alcohol when administered by inhalation is as dangerous as if absorbed by ingestion.

2. The effects as revealed by the study of lesions depend primarily upon the concentration which in its turn depends upon the ventilation and the length and the frequency of exposure.

3. There is no appreciable difference between the effects of the ordinary commercial wood alcohol and those of the so-called Columnar Spirits.

4. The results of the study are all the more significant because the animals used in connection with it are probably more resistant than any other to the effects of wood alcohol, owing to the rapid oxidation of the poison.

5. As in ingestion, so also in inhalation the real cause of the toxic effects of wood alcohol lies not in the toxicity of wood alcohol per se, but in its slow oxidation to formic acid which is very poisonous, acting as it does both as an acid and, during oxidation, as an aldehyde.

6. The danger to workers in industries in which they are exposed to the inhalation of wood alcohol—matter in what form—may be partially, and only partially, obviated by
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1. Allow for each worker much more space than is usually allotted, in order to diminish the concentration of the vapor of wood alcohol.

2. The workers should be warned of the exposure.

3. Perfect health, i.e., perfect oxidation processes, is the best protection against the danger of the inhalation of wood alcohol, and whatever interferes with it—poor nutrition, loss of sleep, alcoholism makes the individual all the more vulnerable.

LITERATURE.

1 EULENBERG, Ihrbuch der Gewerbthygiene, Berlin, 1876.


3 Tytso and Schwen, in the Amer. Med. Ass'n, 1914, LXIII, p. 41.


6 ILARNACK, Korrespondenz fuer Schweiz. Aerzte, 1911, No. 3.

7 HENXER, Biochemische Zeitschrift, 1913, III, Abstr. No. 90.


9 PLACET, These de Paris, 1912, No. 35.

MEMORIAM.

I have been denied the greatest pleasure a pupil is to know—to thank his teacher for the inspiration, encouragement and sympathy. General G. M. Sternberg, Surgeon General U. S. Army, Ret., whose direction the work was done, has now been dead over a year, and it is but in revering his memory that I can do homage to the splendid man and the great scientist that he was.

In other words, there appears to be no standard of measurement. The public health official already realizes that such standardization will promote a unification of thought and action which will make it possible for him to devise ways and means of fairly competing in the field of public health endeavor.

Business efficiency is nothing more nor less than the application of standardization of business methods to the work to be performed. Wideawake


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