

On Chloral.\*

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This interesting compound was discovered in 1832, by Liebig, and was obtained by the action of chlorine upon absolute alcohol. The name is significant of its origin, and suggests at once the method of its manufacture. Chlorine alcohol is abbreviated to chloral, just as aldehyd is al(c)hol de(prived of) hyd(rogen). The Germans have a name for chloral so long that it ought to be mentioned as a curiosity. They call it trichlormethylhydrocarbonoxyd, and sometimes trichloracetylwasserstoff, and again, trichloraldehyd, or trichloracetylhydroxyhydrat. It is not probable that the medical profession will adopt any of the long names in making up their prescriptions, but that chloral will reign in all its simplicity. It is worthy of note that nearly simultaneously with Liebig's discovery of chloral in Germany was Guthrie's preparation of chloroform in the United States, and it is somewhat remarkable that, while the former is just coming into notice as an hypnotic agent, the latter has been employed since 1847 as an anæsthetic, and the present investigations upon it would not have been undertaken if it were not for its relations to chloroform. Although Liebig first prepared chloral, yet we are chiefly indebted to Dumas for a knowledge of its properties and constitution, just as we were for the best investigations upon chloroform. In order to understand how chloral can be made from alcohol, it would be well to write down the formulas of alcohol, aldehyd, &c., and then trace the decomposition that takes place:—

Alcohol.....	C <sup>2</sup> H <sup>6</sup> O <sup>2</sup>	C <sup>2</sup> H <sup>6</sup> O
Aldehyd .....	C <sup>2</sup> H <sup>4</sup> O <sup>2</sup>	C <sup>2</sup> H <sup>4</sup> O
Chloral.....	C <sup>2</sup> Cl <sup>3</sup> H <sup>3</sup> O <sup>2</sup>	C <sup>2</sup> HCl <sup>3</sup> O
Chloroform.....	C <sup>2</sup> HCl <sup>3</sup>	C <sup>2</sup> HCl <sup>3</sup>

When chlorine is passed through absolute alcohol, we can see, from the above table, how it takes the place of hydrogen, and forms hydrochloric acid. The reaction may be represented by the following formula:—  
 $C_2H_6O + 3 Cl = C_2H_3Cl_3O + 3 HCl$ . The actual manufacture of chloral is attended with considerable difficulty and expense.

It is necessary to pass well dried chlorine gas through pure anhydrous alcohol for many hours, as long as it is absorbed, and to keep the vessel cool in the early stages of the operation; later, the temperature must be gradually raised until the liquid boils. If dilute alcohol be employed, instead of the anhydrous, no chloral is formed, but, in its stead, aldehyd, acetic acid and hydrochloric acid; hence the necessity of using absolute alcohol. It is also difficult to prevent the formation of other compounds, especially chloride of carbon, which serve to contaminate the chloral and render its administration dangerous. After the chlorine has been passed through sufficiently long, the crude product is mixed with three times its bulk of oil of vitriol and distilled at a gentle heat. It is sometimes necessary to repeat this operation several times, and finally to distil over quick lime. This is a long and tedious process, and it is not at all probable that it will be followed on a large scale should there be a demand for chloral in medicine. The action of chlorine upon bodies that yield alcohol by fermenta-

tion, such as starch, sugar, &c., will be tried, and even wood, after it has been treated with sulphuric acid, might afford it when acted upon by chlorine. Professor Staedeler, formerly of Gottingen, now of Zurich, thought of the possibility of such a reaction, and actually succeeded in making chloral by distilling a mixture of one part of starch (or sugar) with 7 parts of hydrochloric acid and 3 parts of peroxide of manganese; formic acid, carbonic acid and other bodies accompanying it. Some of these latter methods may eventually prove successful, and thus enable us to obtain chloral at a cheap rate. At a recent meeting of the Chemical Society of Berlin, a pound of chloral hydrate was exhibited by two chemists, Martins and Mendelssohn, who stated that, with the co-operation of Dr. Liebreich, they had discovered a cheap and easy method for its preparation, but they refrained from giving the method because they are not thorough with the research. We also understand that the hydrate is offered for sale in Berlin for about a dollar gold, per ounce. As a dose only consists of a few grains, an ounce can be made to go a long way, and the price may be considered very moderate. We can hardly expect to procure it in this country for any such price until the demand for it has occasioned the discovery of cheap methods for its manufacture. We are sorry not to be able to give more definite hints in reference to a new way of preparing it, but we feel confident that our skillful pharmacutists will soon be able to get on the right track.

We now propose to give an account of the properties of chloral. It is a limpid, oily, colorless liquid with a fatty taste, and a strong caustic smell, producing lachrymation. Its specific gravity is 1.502, and it boils at 95° C., and can be distilled unchanged. It mixes in all proportions with water, also with ether or alcohol. It dissolves sulphur, phosphorus, bromine and iodine, and combines directly with water to form a hydrate. A little chloral put into a moist flask deposits star-shaped crystals of the hydrate on the sides. The aqueous solution of chloral is indifferent to vegetable colors; oxides of silver or mercury have no effect upon it. Concentrated sulphuric acid deprives it of water and separates the anhydrous crystals.

One of its most remarkable properties is the change it undergoes spontaneously when kept; it is altered into a porcelain-like mass called metachloral, which is insoluble, though isomeric with the liquid form. It can be reconverted into chloral by distillation. The white metachloral is insoluble in alcohol and ether, as well as in water, but by contact with water it is gradually converted into the crystallized hydrate of chloral.

Fuming nitric acid changes chloral into trichloroacetic acid. An alcoholic solution of potash converts chloral immediately into formiate of potash and chloroform. This reaction may be represented as follows:—  
 $C_2Cl_3HO + KHO = KCHO_2 + CHCl_3$ . For pharmaceutical purposes chloral hydrate must form a hard, white crystalline mass, be completely soluble in water, not smell of chloride of carbon or hydrochloric acid but retain the peculiar, penetrating odor characteristic of chloral. It would be dangerous to employ hydrate of chloral, contaminated by chlorous acetylene, chloride of carbon and other incidental products, and hence great care must be observed in its preparation.

Much attention has recently been called to the hydrate of chloral in consequence of the

physiological researches of Dr. Liebreich. This gentleman in presenting his paper to the Chemical Society of Berlin, May 24, 1869, gave the following interesting explanation of the occasion of his research.

"There are some substances which pass through the body without decomposition and without exercising any appreciable influence on the even tenor of our life; there are others which go to build up and nourish; others take up something from the body by chemical decomposition and then leave it; some are useful, such as acetic acid and sugar. I experimented recently to ascertain if, by the splitting up of certain compounds in the body, the separated compound would exert the same influence it would if administered alone.

"Trichloroacetic acid of Dumas and chloral of Liebig appeared to be the most favorable for experiment. It is known that these bodies when brought in contact with alkaline solutions split up into chloroform and formiates and carbonates of the alkalis. Both of these substances being soluble in water are easily absorbed; after they have passed into the circulation they come in contact with the alkali of the blood. My experiments proved that the formic acid and carbonic acid had no particular effect, while the chloroform exerted its full influence."

Dr. Liebreich reasoned that what took place outside the body in the chemist's laboratory ought to follow in the alembic of the stomach; but he preferred to bring his agents directly in contact with the blood by subcutaneous injections rather than wait for the action by the way of the stomach; although in some experiments he injected the compound into the stomach.

Some animals slept ten minutes after the application, and continued in this state for eighteen hours with quiet pulse and respiration. One man slept for sixteen hours without bad effects. The length of the action is explained on the theory of the gradual elimination of chloroform in the body, and its continuous effect upon the patient until the whole of it was decomposed.

Dr. Jacobi, a distinguished physician of New York, has repeated many of Dr. Liebreich's experiments with great success, and he recently read a very interesting paper on the subject before the New York County Medical Society, giving a detailed account of what he had done. On the other side of the question, we find in the *Medical Gazette*, of New York, so ably edited by Dr. A. L. Carroll, a translation of some experiments conducted by M. Demarquay and communicated to the Academy of France, from which the experimenter draws the following conclusions:

"1. Chloral has a well marked soporific effect upon debilitated and weak subjects.

"2. The duration of its action is in direct proportion to the weakness of the patient.

"3. The sleep provoked by it is generally calm, and is only disturbed in patients laboring under acute pains. This leads me to advise it in diseases where it is desired to procure sleep and muscular resolution.

"4. Finally, this agent may be given in quite large doses, as it has not caused any accidents in the dose of from one to five grammes."

Dr. Demarquay thinks that the chloral is eliminated through the lungs, and states that the breath of the patients smells of it; he does not agree with the theory of Liebreich, that it is split up into chloroform and formic

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