# HYPOCHLORITE SOLUTIONS.

BY RUTH M. DAVIS AND H. A. LANGENHAN.

*Prefatory Remarks:* In formulating this paper an attempt was made to collect the literature available and compile the information obtained in logical sequence. When one considers the volume of the material printed relating to hypochlorite solutions, the possibility of having the compilation complete is slight. Furthermore many articles published represent duplications to a greater or lesser degree and including these repetitions would tend to make this paper too lengthy. This summary was submitted, in part, by Miss Davis, as a thesis requirement for a Master of Science degree in Pharmacy. It consists of the following parts:



## (NO. 1) HISTORICAL INTRODUCTION.

It is very seldom that a pharmaceutical product offers such an interesting study as the *Solution of Chlorinated Soda*. This solution resulting from chemical investigations relative to the study of chlorine, nearly a century and a half ago, founded one of the first arts in the commercial world, that of bleaching, and contributed to a most important medicinal process, that of antisepsis. Its use as a bleaching solution as well as its use as a disinfectant popularized it quickly, but after it had become fully established, its popularity in the medical practice gradually diminished. During the past decade, however, its use as an antiseptic has been renewed until at the present time it has been placed among the foremost.

The bleaching property of chlorine was discovered by Scheele during his investigations on that halogen. In 1785 Berthollet, a French chemist, was the first to commercialize this property. He used an aqueous solution of chlorine but soon realized the need of a "stronger" liquid which could be prepared on a commercial scale. In 1788 he found that chlorine would unite with an "alkali hydrate" and still retain its bleaching properties. He was delighted with his new bleaching fluid, and, realizing its great commercial value, at once attempted to utilize his discovery but not for personal benefit, for he refused any financial return for his labors. He established his new process of bleaching at the Javel works in 1789, where the bleaching fluid was prepared by passing chlorine into a solution of "potash" (potassium carbonate). The physician Percy, in 1792, was placed in charge of the factory and prepared the fluid on a commercial scale, calling it "eau de Javelles"—the present *Liquor Potassæ Chlorinatæ* of the N. F. IV. Morveau and Berthollet advocated its use as a disinfectant and it was used for such purposes by Percy. The composition of the fluid was obscure but Berthollet presumed that a salt was formed as an additive product of "oxidized hydrochloric acid" (Chlorine) and the alkali; for example, NaOCl.

Watt, who had been in Paris when Berthollet had begun his research, introduced the solution as well as the new art of bleaching into England. The new

bleaching fluid was first manufactured in quantities at MacGregor's factory in Glasgow. Tennant of Darnley, wishing to find cheaper materials, tried saturating lime water with chlorine and obtained an effective but weak bleaching fluid. He continued his research and finally produced *Chlorinated Lime*, which at that time was called *Tennant's Bleaching Powder*, by saturating slaked lime with chlorine gas. In 1798 he took out a patent for the manufacture of "calcium, baryta and strontium earths" for the purpose of bleaching. (See copies of original patents in appendix.)

This bleaching powder was first used as a disinfectant by Massuyer, professor of chemistry in the medical school of Strasburg, in 1807. He used the dry "chloride of lime" to "neutralize miasmata" of hospitals. In 1820 Labarraque, a pharmacist, used "chlorides" as a disinfecting agent for catgut, but in 1822 he substituted an aqueous solution of bleaching powder, that is, a "solution of calcium hypochlorite," for the "chlorides" and used this for disinfecting dead bodies, amphitheatres, dissecting rooms and also as a medicinal agent for "sores." It is related that Labarraque who was pharmacist first to the Emperor and subsequently to Louis XVIII achieved great renown on the death of the latter monarch for he was able to proceed with the embalming of the royal body, which was so profoundly decomposed that no one was able to approach it until after the application of the hypochlorite solution. In the same year Labarraque suggested replacing the "potash" by sodium carbonate in the "eau de Javelles." He prepared a solution of chlorinated soda by passing chlorine into an aqueous solution of sodium bicarbonate "saturated" with sodium carbonate. This preparation, containing much free alkali, became known as *Liquor de Labarraque* or *Labarraque's Disinfecting Fluid*. Faraday used the same materials but doubled the amount of chlorine used by Labarraque, thereby obtaining a much stronger liquid. Payen offered a simpler method. He mixed a solution of "calcium hypochlorite," obtained by digesting bleaching powder with water, with a solution of sodium carbonate.

Up to the time when Labarraque prepared his new solution, the composition of these various bleaching and disinfecting solutions was unknown. In 1834 Balard's discovery of hypochlorous acid and its salts, the hypochlorites, went a long way towards clearing up some of the confusion. From this time on, medical men began gradually to use the solution, pharmacists to prepare it, and chemists to work over the composition of the mixture. In 1846 Semmelweis made use of it in ridding his clinic of "endemic puerperal fever." In 1859 Watt discovered a method of preparing it by electrolysis, and in 1890 Androeli patented a similar process. It was not until the advent of the European war that the hypochlorite solutions became known as among the most satisfactory disinfectants and antiseptics. It was through the investigations of Drs. Carrel and Dakin that an interest in the solutions was revived. They reworked the formula in the attempt to neutralize the excess alkalinity, one of the objectionable factors, and to reduce the available chlorine content. An interest in chlorine antisepsis having been aroused, many modifications of Labarraque's formula have been offered in an effort to obtain a more stable chlorine disinfectant.

The antiseptic action of the hypochlorites was for a long time thought to be due to their decomposition, with the liberation of oxygen, in the presence of organic matter. But this was questionable, since chlorine and not oxygen was invariably

set free when strong solutions of hypochlorites were applied to animal tissues. Dakin, working on the theory that some of the amino groups of the proteins were changed to —NCL— groups, prepared a chloramine and found that it possesses approximately the same antiseptic action as the original hypochlorites. This resulted in the introduction of the organic chlorine compounds into the market under the titles of *Chloramine, Di-chloramine* and under various trade names which have been found to be satisfactory substitutes for the hypochlorites in some types of antisepsis.

The first pharmacopœia to introduce *Labarraque's Solution* was the French *Codex Medicamentarius* of 1837. It applied the title *Hypochlorite de Soude Liquide.* The London Pharmacopœia of 1838 and the United States Pharmacopœia of 1840 introduced it under the title *Liquor Sodæ Chlorinatæ.* Whereas the French and London Pharmacopœias adopted the method of Labarraque for preparing the solution, the United States Pharmacopœia selected the modified process of Payen. The solution found its way into the other pharmacopœias in the following order:

1854 Belgian Pharmacopœia
1864 British Pharmacopœia
1872 German Pharmacopœia
1874 Mexican Pharmacopœia
1876 Portuguese Pharmacopœia
1884 Spanish Pharmacopœia
1892 Italian Pharmacopœia

In spite of the fact that Labarraque prepared his "Liquer" by using sodium bicarbonate and sodium carbonate, a characteristic of Dakin's solution, some contributors to pharmaceutical literature are advocating the replacement of *Labarraque's Solution* by *Dakin's Solution* in the Pharmacopœia of 1920, although the latter is only a modification of Labarraque's original preparation as is also *Liquor Sodæ Chlorinatæ U. S. P. IX*, official synonym, *Labarraque's Solution.*

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UNIVERSITY OF WASHINGTON,
COLLEGE OF PHARMACY,
SEATTLE

(*To be continued.*)