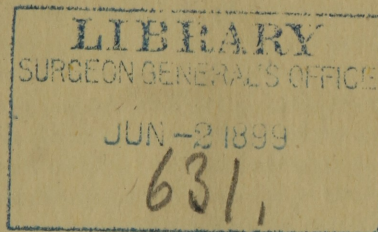


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Report on Condensed milk

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NEW YORK ACADEMY OF MEDICINE.

REPORT ON CONDENSED MILK.

By the Section on *Materia Medica* and *Botany*.

NOVEMBER 4th, 1857.

The Section on *Materia Medica* and *Botany*, to which was referred the subject of "Condensed Milk," with a specimen thereof for examination, respectfully beg leave to report :

The elements that enter into the structure of organized bodies, whether of the animal or vegetable kingdom, are extremely simple and few in number. When we mention carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulphur, we have enumerated the sum total of all organic compounds. Yet few and simple as they are, they possess powers of combination so extraordinary and complicated as to enable them to produce an almost unlimited variety of substances, each possessing characteristics peculiar to itself, and liable sooner or later to decomposition, owing to the great tendency of the elementary constituents to assume new relations, and enter into the formation of other compounds differing materially from those which previously existed. Thus, when the juice of the grape is exposed to the atmosphere, the process of decomposition soon commences. The elements of sugar contained in the fluid being influenced by the oxygen of the atmosphere, gradually enter into new combinations producing alcohol and carbonic acid, neither of which existed in the original fruit. The most fruitful cause of the decomposition of organic substances, then, is moisture and exposure to the atmosphere, and hence the best means of their preservation is the exclusion of these two agents.

From this liability of organized bodies to decomposition and decay, has arisen the necessity of inventing some method by means of which the different articles of food may be preserved as nearly as possible in their original state of freshness and purity, a subject that for the last half century has received no small degree of attention. As early as the year 1810, the French Government awarded a premium of 12,000

francs for the discovery of a method of preserving food, by first parboiling, and afterwards enclosing in earthenware vessels so as to entirely exclude the air. The success of this method has been followed by other attempts, and as the science of chemistry has advanced, and the causes of the decomposition of animal and vegetable substances been more clearly understood, in the same proportion have the means of their preservation been suggested to the inquiring mind; and man has so well succeeded in applying the principles of science to this branch of the useful arts, as to be able to preserve the most ordinary articles of food for years, without injury, and many of them in so concentrated a form as to be readily transported, thus affording the enjoyment not only of the necessities, but also the luxuries of life, under circumstances where they have been hitherto unattainable.

Thus the abundance of one season may contribute to supply the deficiencies of another; the severity of our northern latitudes may be to some extent relieved by the productions of a more genial climate. In mid winter we may regale ourselves with the most delicate fruits of summer; and the sea-faring man, whether sweltering beneath a tropical sun or shivering in the polar regions, may, at a moderate expense, vary his miserable scurvy-generating routine of salted meat with the fresh meats, fruits, and vegetables of his native soil. Foremost among the many articles of diet, in interest and importance, stands milk, that fluid assigned by Nature as the type of nourishment for all the young mammalia. In order to estimate correctly the value of this important secretion, and comprehend more clearly its physiological relations, perhaps a hasty glance at its chemical constituents would not be out of place here. Pure cows' milk has a specific gravity of about 1027; when skimmed, about 1035; the specific gravity of cream is 1024.

The following analysis, by Mr. Haidlen, is perhaps the one more generally received: In 1,000 parts of milk we have, of water 873.00; butter, 30.00; casein, 48.20; milk sugar, 43.90; phosphate of lime, 2.31; phosphate of magnesia, 0.42; phosphate of iron, 0.07; chloride of potassium, 1.44; chloride of sodium, 0.24; soda in combination with casein, 0.42=1,000. A more recent analysis has given us, in addition to the above constituents, a small portion of sulphur. Although other analyses may vary slightly from the foregoing, it is probably not so much from want of accuracy on the part of the experimentalist as from the influence exerted upon its composition from the nature of the food, condition of the animal, and other circumstances that may combine in some manner to vary the proportion of its

constituents. The milk of cows fed upon potatoes has been found to yield more casein than when otherwise fed.—(*Boussingault*.) Playfair found that cows subjected to much exercise yielded less butter than stall-fed cows. Every practitioner is aware of the influence that diet, certain medicines, mental emotions, and various other circumstances exert upon the milk of the nursing mother. Simon found that, during the period of lactation, the milk is gradually undergoing alterations, the casein and insoluble salts increasing in quantity, the sugar diminishing, while that of butter remains about the same.

Of all the constituents that enter into the composition of milk, that most immediately concerned in the nourishment of the muscular system and soft parts generally, is casein. This exists for the most part in solution, though a portion of it forms an investing membrane for the fat globules. It differs from albumen by not coagulating by heat. It is held in solution by its being in combination with soda, and therefore will only coagulate readily through the intervention of an acid. This is afforded by the gastric juice in the stomach, when milk always coagulates before digestion commences. It is also furnished spontaneously, if the milk be allowed to stand for some time, by the sugar being converted into lactic acid; this uniting with the soda, leaves the casein free to coagulate. Butter exists in the form of minute globules, each one surrounded, as before stated, by a thin investing membrane of casein. These fat globules, as is well known, being of a less specific gravity than the fluid through which they are diffused, soon gather upon the surface of the milk in the form of cream, which being removed and subjected to continual agitation, as in the well-known process of churning, they become further separated from the milk by the rupturing of the investing membrane, allowing the fatty particles to come into more immediate contact in the form of butter. It is well known the important office that this performs in the nourishment of the individual.

The next important constituent in the composition of milk, is sugar, upon which its sweetness depends. Though the proportion of its elements does not vary from that of cane sugar, yet it is a remarkable circumstance that it differs considerably in its properties, being harder, less sweet, and with more difficulty dissolved. It is obtained by evaporating whey. It is this, as before stated, that first assumes the process of decomposition, by being converted into lactic acid, thus causing the milk to become sour. This process commences soon after the milk has been exposed to the atmosphere, as may be detected by litmus paper long before any sour taste is imparted to the milk. At

an ordinary temperature this process of decomposition is gradual, but in very hot weather or in certain electrical conditions of the atmosphere it may be completed in a few hours. These three, viz., casein, butter, and sugar, constitute the organic constituents of milk. It now remains for us to notice, briefly, the inorganic portion which consists of saline matter nearly identical with that contained in the blood. These salts are of two kinds, soluble and insoluble. The former are the chlorides of sodium and potassium, the phosphate of iron, and the soda that exists in combination with casein. The insoluble are the phosphates of lime and magnesia. These, like the organic constituents, vary in proportion in the milk of different animals, and in that of the same animal, according to the variety of its food. From this brief review of its composition, it will be seen that milk contains all the elements of nutrition, combined in such proportions as to render it the best adapted to the sustenance of life, and the rapid development of the various tissues of the animal economy. For, while the casein supplies material for the muscular system, the butter and sugar supply fuel in the form of carbon and hydrogen for supporting the animal heat; for the development of the osseous system, we are indebted to the earthy salts; the hair and blood are nourished by the iron, and the gastric juice by the alkaline chlorides. It is also seen that in milk is represented both animal and vegetable food. The beefsteak and fat are furnished by the casein and butter, while the starchy matter of potatoes and bread is plentifully supplied by the sugar. Its adaptability, then, to the wants of man, the important part which it plays in his sustenance and nourishment, the readiness with which it assumes the process of decomposition, its liability to adulteration at the hands of those who have assumed the duty of furnishing it to our citizens, combine to render any successful attempt to furnish the article in its purity, and in such a form as to be easily transported and retain for a longer time the integrity of its composition, worthy the liberal encouragement of the public, and the warm and earnest sanction of the medical profession. It does not come within the province of this report to dwell upon the morbid changes produced in the quality of milk by the diseased condition of cows, with the disastrous consequences often attendant upon its employment, to which we believe thousands of children in our city have been sacrificed, as this subject in all its horrowing details has been most ably presented to this Academy on a former occasion. It will suffice, therefore, for the present, to examine more particularly the article under consideration. It affords the Section no small degree of satisfaction to be able

to state to the Academy that, after a thorough examination of this subject, they are fully convinced that in "Borden's condensed milk" the citizens of New York may be furnished with an article that for purity, durability, and economy, is hitherto unequalled in the annals of the milk trade. The facilities that he enjoys, both in a pecuniary and scientific point of view, added to the high character he sustains as an honest, upright man, not only afford him no inducement for deception, but on the contrary, should be sufficient to inspire all with implicit confidence in the truth of his statements, and insure the final success of his undertaking.

In order to carry out his views to the greatest advantage both to himself and patrons, he has selected for the seat of his operations a section of country abounding in rich pastures and healthy cattle, and so remote from the city as to enable him to procure milk from the neighboring farmers at a much cheaper rate than is usually paid by the milk dealers. As soon as received, it is with as little delay as possible deprived of a greater part of its watery portion, leaving the nutritious portion wholly unaffected, and in a portable condition. In the examination of the merits of this article, the Section have thought proper to acquaint themselves, as far as possible, with the mode of its preparation, to test its value as an article of diet, its therapeutic virtues, its purity, its durability, and economy.

In order to become more thoroughly satisfied concerning the manner in which this milk is prepared, it was thought advisable that the whole process be submitted to the careful inspection of some member of the Section. Accordingly, the Secretary, accompanied by Dr. Griscom, (who has kindly volunteered his assistance in the investigation of this most interesting subject,) at their earliest convenience, visited the laboratory of Messrs. Borden & Co., and were enabled to witness the process through its different stages, from the milking of the cows to its final completion. The milk, immediately after leaving the cow, was strained into an ordinary milk can, then placed in a cold water bath, and there it remained until it was entirely deprived of its animal heat. It was then placed in a hot bath, and soon as possible raised to a temperature of about 175° Fahrenheit. This caused a slight deposit of a viscid albuminous matter upon the sides of the can, which, if allowed to take place in the evaporating pan, greatly retards the process of evaporation. The milk is now passed through a second strainer, and without delay removed to a vacuum pan, where the water is evaporated. This pan consists of a large metallic vessel, supplied with a jacket for the reception of steam, by means of

which the heat is applied. Connected with the pan, by a tube, is a barometer that indicates at a glance the extent of vacuum, and by another tube, which serves also for the escape and condensation of steam, an air pump in constant motion. A thermometer, also in direct communication with the interior of the pan, indicates the temperature, and by means of a glass light in either side of the pan we can from time to time witness the progress of the evaporation. While witnessing the process, every few minutes a note was made of the temperature, extent of vacuum, and other points of interest. For instance, at 9 o'clock there were 247 quarts in the pan, boiling at a temperature of 118° in a vacuum of $27\frac{1}{2}$ inches. At forty minutes past 9, 180 quarts were added; at thirty-five minutes past ten, 240 quarts were added, making in all 667 quarts, which by thirty-five minutes past 1 o'clock was evaporated to one-fourth the quantity. During this time the temperature was twice observed to be above 130° , but most of the time it was from 115° to 126° . An opportunity was also afforded to test the relative quality of milk from the respective farms. Thus, from five different farms the milk was examined by the lactometer, and showed that the morning's milk was of a richer quality than the evening's. The cows taking little or no exercise during the night, less fat is required to support the respiration, and consequently more allowed to pass into the milk. The milk from one farm, where the cows were thin in flesh and seemed destitute of fat, was superior to the milk of cows that presented to the eye a more attractive figure. It is a fact familiar to every medical man, that those mothers who are of a slender frame, small muscular development, and deficient in adipose tissue, often afford better nourishment for their offspring than many mothers of a full and plethoric habit. In the one case the fat and casein supplied by the food passes into the milk; in the other, more of the one is deposited and retained in the areolar tissue, and the other contributes to the support and development of the muscular system. During the preparation of this milk, your committee beheld nothing that was not to their minds eminently satisfactory, both in the frankness with which everything pertaining to the subject was submitted to our examination, and the intelligence manifested in the replies to our many inquiries.

In reference to the condensed milk as an article of diet, its importance is at once established by the fact that it retains all of the nutritive qualities of milk uninjured. Cheese made from it is superior to common cheese, as it contains not only the casein and butter, (the beef and fat,) but the sugar also, which, as before stated, supplies the

starchy matter of vegetable food. In the ordinary method of cheese-making, the sugar is lost in the whey, thus depriving us of a very important element of nutrition. Used in its condensed form, this milk imparts a delicious flavor to coffee, fully equal to that of thick cream, and in short, as far as could be ascertained upon the most rigid inquiry, it has, whenever used in the various departments of the culinary art, given entire satisfaction. Its therapeutic value is restricted to that of pure milk and cream, and wherever these are indicated the condensed milk is equally valuable. It has been suggested as a substitute for cod liver oil, and in those cases in which the oil is not tolerated by the stomach, and cream has fulfilled the indications presented, the same amount of benefit may be derived from its employment; but as its amount of carbonaceous matter is so much less in proportion to its volume than exists in the oil, the Section are not prepared to say that it can in all cases be substituted for that remedy. The opinion prevails to a considerable extent that boiled milk has a strong tendency to constipate the bowels, and that question has been raised in reference to the condensed milk. To a note addressed to Professor Henry G. Cox, Physician to the Nursery Hospital, where the milk has been used for the last two months, that gentleman replies that it has no such tendency. He is pleased with it as an article of diet for children in the absence of pure new milk, and he adds, "if Mr. Borden continues to furnish it unadulterated, I think it will be a great improvement to the public over the manufactured milk now so generally in use."

In order to test its purity, it has been submitted to careful microscopical examinations as well as different chemical tests, and found to contain nothing but pure milk. In this connection it might be well to add, that when allowed to stand for some time, small crystals are deposited upon the bottom of the can, which has given rise to the remark, that some foreign substance had been added to the milk. These crystals are nothing but the sugar of milk, and so far from being an objection, they afford proof that the milk has undergone no decomposition. They are readily dissolved upon the addition of water. Its durability depends in a great measure upon the manner in which it is kept. When exposed to the influence of hot, damp weather, it will remain sweet but little longer than ordinary milk. If kept upon ice, or in cold weather, it will remain sweet for many weeks. When hermetically sealed, it will keep for many months, or even years. In answer to inquiries on this part of the subject, the following communications were received :

Office of N. Y. and Liverpool U. S. M. Steamers, Oct. 29, 1857.

Dr. E. H. JANES, Sec'y of Med. Com.

DEAR SIR—In answer to your inquiries relative to Borden's Condensed Milk, I have to state that it has been used on board of this line of steamers for several voyages, and ascertaining that it would keep to Europe and back, it is put on board for the return voyage, and found good on return of ship to this port. G. BRIGGS,
Supt. of Collins' Steamships.

Steamship Augusta, Oct. 29th, 1857.

Dr. E. H. JANES, Sec'y of Med. Com.

DEAR SIR—In answer to your inquiries in relation to Borden's Concentrated Milk, I beg leave to state that the Steamer Augusta has used it exclusively for the last two or three months on her passage to and from Savannah, Geo., with convenience to the ship and comfort of the passengers. I also learn that the Steamer Alabama, sailing to the same port, exclusively uses the milk.

Respectfully,
DAVID SIMMONS,
Chief Steward Steamer Augusta.

A communication was also received from Hutchinson & Co., ice dealers, stating that they had furnished steamships with this milk, and in no instance had heard any complaint of its becoming sour. Full directions are given by the proprietor on this subject, and those who follow out faithfully these directions, will find it quite as durable as is represented. Its economy is entirely in the hands of the consumer. It is sold in its condensed form at thirty-two cents per quart. Add three quarts of water, and we have four quarts of pure cows' milk. Add another quart of water, and we have five quarts of better milk than is usually supplied at our doors. Should any one desire a still cheaper article, he can learn how to obtain it, by referring to an account of a recent meeting of milkmen, given in the *New York Daily Times* of Monday, Nov. 2nd.

In conclusion, the Section beg leave to assure the Academy that they believe Borden's Condensed Milk to be what it purports to be, and nothing more; viz., pure milk deprived of most of its water, and deficient in none of its nutritive elements. They believe it to be the best possible substitute for pure new milk that can be had in this or any other city. Equally adapted to the wants of all conditions of life, and often a valuable auxiliary to the physician, either in private or hospital practice. And as such, the Section would earnestly recommend it to the favorable notice of the Academy.

Respectfully submitted,

JOEL FOSTER, M.D., *Chairman.*
E. H. JANES, M.D., *Secretary.*

