

use, and many epidemics of stomatitis aphthosa or aphthous fever have been reported. According to Dr. Salmon, of the Bureau of Animal Industry, this epizootic does not now prevail in the United States, the last cases having occurred in Maine some years ago. There is, of course, danger from a return of the disease at any time; it annually affects about ten per cent. of the cattle in Europe.

Mr. E. Hart described an epidemic at Aberdeen, which affected about three hundred persons with rigors, fever, tonsillar enlargement, and swollen cervical glands. The boys at the reformatory school, whence the milk came, receiving only skimmed milk, entirely escaped. The water supply of the dairy was bad, but no explanation of the epidemic was given. The symptoms resembled the outbreak at Dover in 1884, which affected in one week two hundred and five cases, all supplied with milk from one dairy, the cows at one of the farms suffering from foot-and-mouth disease. Baum refers to a number of instances in which the infection was conveyed in the milk.

(f) *Cowpox*.—Dr. J. M. Cotterill read, before the Medico-Chirurgical Society of Edinburgh, a paper in which he gave the history of two epidemics of sore throat which occurred at Fettes College. The first began in October, 1886, and comprised fifty cases; the second occurred a year later, and comprised eighty-four cases. The symptoms of the disease were as follows: When first seen the patients (all boys) were generally out of sorts, complaining of headache, want of appetite, and lassitude; occasionally there was sickness or nose bleeding; in most cases a furred tongue, foul breath, and other symptoms of gastric disturbances were present. The tonsils and posterior wall of the pharynx were bright red, with considerable swelling of the mucous membrane. The uvula and soft palate were also congested, but in no case was there any membranous deposit on these parts. Upon the tonsils and walls of the pharynx, however, there were always follicular exudations, and sometimes a considerable patch of deposit on the tonsils, which were often much swollen and deeply fissured. These patches could always be easily removed. Albuminuria was very frequent. The disease usually lasted about seven days in its acute stage. A peculiar symptom was the implication of the uppermost of the chain of lymphatic glands behind the sterno-mastoid. This always happened several days after convalescence had commenced. There would be a large brawny swelling in the neck, which in every case subsided slowly, without suppuration. Meantime the cows had been inspected by Professor Williams, and two of them had been certified to be suffering from variola vaccina in its later stages.

(g) *Anthrax*.—The milk of animals infected with anthrax is unfit for use, because Feser, Manotzkoff, Nocard, and others have actually demonstrated the bacillus anthracis in the milk, and if infection has not more frequently taken place it is because the secretion is arrested in the very first stage of the disease. Heusinger, however, refers to an instance which occurred in the daughter of a plantation owner, in 1795, at Barbadoes, who drank one morning most of the milk from a cow suffering with anthrax. Four days afterward the child presented symptoms of the disease. A carbuncle also appeared on the left arm. The direct transmission through the milk, although probable, has not been proven; still there can be no question as to the objectionable character of the milk.

(h) *Pleuropneumonia*.—It is claimed that the milk of animals suffering from this disease may convey the germs, and Lécuycr, Schüppel, Jürgensen, and others have actually reported a number of transmissions, but the question is by no means settled. Fortunately, the disease has been stamped out in the United States; at least Dr. Salmon informs me that not a single case has been reported for some years.

(i) *Rabies and Tetanus*.—In olden times the consumption of milk from rabid cows was regarded as dangerous, and Faber refers to a few instances of transmission of the disease in human milk, which all date back to the last

century. Feeding experiments have proved in the majority of instances negative, and Hertwig, Bollinger, Reder, Fröhner, and others conclude from them that there was no danger from this source. Since Pasteur pointed out, however, that the mammary glands were among the organs selected for the deposition of the virus, there has been a renewed interest in the subject, and Nocard has experimentally proven that the virus may be conveyed in the milk. Burdach also determined, in the Pasteur Institute, that the milk of a woman bitten by a rabid wolf proved infectious to rabbits and guinea-pigs, but was quite harmless to the child. This question remains unsettled, as the accidental admixture of virus outside of the body in the Pasteur Institute is not excluded; but all authors agree that cows may suffer from hydrophobia, and that the milk should not be used. It is not improbable that the milk of animals suffering from tetanus contains some of the specific bacterial products, but it seems almost inconceivable that animals suffering from these affections should be milked at all.

(j) *Tuberculosis*.—While it is possible for milk to be contaminated with the sputum of tuberculous matter of consumptives, we are considering here the transmission of the germs from the animal to man through the medium of milk. When it is remembered that one-seventh of all the deaths are due to tuberculosis, and that the identity of bovine and human tuberculosis has been a source of contention for years, we need not wonder that much attention has been given to the study of milk from tuberculous cows. Dr. H. C. Ernst presents evidence from thirty-nine veterinarians representing seventeen States, most of them reporting for one year only, which indicates that there were 549 cases of tuberculosis and 242 suspicious cases, a total of 791 among 165 herds, representing about three thousand animals, *i. e.*, 18 per cent. of positively tuberculous animals and over 8 per cent. of suspicious cases, a total of about 26 per cent. According to Dr. Salmon it has been proved that in some countries from 40 to 50 per cent. of all cows have tuberculosis. In the United States the proportion is very much less, being probably not over 5 per cent. in our worst affected States. Yet there are many herds here as badly affected as the worst herds of Europe. The possibility of the presence of tubercle bacilli in the milk of animals was pointed out first by Virchow and by Koch as early as 1882, and subsequently the bacilli have been demonstrated by Bang, Johnne, Bollinger, Ernst, Woodhead, MacFadyan, and many others, in the milk of animals in which the udder was also the seat of lesion, and for some time it was doubted whether the milk from a cow is virulent unless the udder is the seat of the tuberculous deposits. In 1893, Theobald Smith from a number of experimental observations finds that tubercle bacilli may be present in the milk of tuberculous cows when the udder, so far as the naked eye could tell, contained no foci of disease, and the result presented by Ernst in his report on the infectiousness of milk appears fully to justify the conclusion reached by him in 1889 that the milk from cows affected with tuberculosis in any part of the body may contain the virus of the disease. These conclusions are moreover supported by the investigations of Bang, Bollinger, Adami, May, Delépine, Stein, Rabinowitch, Kempner, and Hirschberger, the latter being also the first to point out that the inoculation experiments are the more certain guide as to whether the milk is infectious or not, as he obtained positive results from milk of undoubted tuberculous animals, in which he was unable, however, to demonstrate the presence of tubercle bacilli. The general results of inoculation experiments would seem to indicate that the infectious qualities are greatest with milk from animals with udder lesions, and next from those affected with general tuberculosis. The feeding experiments of Bang, Bollinger, Klebs, Ernst, Baumgarten, Fisher, Wesener, and others, with tuberculous milk proved infectious in about forty-five to fifty per cent. of the cases. When we recall the fact that the last three observers in their feeding experiments were especially impressed with the resulting tuberculous lesions of the intestinal mu-

cosa, mesenteric glands, and liver; when we next consider the large mortality of children under five years from primary tuberculous ulceration of the intestines, tuberculous peritonitis and tuberculous mesenterica, and the fact that the food of these children consists largely of unboiled milk, the chain of evidence seems wellnigh complete, but has been materially strengthened by a number of clinical cases.

Professor Klencke, in an excellent little work published at Leipsic, in 1846, gives the clinical history of sixteen children who had been fed with milk from "scrofulous tuberculous" cows, and all point to tuberculosis of the intestines, glands, skin, or bone. In three of the intestinal disorders, he refers to the presence of indurated mesenteric glands. In this connection, the writer can hardly resist the conclusion that the difference in degree of virulence observed in the various tuberculous manifestations is perhaps not always attributable to the condition of the host, but may possibly be due to an attenuated character of the tubercle bacilli. Whether or not the German habit of boiling the milk, or adding boiling water, or the action of the gastric juice modifies the virulence of the bacilli, as shown by the slower forms of tuberculosis, remains to be seen; but in the feeding experiments with raw and boiled milk, of Bollinger in 1878, and Bang in 1890, a marked difference in the resulting lesions may be noticed.

Dr. Ernst's clinical inquiry on the transmission of bovine tuberculosis revealed the following facts: Among 1,013 replies from physicians, 895 were negative, 8 reported cases of infection of a child by the mother, 11 reported cases of infection by cow's milk, and 16 reported suspicious cases. The veterinarians gave much more striking evidence, since among 54 replies 14 reported positive and 9 suspicious cases. The positive replies quoted by Dr. Ernst are not such as will be considered conclusive evidence by pathologists and really lack scientific accuracy.

Johnne, Hermsdorf, Leonhard, Demme, Sonntag, Meyerhoff, Stang, Schöngen, Uffelmann, Brouardel, Ollivier, and others have reported instances of transmission in which all other causes could be reasonably excluded. The entire subject still requires careful consideration, and the work of Klencke, who as early as 1846 described the condition of the patients, the cows supplying the milk, and the post-mortem appearances, should serve as an example for investigators in this field.

5. MILK MAY ACQUIRE INFECTIVE PROPERTIES AFTER IT LEAVES THE UDDER OF THE ANIMAL.—Numerous instances have been observed in which outbreaks of typhoid fever, scarlet fever, and diphtheria, by their sudden and explosive character, affecting families living in streets and localities supplied by the same milkman, naturally pointed to the milk supply as a common cause. Dr. Michael Taylor, however, was the first physician (in 1857) to point out definitely that cow's milk might serve as the medium of spreading typhoid fever from a dairy where the disease prevailed. In 1867 he also showed that scarlet fever might be distributed in the same way. In 1877 Mr. Jacob traced a diphtheria epidemic at Sutton to the milk supply, and in 1872 Macnamera traced an outbreak of cholera at Calcutta to an infected dairy. These facts could not fail to sharpen the powers of observation in others, and in consequence similar outbreaks were more frequently reported, so that Mr. E. Hart, the editor of the *British Medical Journal*, was enabled to present to the International Medical Congress, held in London in 1881, the history of 50 outbreaks of typhoid fever, 15 of scarlet fever, and 7 of diphtheria, all traceable to the milk supply. In a similar communication made before the International Medical Congress at Paris, in 1900, the writer presented his conclusions based upon the tabulated histories of 330 outbreaks of infectious diseases spread through the milk supply; these outbreaks consist of 195 epidemics of typhoid fever, 99 epidemics of scarlet fever, and 36 epidemics of diphtheria.

It has been demonstrated by numerous bacteriologists that disease germs may not only survive, but in many in-

stances actually proliferate in the milk; and it is not a difficult matter to point out the many ways by which these germs gain access, especially when some of the employees are also engaged in nursing the sick, or are suffering themselves from some mild infection while continuing their duties, or are convalescent from the disease. It is quite conceivable how animals wading in filth and sewage-polluted water may infect the udder with the germs of typhoid fever and through it the milk. We can also appreciate how infected water may convey the germs by washing the utensils or by deliberate adulterations. Infection may also take place through the agency of scrubbing-brushes, dishcloths, exposure to infected air, and the agency of flies.

(a) *Typhoid Fever*.—Of the 195 epidemics of typhoid fever tabulated by me, there is evidence, in 148, of the disease having prevailed at the farm or dairy. In 67 instances the infection probably reached the milk by percolation of the germs into the well-water with which the utensils were washed; in 16 of these the intentional dilution with water is a matter of evidence. In 3 instances the bacillus coli communis and the typhoid germs were demonstrated in the suspected water. In 7 instances infection is attributed to the cows wading in sewage-polluted water and pastures; in 24 instances the dairy employees also acted as nurses; in 10 instances the patients, while suffering from a mild attack or during the onset of the disease, continued their work, and those who are familiar with the personal habits of the average dairy hands will have no difficulty in surmising the manner of direct digital infection. In one instance the milk tins were washed with the same dishcloth which had been in use among the fever patients. In two instances the dairy employees were connected with the night-soil service, and in another instance the milk had been kept in a closet in the sick-room.

(b) *Scarlet Fever*.—Of the 99 epidemics of scarlet fever the disease prevailed, in 68 instances, either at the dairy or at the milk farm. In 6 instances persons connected with the dairy either lodged in or had visited infected houses. In two instances the infection was conveyed by means of infected bottles or milk cans left in scarlet-fever houses. In 17 instances the infection was conveyed by persons connected with the milk business while suffering or recovering from the disease, and in at least 10 instances by persons who acted as nurses while handling the milk. In 3 instances the milk had been stored in or close by the sick-room. In one instance the can had been wiped with an infected cloth. In 19 instances the infection was attributed to disease of the milk cows, such as puerperal fever and inflammation of the udder and teats; but these outbreaks were probably not genuine scarlet fever, but a so-called streptococcus or staphylococcus infection, the symptoms of which closely resemble those of scarlet fever.

(c) *Diphtheria*.—Of the 36 outbreaks of diphtheria tabulated there is evidence that the disease prevailed at the dairy or farm in 13 instances. In three instances the employees continued to handle the milk while suffering themselves from the disease. In 12 instances the disease is attributed directly to the cows having inflammatory conditions of the teats and udders. These instances, however, may be regarded as typical examples of streptococcus and staphylococcus infection, giving rise to a form of follicular tonsillitis or pseudodiphtheria, often difficult to distinguish clinically from true diphtheria or scarlet fever.

(d) *Cholera*.—Professor Koch, in 1884, first pointed out that milk is a suitable culture medium for the cholera bacillus, but the possibility of the virus being transmitted in the milk had been emphasized before. Gaffky, in the report of the Cholera Commission in India, refers to the unsanitary condition of the dairies in India, where the water supply is derived from tanks which are promiscuously used for bathing, laundry, and dairy purposes, and as Dr. Payne, the health officer of Calcutta, in his report in 1876, expressed it, "milk cows are stalled in the neighborhood, and the nearest water is freely mixed with

the milk and distributed through the town." Dr. Cayley refers to the fact and consequent danger that at Katarhatti, a suburb of Calcutta of 300 families, 70 are engaged in the milk business, all located near one of these notorious water tanks, and that in September, 1872, not less than 16 cholera cases with 6 deaths occurred among these dairy people.

Dr. Macnamera reports an outbreak in a boarding-house at Calcutta attacking six Europeans and the cook of their department, while the other inmates and servants of the house escaped. They had all consumed the milk from a particular dairy, and it was determined that immediately before this outbreak eight cases of cholera had occurred in close vicinity of the water tank used by this milkman. Dr. Simpson, health officer of Calcutta, describes a limited epidemic which occurred on board the ship *Ardenchutha* resulting in nine cases and four deaths, and affecting, with one exception, consumers of a particular milk derived from a dairy located near a tank into which dejecta from a cholera patient found access, and the dairyman, with unusual frankness, admitted the dilution of the milk with about one-fourth of water from this source. Hesse claims that cholera germs will not survive in fresh raw milk; Basenau maintains that they retain their vitality and increase in number up to the point of coagulation, while Weigmann and Zirn declare that their activity is largely influenced by the number of other germs present.

It is interesting to note that of the 330 milk-borne epidemics analyzed by me, 243 have been recorded by English authors, 52 by American, 14 by German, 11 by Scandinavian, and 5 each by French and Australian writers. This is probably due to the fact that the English and Americans usually consume raw milk, while on the Continent the milk is rarely used without being boiled.

Adulteration of Milk.—According to the United States Census of 1900, we have 18,112,707 milch cows with an average annual production of 7,728,583,350 gallons of milk, 186,921,787 gallons of condensed milk, 1,492,699,143 pounds of butter, and 298,905,404 pounds of cheese. These figures furnish an indication not only of the extent of milk consumption but also of the amount of danger from an impure supply, and lastly of the temptation which still exists, from a monetary point of view, for the practice of shameful adulterations. The most frequent of these are the intentional dilution with water, the removal of cream, and the addition of skimmed milk. The former, apart from diminishing the nutritive value of the milk, a matter of great importance, is often the immediate cause of transmitting disease germs, if the water happens to be infected. A very common fraud appears to be the removal of cream and adding just enough separated milk until the amount of fat present is on the limit that will pass inspection. The introduction of cream separators affords an opportunity of removing almost the whole of the fat from the milk, and the sophisticator has thus the power of reducing its cream to the lowest salable standard without exposing himself to any such risk of detection as would attend the process of "watering," a process by which the total non-fatty solid might be so reduced as to lead to the detection of the fraud. Indeed Spiegelhalter, of St. Louis, from a large number of examinations, concluded that the fraud by removal of cream in that city amounts to 1,600 gallons per day, or a loss of about \$900,000 per annum, largely made up of the pennies of poor and sickly women and half-starved children. Similar testimony has been recorded regarding the milk supply of other cities. Dr. W. H. Kent, the chemist of the Brooklyn Department of Health, in March, 1889, examined a number of samples of condensed milk with reference to previous skimming, and from the results he concluded that 17 of the 23 different brands were made from milk the cream of which had been more or less removed. The glaring cases which come under the notice of the authorities afford no evidence as to the actual extent of these frauds, but they simply show that in these instances the milk had been so recklessly treated as to pass beyond the limit of a low official standard of

milk. Formerly it was almost impossible to secure conviction on account of the difficulty of proving the addition of water or removal of cream, for there are instances of deficiency of solids in milk known to be genuine and the charge of fraud or criminal knowledge could not always be sustained.

Milk Standards.—These difficulties and the fact that the composition of milk varies greatly with the breed and feed of the animals, climate, and season, led to the adoption of legal standards of milk offered for sale. There are instances of analysis in which the total solids fluctuated from 10.33 to 15.83 per cent. and the fat varied in the same manner from 2.43 to 5.97 per cent. If between these limits a high standard were fixed the result would be to condemn much genuine milk, while if a low standard were adopted, it would virtually legalize dishonest manipulations of the milk or else place a premium on indifferent care and breed of the dairy stock. Indeed, if we follow up cases of poor milk to their source, we usually find half-starved or badly cared-for cows, and for obvious reasons we can only deal with averages based upon a large number of samples and which, while fulfilling modern sanitary requirements, are also just to the producer. As a result of the analyses obtained by different chemists covering over 120,000 samples of milk, we have a right to expect a milk containing 12.50 per cent. of total solids, composed of 8.75 per cent. non-fatty solids and 3.75 per cent. of fat, and also that the legal standards which vary in different States be modified accordingly.

By the adoption of legal standards, the prosecution of milk sophisticators has been simplified, for by prohibiting the sale of milk below a fixed standard the question of fraud or adulteration need not be proven, and the allegation that it is below the prescribed standard can be sustained by the results of the analysis and suffices for conviction, regardless of the fact whether it is the product of fraudulent practices or the peculiarity of individual cows or their care.

Adulterants Most Commonly Used.—In order to conceal adulteration with water or the removal of cream and other fraudulent practices, all sorts of substances have been added. Lengfelt, of San Francisco, communicated to Professor Wiley the composition of a milk adulterant commonly used in that city and consisting of common salt, saltpetre, saleratus, a trace of caustic soda, and a large quantity of sugar and colored with caramel. Chalk, gypsum, starch, finely ground calves' brains, and gelatin figure among the recorded instances of adulterants, but it is about time that the popular fallacy of chalk and water mixtures and emulsions of calves' brains should be dispelled. A moment's reflection will indicate that chalk and water would have to be constantly stirred and that calves' brains are too expensive, and moreover quite unsuited for such a purpose. Starch and gelatin are occasionally used, and Harrington reports that a preparation largely advertised to the trade at one time as a "cream thickener" was analyzed by him and found to be a mixture of gelatin, borax, and boric acid. Annatto, turmeric, yellow coal-tar colors, and even chromates have been employed to give a rich yellow color to poor or watered milk, or during the winter season when the cream has not the characteristic yellow tint.

Preservation of Milk.—Bitter, an authority on sanitary milk, maintains that the maximum limit for milk that is fit for food is 50,000 germs per cubic centimetre. Dr. Turner, the Dairy Inspector of the District of Columbia, found only 52 of the 117 samples examined by him to contain less than 50,000 per cubic centimetre, while most of the samples showed a higher number of bacteria than the sewage of the city. The changes due to bacterial action have been described under "Bacteriology of Milk," and the effects of such changes have been pointed out in the section relating to Milk Sediments, on page 834. The multiplication of milk bacteria goes on most rapidly at a temperature of between 70° and 85° F., and they practically cease to proliferate at a temperature below 50°. In order to reduce the number of germs to a mini-

mum, it is necessary to reject the first strippings of the milk, because it has been shown by Schultz and Moore that the foremilk always contains an excess of bacteria, which have invaded the lacteal ducts and multiplied since the previous milking. Absolute cleanliness of animals, stables, milking-rooms, utensils, employees, and the very air, are equally essential. This has been demonstrated by Sedgwick, Batchelder, Freeman and others. Freeman's experiments are especially instructive; he exposed three plates, each three and a half inches in diameter, for two minutes as follows: one in the open air, one outside a barn, and a third in front of the milk pail under a cow in the same barn while the milking was going on. The first showed 6, the second 111, and the last plate 1,800 colonies, and strikingly illustrates the dangers of dust being stirred up. Next to clean and intelligent methods in milking, the temperature of the milk should be quickly brought down to 40° F., kept cool, and delivered to the consumer at a temperature below 50° F., so as to inhibit the growth of the micro-organisms. That this can be done is shown by the fact that the average number of bacteria in the product of a sanitary dairy in the city of Washington was only 6,485, against 52,000 per cubic centimetre, found in average market milk. This involves, to be sure, the free use of ice and its transport in refrigeration cars, but milk of this character can be sold with a good profit at ten cents per quart. In some parts of Europe a portion of the milk is frozen into solid blocks by the ammonia process and placed in the shipping cans to keep the other milk at a low temperature.

Heat has been employed as a preservative because the operation of certain temperatures destroys the vitality of the germs. Two methods have been proposed, viz.: sterilization and pasteurization. Sterilization is usually accomplished by boiling the milk for ten minutes, which is sufficient to destroy all living organisms, including, of course, disease germs; a longer exposure is necessary, however, for the destruction of the spores of the anthrax bacilli, although continuous heating under pressure for two hours at a temperature of 248° F. accomplishes the same purpose. The formation of the coat on top consisting of fat, casein, and lactalbumin, can be prevented by boiling the milk in a long-necked bottle. In boiling, milk loses its gases and aromatics, and also some of its watery constituents, part of the sugar is converted into caramel, and the proteids and salts are also modified; these and other modifications which have been pointed out in Dr. Blackader's article, Vol. IV., p. 866, affect the digestibility of the milk, and rickets and scurvy have been attributed to this cause. For these reasons pasteurization, or the exposure of the milk for from ten to fifteen minutes to a temperature of 158° F., was regarded as a distinct advantage. The milk does not acquire a cooked taste, but in order to inhibit the growth of some of the more resistant organisms and their spores, the temperature of the milk must be promptly reduced to 50° F. and kept there, and if need be the process can be repeated in twenty-four hours, and thus the keeping qualities increased. Bitter prefers a temperature of 155° F. for thirty minutes, while others maintain that a temperature of between 140° and 147° F. suffices for the destruction of all pathogenic organisms; but Theobald Smith's experience with the tubercle bacillus shows the necessity of a temperature of 149° F., and, on the whole, Bitter's limit of 155° F. ought not to be lowered.

It is claimed by quite a number of physicians that the operation of even such low temperatures impairs the digestibility and nutritive qualities of the milk, and that preference should be given to raw milk obtained under special sanitary precautions. Unless, however, the milk is obtained from dairies operated under special milk commissions, the writer strongly urges pasteurization as the lesser evil of the two; indeed, he believes that the dangers of pasteurized milk have been exaggerated, and the question of incomplete absorption of the salts as a cause of scurvy and rickets has not been sufficiently considered. These diseases are most frequently developed in children

after prolonged diarrhoeal affections, and the diarrhoea, and not the modified character of the component parts of the milk, may be responsible for the incomplete absorption. To overcome the objections to pasteurization of milk, Freeman recommends that the cream be allowed to rise, and as it carries about ninety-nine per cent. of the bacteria along to the surface, it will be sufficient to sterilize the cream only. This suggestion has been before the profession only a few years, and sufficient time has not elapsed to determine its merits.

Chemical Preservatives.—In order to promote the keeping qualities of milk, the use of antiseptics has been invoked by farmers who ship milk by railway to the city. The agents which have been used are borax and boric acid, salicylates, benzoates, formalin (a forty-per-cent. solution of formic aldehyde) and sodium chloride, carbonate of sodium, saltpetre, and chromates. Of late years most of these chemicals except formaldehyde have fallen into disuse. According to the tests made by Dr. C. P. Worcester, quoted by Harrington, 1 part of commercial formalin in 100,000 parts of milk will postpone the curdling point 6 hours; 1 in 50,000, 24 hours; 1 in 20,000, 48 hours; 1 in 10,000, 138 hours; 1 in 5,000, 156 hours. Rideal and Fullerton regard formaldehyde in the proportion of 1 to 50,000 as an effective preservative of milk for 24 hours, and although it is claimed that in this strength, even during extended periods of use, this substance appears to have no injurious effects upon the consumer, the writer protests against the use of this or any other chemical preservative, so long as we possess in clean methods and cold storage a more rational and natural method. It must be remembered that few of these agents are normal constituents of the body and that their ingestion can do no good and may do harm.

Boric Acid and Borax are generally used in combination, and in order that it shall act as a preservative it is necessary that about ten grains of the mixture shall be added to a quart of milk. Prof. R. H. Chittenden reports that borax retards the amylolytic action of saliva, boric acid in amounts less than one per cent. favor it, and that both substances increase gastric digestion in small amounts and retard it in large. Foster and Schlenker found that boric acid limits albumen digestion and produces increased exfoliation of the intestinal epithelium, and also increased phosphoric acid elimination. Dr. H. E. Annet, in the *London Lancet*, November 11th, 1899, presents the results of his studies of boric acid and formalin as milk preservatives, and regards them as injurious especially to young infants.

Sodium Carbonate has been used more for the purpose of neutralizing acidity than as a preservative. It forms a lactate of soda which is believed to be a mild cathartic. Saltpetre, the salicylates, benzoates, and chromates are rarely used in this country, although reports from Europe indicate their occasional employment, especially that of the chromate and dichromate of potassium. Professor Hird, chemist of the Health Department, D. C., informs the writer that as a result of his crusade against the use of preservatives he encounters only now and then samples of milk containing formaldehyde.

Milk Inspection and the Methods of Detecting Adulterations and the Preservatives of Milk.—It is practically impossible to examine all the milk brought to a large city, nor is this necessary, provided the examinations are sufficiently frequent to cover within a reasonable time all the establishments connected with the milk traffic. Accurate records should be kept of these examinations, which should be directed to the determination of the most common forms of adulteration, viz.: (1st) milk which has been robbed of its cream and offered for sale as sound milk; (2d) milk which has been diluted with water; (3d) milk which has been creamed and watered; (4th) milk which is reduced by the addition of skimmed milk; (5th) milk to which various substances have been added to conceal adulterations; (6th) milk to which preservatives have been added. The methods usually employed by milk inspectors when dealing with a large number of samples are limited to the determination of the specific