gravity and the estimation of fats by which at least the suspicious cases can be singled out, and when found, liberal samples should be taken for the more accurate methods of the official laboratory.

In some States the authorities depend chiefly upon the lactometer. The normal average specific gravity allowed is 1.030 at 60° F., or 1.029 at 70° F. If the spindle floats below 29°, the inspector usually concludes that the milk is probably watered, or if it floats above 33° that it has been skimmed. As a matter of fact, however, an excessive amount of cream might diminish the specific gravity of a really rich milk, and the inspector should take this into consideration as well as the fact that the removal of fat raises the specific gravity, and the addition of water lowers it, rendering it quite possible that a milk which has been creamed and watered may have a normal specific gravity. For all these reasons a chemical analysis should be required, in order to secure conviction; and, so far as the methods for the determination of fats, milk sugar, proteids, and mineral matter are concerned, the reader is referred to Dr. Ladd's article on *Milk* for the desired information.

The Presence of Nitrates and Nitrites in milk is suggestive of adulteration with water derived probably from a polluted source. For the detection of these salts E. Pfeiffer recommends the following: Add sufficient acetic acid to 50 c.c. of the milk to precipitate the casein, filter carefully, boil the solution and filter again, acidulate 20 c.c. of the filtrate with one drop of pure sulphuric acid, and add small quantities of powdered diamidobenzol; a change to a yellow color indicates the presence of nitrous acid.

Also place 0.5 gm. of diphenylamin in a clean porcelain capsule or test tube and pour about 2 c.c. of pure concentrated sulphuric acid over it; then drop along the side of the capsule or test tube one or two drops of the above filtrate; the development of a blue color indicates the presence of nitrites or nitrates (Soxhlet).

Bacteriological Examination.—Since it has been claimed that nitrates and nitrites may be present in the milk if ingested by the animal either in water or in food, it will be well to examine the milk and suspected water also bacteriologically, which has become a well-recognized procedure, with a view of determining not only the number, but also the character of the germs, especially of the sewage group. Milk containing over fifty thousand germs per cubic centimetre is practically unfit for food, and for infant feeding the number should not exceed five thousand per cubic centimetre. Since milk may contain such a large number and variety of liquefying organisms as to spoil the plates, the phenol methods should be employed, and it is also best to make a number of plates in which the drop of milk has been diluted with sterilized water in various proportions, properly labelled and exposed to a temperature not exceeding 68° F. With this precaution the inspector may proceed with his technique, with which it is presumed that he is fully familiar.

Detection of Starch is usually accomplished with the microscope, also by the blue color developed on the addition of tincture of iodine to the milk previously heated to the boiling point and then cooled.

Detection of Gelatin in Cream.—Stokes recommends the following: Dissolve some mercury in twice its weight of strong nitric acid (specific gravity 1.420), dilute with water to twenty-five times its bulk; to about 10 c.c. of this solution add a like quantity of the cream and about 20 c.c. of cold water; shake the mixture vigorously; leave it for five minutes, then filter. If much gelatin be present it will be impossible to get a clear filtrate. To the filtrate or a portion of it add an equal bulk of a saturated aqueous solution of picric acid. If any gelatin be present a yellow precipitate will be immediately produced. The whole operation is performed in the cold, and if the mercury solution is ready, it will not take more than ten minutes. Picric acid will show the presence of 1 part of gelatin in 10,000 parts of water.

Detection of Added Coloring Matters.—*Annatto.*—Add a few cubic centimetres of sodium carbonate solution to about 100 c.c. of milk to insure a strongly alkaline reaction during the examination, and then immerse a slip of heavy white filter paper, allowing it to remain over night in a dark place. The strip is withdrawn from the milk, gently washed in running water, and laid upon a piece of similar paper; it will present a distinct salmon tint if annatto is present in the proportion of 1 to 100,000. On dipping the paper into stannous chloride the color is changed to pink (Harrington).

Coal-Tar Colors.—According to Leffmann and Beam, these colors are detected by adding to the milk ammonium hydroxide and allowing a small piece of white wool to remain in it over night. The dye is taken up by the wool, which acquires a yellow tinge. When milk contains Martin's yellow, ammonium hydroxide intensifies the color, and hydrochloric acid bleaches it.

Chromates, according to Guérin, are detected by the following method: To 5 or 10 c.c. of milk add two drops of a one-per-cent. solution of sulphate of copper and two or three drops of freshly prepared tincture of guaiacum. Pure milk gives a greenish color; while milk containing 1 part in 100,000 of chromate will give an intense blue which reaches its maximum in a few minutes.

Caramel.—Harrington's method is as follows: Pour from 125 to 250 c.c. of the suspected sample into an equal volume of ninety-five-per-cent. alcohol and filter. The filtrate, if not perfectly clear, must be returned and passed through until it is quite free from turbidity. Any caramel present will be in solution in the alcoholic filtrate and may modify considerably its color, which is normally yellowish or greenish according to season, the latter obtaining in spring and summer. To 100 c.c. of the filtrate add 2 c.c. of solution of basic acetate of lead, which will precipitate the caramel together with any remaining proteids, the precipitate showing a slight brownish color if caramel has been used in sufficient amount to bring about the improved appearance, which is the object of its employment. Filter, wash with distilled water, and dry in an air-bath; according as the amount of caramel present is large or small, the horny residue on the filter paper will have a more or less deep chocolate tinge. The residue yielded by a pure milk will be either almost colorless or yellow, or slightly inclined to brownish, but not to chocolate color.

Determination of Free Lactic Acid.—Pfeiffer recommends to mix 10 c.c. of milk with 40 c.c. of water and 1 c.c. of a concentrated solution of phenolphthalein (made with fifty-per-cent. alcohol). The acid is now neutralized by gradually adding one-tenth normal soda solution until a pink-rose color develops. It is not necessary to calculate the result in lactic acid, as it is sufficient for comparison to state the numbers of cubic centimetres of the soda solution used.

Detection of Preservatives.—*Determination of Sodium Carbonate* is most readily accomplished by E. Schmidt's method: 10 c.c. of the suspected milk are mixed with 10 c.c. of alcohol, and a few drops of a one-per-cent. solution of rosolic acid are added. If the carbonate or bicarbonate of soda be present, a more or less intense pink or rose-color is developed, while pure milk presents a brownish-yellow reaction; for comparison it is best to test milk known to be sound.

Determination of Salicylic Acid.—Fifty cubic centimetres of the suspected milk are treated with sulphuric acid for the removal of the proteids and fat and filtered. The filtrate is shaken violently with the same quantity of ether, and after separation of the ether the liquid is evaporated in a porcelain capsule, the residue is dissolved in a little alcohol, and a few drops of a neutral solution of ferric chloride are added. If salicylic acid be present even in traces, a characteristic violet color develops.

Determination of Boric Acid is best accomplished by Meissel's test: 50 c.c. of suspected milk are rendered alkaline with milk of lime, evaporated and washed. The residue is dissolved in strong muriatic acid; this solution is filtered and evaporated to dryness. The residue is moistened with sufficient very dilute muriatic acid to give it a soft consistency, mixed with tincture of turmeric

and dried on the water-bath. If boric acid be present the residue develops a cherry-red color, which does not disappear when diluted with water. A little of the ash may be moistened with just sufficient alcohol and ignited, when a greenish flame reveals the presence of boric acid.

Determination of Formaldehyde in Milk (*Method by Decolorized Fuchsin*).—Through a solution of fuchsin, 1 to 500, pass a current of sulphurous acid gas, obtained by heating copper wire or foil with sulphuric acid until the color is discharged. Preserve in a glass-stoppered bottle. To 10 c.c. of milk add 1 c.c. of the reagent and let

Fig. 3357.—A Walker-Gordon Barn at Burnside Farm, Baltimore County, Maryland, U. S. A. Floor and feeding alleys continuous and connected by an unbroken curve with the lower side of windows; absolutely waterproof; drained and trapped; composed of granolithic pavement. Stalls hardwood, dressed with waterproofing so as to admit of complete washing. Roof ceiled with cement plaster. Ventilators regulated to admit air but exclude draughts. Windows opened or shut with continuous rods so as to regulate them easily and perfectly. Ties or tie-ups, galvanized pipe-iron bent to compel cows to stand back when up and fitted with cross chains to prevent cows from lying down between grooming and milking. Drinking cups, galvanized iron, connected with large boilers for boiling out and sterilizing. Overhead tracks for carriage of food into barn and manure away from it. Bedding employed, kiln-dried spruce shavings. Cubic air space per cow, twelve hundred feet.

it stand ten minutes. Add 2 c.c. of strong hydrochloric acid and shake or stir briskly. The color which appears in the first instance is completely discharged by the acid if no formaldehyde is present, otherwise a violet-blue tinge remains. If the amount present is large the end color will be correspondingly intense. This method will detect the admixture of 1 part of formalin in 50,000 parts of milk. If the milk be first distilled and the first part of the distillate treated with the fuchsin solution, the test is delicate to the extent of revealing 1 in 500,000 (Harrington). The phloroglucin and Hehner's tests are also very reliable.

Phloroglucin Test.—Dissolve 1 gm. of phloroglucin in 100 c.c. of distilled water. Put 10 c.c. of the suspected milk in a test tube, and add 5 c.c. of the phloroglucin solution; shake and add 1 c.c. of solution of potassa, United States Pharmacopœia. If formaldehyde is present a red color is developed at once, fading usually within five or ten minutes; hence the color must be observed at once. One part in twenty thousand gives a decided reaction.

Hehner's Test.—To 15 c.c. of concentrated sulphuric acid in a test tube add one or two drops of ferric chloride test solution, United States Pharmacopœia, and mix. Then pour upon this, in such manner as not to mix the layers, the suspected milk. A violet color indicates the presence of formaldehyde. In the case of cream dilute the cream with an equal volume of water, and then apply the test as above described. The violet color is sometimes produced at once, but oftener not for five or ten minutes, and sometimes not for an hour or so, depending upon the amount of formaldehyde present. By this test 1 part in 10,000 or 15,000 is readily detected.

Control, Management, and Inspection of Dairy Farms.—Sufficient data have been given to furnish the inspector with a basis for his examination and the accomplishment of fruitful results. Pure natural milk can be secured only at dairies with sanitary buildings, a pure water supply, healthy, well-fed and well-cared-for cows, a well-

equipped and well-kept milk-room, provisions for thoroughly sterilizing all utensils, intelligent people in charge, and cleanly methods throughout. There are a number of persons—thanks to the training received at the various dairy schools—who make an honest effort to place on the market milk obtained under such conditions, but by far the majority are ignorant or wilfully indifferent to hygienic requirements, and therefore matters of this kind should never be left to the individual, but the principles which ought to be carried out should be embodied in effective laws, and accepted and executed in a practical sense. Honorable men will not object to laws placing dairies, the herds, and the milk market under strict sanitary control, and as many of the most serious dangers are the result of ignorance, rather than of intentional negligence, the difficulties will be materially lessened by proper education and trade competition. It is highly desirable that some uniform legislation, preferably a national pure-food law, be enacted to regulate the inspec-

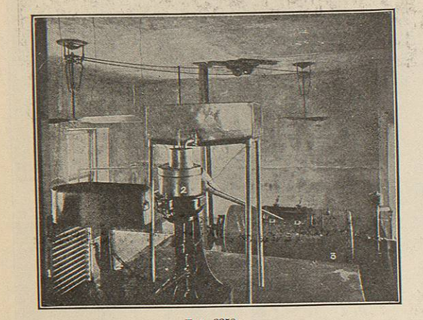

FIG. 3358.

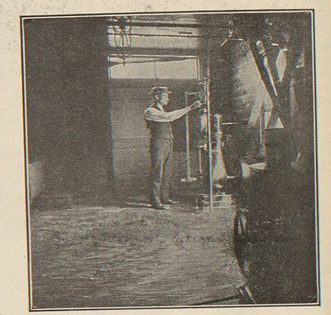

FIG. 3359.

FIGS. 3358 AND 3359.—Separating, Pasteurizing, and Cooling Department at Senator Stewart's Farm near Washington, D. C. 1, Cooler; 2, separator; 3, pasteurizer.

tion of dairy farms, etc., for, as it is now, milk consumed in New York City, for example, may be produced in a number of States over which, of course, the local authorities have no jurisdiction. A compulsory inspection of the dairy herds will be a source of ultimate profit to the owner, as the presence of tuberculosis or other communicable diseases endangers his entire herd, and great losses can be prevented by the extermination or isolation of the first case. The farmer will also find it to his advantage if he is obliged to house his cattle in spacious, well-ventilated and lighted stables (at least six hundred cubic feet of air space and nine feet window space for each animal, with good cemented floors, proper drainage, clean hay, straw, or shavings for bedding, and a standard ration.

The Feed and Care of Cows.—The animals should not be allowed to feed upon pastures with stagnant water or noxious weeds such as meadow saffron, henbane, Jamestown weed or stinkweed, poppies, mustard, carrot tops, milkweed, poison oak, sumach, skunk cabbage, and other euphorbiaceous and ranunculaceous plants, nor upon the swill or products from distilleries, breweries, glucose factories, etc. The use of turnips, kohlrabies, rutabagas, carrots, mangels, and the leaves of all kinds of root crops are also objectionable.

An abundance of wholesome pasture in season with hay and meal fodder should be allowed. At some of the "milk-cure institutes" in Germany each cow is allowed daily 10 pounds of meadow hay, 17 pounds of clover hay, 6 pounds of hulled barley meal, and 4 pounds of wheat flour. The United States Department of Agriculture recommends the following:

Adjustment of Ration to Milk Yield.—In making allowance for the difference in milk yield of different cows, a uniform basal ration can be fed to all the cows, and the amount of the richer grain mixture varied to suit the demands. For example, a basal ration might be made up of 25 pounds of corn silage, 8 pounds of rowen hay, and 3 pounds each of cornmeal and wheat bran, which would supply 1.43 pounds of protein and a fuel value of 23,712 calories. To this could be added a richer grain mixture composed of two parts of gluten meal and one part of cotton-seed meal, the amount of this being varied according to the milk yield of the cow. Two pounds of this mixture would bring the ration up to 1.97 pounds of protein and 26,999 calories, which would meet the requirements of cows giving from 12 to 15 pounds of milk a day, while 4 pounds would bring it up to 2.50 pounds of protein and 30,286 calories of heat, suitable for the cows giving from 20 to 25 pounds of milk, and so on, 5 or 6 pounds of the grain mixture being fed to the heavier milkers.

The water supply should be pure and closely guarded against pollution. In the absence of a spring, a deep-driven well should be preferred. While it is true that at the majority of dairy farms wells and privies are dangerous neighbors, the agency of flies in carrying infection should not be underrated, and points to the necessity of prompt disinfection; an effort should also be made to get rid of the flies by prompt disposal of the horse manure in which they breed, the abandonment of open privies and surface pollution, removal of garbage, and other fly-breeding matter. The animal should be groomed, and the teats and udders washed with sterilized water before milking; this is of importance, as the presence of fecal bacteria in milk is next in danger to disease germs.

Milking and Care of Milk.—The requirements of cleanliness apply with equal force to the milkmen, their person and clothing, and they should be required to keep their finger-nails clean from dirt and make a careful toilet before milking. The milking should be done in a dust-free atmosphere, preferably in a special room with cemented floors, previously sprinkled in order to reduce the number of germs to a minimum. It is impossible to secure bacterial purity of the milk when the milking is done in a stable with a hayloft above. The best results observed by the writer were obtained at a dairy supplied with one-story frame stables, cemented floors, well

lighted and ventilated by windows and Ridge ventilators, and where the animals after grooming were taken into a similarly constructed room for milking. Attention has already been called to the necessity of absolute cleanliness of the utensils and bottles, which can be accomplished with a weak solution of boiling soda water, subsequently rinsed in sterilized water. Before bottling, the milk must be rapidly cooled to a temperature of 40° F. and delivered to the consumer at a temperature not exceeding 50° F.

Sickness among Milkers and Employees.—All persons engaged in handling the milk should be free from disease. No family ever thinks of employing or keeping a cook afflicted with a communicable disease, and yet not the slightest restriction is placed upon, nor a question asked about, the persons who handle our milk supply, which we know affords an excellent culture medium for disease germs. After the recital of numerous epidemics and milk-borne diseases, we need hardly insist upon the necessity of compulsory notification of all infectious diseases, and that the milk should not be permitted to leave a farm, dairy, or milk-shop during the existence of any of these diseases among the inmates or employees, nor should the latter be permitted to reside in or visit infected premises while engaged in the milk traffic, without permission from the Health Department. The farmer or retailer should, in fact, be prepared by previous instructions to guard the milk supply from these sources of danger and call upon the authorities for an immediate inspection. To prevent great loss incident to these restrictions, they may be modified so as to utilize the milk after proper sterilization under the direction of the Health Department. The retailer should be duly registered and be required to furnish the health office with a list of customers. These lists should be arranged on the "index card system," so that the simultaneous occurrence of infectious diseases in a number of families supplied by the same milkman may be promptly discovered and the mischief checked.

There is nothing strained in these requirements, as good and sufficient reasons have been adduced, and by their enforcement we may hope to obtain such a standard of milk as will not only effect a decided reduction in infantile mortality, but will render the dissemination of infectious diseases through the milk supply a matter of history only. Until this is accomplished, we should patronize only such dealers as sell "certified milk," or subject the milk in pint bottles to pasteurization at a temperature of 155° F. for thirty minutes, and after cooling keep it on ice; this will not make bad milk good, but it will at least destroy its infectiousness.

George Martin Kober.

MILK SICKNESS.—The early settlers in the Middle West, or the region between the Alleghany Mountains and the Mississippi River north of Georgia and Alabama, suffered in their own persons and in their cattle from a severe and often fatal malady, called by the term which heads this paragraph. In cattle the affection was called "trembles," but its relation to the "milk sickness" of man was so close as to leave no doubt in the minds of either the physicians or the laity of those times that the two were one and the same disease.

In animals the first symptom noted was marked apathy; the animal stood apart from the herd, motionless with drooping head, and persistently refused to graze. Later a general tremor came on, its appearance being hastened by forced exercise of the animal, there was extreme thirst in most cases, and constipation was pronounced. Soon the animal lay down, respirations became less and less frequent, the extremities grew cold, the eyes glassy, and death usually occurred at the end of eight or ten days.

In man the symptoms were very similar. There was complete anorexia, nausea and vomiting were frequent, and constipation was absolute. The urine was clear and limpid, but reduced in amount despite the large quantities of water taken to quench the intolerable thirst. The pulse was weak and compressible; the temperature was usually below normal, but in exceptional cases might rise to 99° or 100° F.; there were never any chills, and the headache ushering in malarial and typhoid fevers was conspicuously absent.

Milk sickness was a very grave malady, and recovery seems to have been the exception, though not impossible. There was no specific treatment, but the best results were obtained by judicious stimulation and careful nursing.

As the disease is no longer recognized—whether because it has become extinct or because better diagnostic methods have corrected our nosology, it is difficult to say—it is impossible to determine what its true nature was. Indeed, many observers to-day question whether there really ever was a morbid entity such as that described under this name. In Volume V. of the first edition of this work Dr. William M. Beach, a pioneer physician in Central Ohio who had had a wide experience with "milk sickness," contributed an article on the disease, and to this we should refer readers who desire to learn more of the facts than are here detailed. This brief abstract of Dr. Beach's article is inserted in this place for purely historical reasons, the disappearance of the disease having rendered a more extensive treatment of the subject unnecessary.—[Abstract of article by *William M. Beach.*]

MILK, SUGAR OF.—SACCHARUM LACTIS. "($C_{12}H_{22}O_{11}+H_2O$). A peculiar, crystalline sugar, obtained from the whey of cow's milk by evaporation, and purified by recrystallization" (U. S. P.). Sugar of milk crystallizes in four-sided rhombic prisms. These are usually collected upon sticks or strings hung in the concentrated solution; thus are formed long rolls, three or four inches in diameter, the crystals densely massed and tapering to a point at the axis of the roll. Much of the sugar, however, is crystallized in pans and comes in fragments of large cakes, two or three inches in thickness. The following is the official description:

"White, hard, crystalline masses, yielding a white powder feeling gritty on the tongue, odorless, and having a faintly sweet taste. Permanent in the air.

"Soluble in about six parts of water at 15° C. (59° F.), and in one part of boiling water; insoluble in alcohol, ether, or chloroform.

"The aqueous solution of sugar of milk is neutral to litmus paper.

"On adding to a few cubic centimetres of a hot, saturated aqueous solution of sugar of milk an equal volume of sodium hydrate T. S., and gently warming, the liquid will turn yellow and brownish-red. On the further addition of a few drops of copper sulphate T. S., a brick-red precipitate will appear.

"If about 1 gm. of powdered sugar of milk be sprinkled upon about 5 c.c. of cold sulphuric acid contained in a flat-bottomed capsule, the acid may acquire a greenish or reddish but no brown or brownish-black color within half an hour (absence of *cane sugar*)."

The aqueous solution differs from that of ordinary sugar in being thin and not in the form of a syrup.

The very numerous uses of milk sugar in the pharmacy, in connection with other substances, as an excipient, makes it unusually important that it be kept fresh and pure. Its delicate and extensive use in the preparation of artificial milk for infants renders this caution still more important. The substance has no special physiological action, and its use in milk preparations will be found described under *Milk.*

Henry H. Rusby.

MILLBORO SPRINGS.—Bath County, Virginia.

POST-OFFICE.—Millboro. Hotel and sanitarium.

ACCESS.—Viâ Chesapeake and Ohio Railroad to Millboro Depot, thence by carriage two miles to springs. The hotel is situated on a gently sloping eminence about two thousand feet above the level of the sea. The situation commands a fine vista of green fields, fertile valleys, lofty forest-capped hills, and in the distance the towering summits of the Alleghanies. The climate here is of the usual dry, bracing character of the Virginia