at any time after 3 o'clock in the afternoon, and preferably before 9 o'clock in the evening. But, of course, the sooner the cream is removed after the full quantity obtainable by gravity has arisen, the more closely it will represent the desired fat percentage in each case. It appears, therefore, that a single variety of cream, which may be 16 per cent. or 20 per cent. cream, serves every purpose; that the required quantities of cream and milk for all the mixtures ordinarily required may be computed by a single series of equations; that for the normal infant but few modifications need be made, the percentages that are indicated at different ages being readily determined by the ratios of fat to proteids required, without having reference to the feeding chart; that the simple instructions to be given for obtaining by gravity the cream to be employed are the same in all cases, to be followed throughout the period of substitute feeding; that the preparation of mixtures of cream and milk presents no difficulties and that even at an advanced price for suitable milk the necessary materials cost very little.

The complexity, and therefore the perplexities, of percentage modifications depend altogether on the use of a variety of creams and of milk of different analyses; if suitable milk is in use, or if the analysis of the milk to be employed is known, the mixtures usually required, at any rate, may be computed by the working equations with substantial accuracy and as readily as mixtures of drugs. If, therefore, modified milk is to be employed as a substitute food for the infant, under the immediate direction of the physician, as all artificial feeding should be, percentage modification furnishes a very simple and a very practicable method for its preparation and its use.

The real difficulty in the way of the scientific method, and of other methods as well, is the lack of suitable milk for the preparation of infant food; and until suitable milk is generally available, the milk-laboratory offers the best solution of the problem. Here and there "baby-milk" is furnished; and always, it is understood, the supply, at largely increased prices, is unequal to the demand that has been quickly created—among the laity; the family physician appears to be content to leave the matter of the milk supply to the average milkman, and the feeding of the infant to the enterprising and insistent manufacturers of patent foods; and the records of infant mortality, ill development, malnutrition and disease, the direct results of imperfect or improper food and feeding, continue to be written.

It is true that the great majority of bottle-fed babies live, and the greater number of them thrive, apparently, in spite of dietetic adversity. They live because they were born to live. Infant mortality is unnatural. And it is not less true that many of these fair, fat babies—all of them are fat—have less than the normal powers of resistance and recuperation; while the less vigorous, or the imperfectly developed, are subject to disorders and diseases which the well-fed infant escapes. The strong survive, for precisely the same reason that the Scotchman survives his diet of oatmeal. But in the case of the feeble infant, and of the dyspeptic infant in particular, health and growth and life, it may be, depend on its having the right food, which is suitable milk, suitably modified.

The production of suitable milk is perfectly practicable; and the effort, even the organized effort, of physicians may well be directed to this end. In view of the diminished and diminishing birth rate in American

families, and of the growing indisposition and inability of the American mother to nurse the baby, the question of artificial feeding has become of vital importance to the community. There is no subject within the domain of medicine, not even the control of tuberculosis, that concerns common interests and the common welfare more intimately. Indeed, tuberculosis is in itself a disease of imperfect nutrition, and to provide for the nutrition of the infant may well be among effective measures for its prevention. It is not unreasonable to believe that the constitution of the individual may be affected in some manner, to some degree, by the character of the food during the period when, normally, the physical development is most rapid.

SIMPLICITY IN INFANT FEEDING.*

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BOSTON.

The average physician is generally appalled by the mathematics which play so important a part in present-day papers on infant feeding. He either comes to look on infant feeding as in the highest degree a difficult problem, and babies' digestions habitually delicate, requiring complicated formulæ and frequent minute changes in percentages, or he discards all theories in disgust and leaves the feeding of the baby to the mother or nurse, or even resorts to the wares and printed directions of the advertising food manufacturers. Both of these extremes are undesirable.

While there is no doubt that a fairly accurate idea of percentages is of great value in infant feeding, and that the difficult cases can be managed best by keeping these well in view, yet it is perfectly possible for a physician to feed babies successfully without this expert knowledge and to give simple directions for the preparation of the food without the use of formula lists or patent foods.

NEED OF SIMPLE RULES.

It is evident that the simpler the rules and formulæ for making up the daily food of the baby, the less liability will there be for error on the part of the mother or nurse and the easier it will be for the physician to prescribe. It is also reasonable to suppose that the less the milk is manipulated in order to obtain the desired formula the more easily will it be digested by the infant.

The physician who looks on the baby's stomach as a test tube and on the food merely as so much per cent. of different ingredients is apt to disregard every factor but the percentages and to blame the baby and not the food if the former does not thrive. Theoretically the food is right and the baby at fault.

NEED OF STUDYING CASES INDIVIDUALLY.

Some infants thrive on mixtures made up of centrifugal cream and fat-free milk recombined so as to give the theoretical percentages required. But the fact that others do not, and yet will thrive on similar percentages made up of gravity cream, shows that there is something besides chemical percentages that must be considered—some vital characteristic as yet but little understood. In the same way the fact that while many infants thrive on Pasteurized or even sterilized mixtures, yet others grow pale, lose their appetite and develop scurvy, shows that certain characteristics of the milk destroyed or

* Read in the Section on Diseases of Children of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

altered by heat must be considered as well as its chemical composition.

Another fact is brought out by these observations, namely, that infants are not machines and that they can not all be treated alike. It is evident that we should avoid, if possible, what is harmful to some infants even if others are not disturbed thereby. Because an infant of a year appears to thrive and be in robust health on a diet which includes tea and cabbage, no argument should be adduced in favor of tea and cabbage.

NEED OF SPECIAL BREED OF COWS.

The basis of infant feeding is the milk of some animal, and for practical purposes we are limited to the cow. When one considers what great modification in external forms has been accomplished by artificial selection in the case of dogs and pigeons, for example, it is not, I hope, idle to expect that some day a race of cows will be developed by careful breeding and selection whose milk shall approximate very closely in chemical analysis the milk of woman. The difficulties in the way of artificial feeding would then be less, although the differences in the vital characteristics of the two milks can never, of course, be eliminated. At present we must take cows' milk as we find it and modify it to suit the infant's digestion.

NEED OF MILK INSPECTION.

When milk commissioners give their seal of approval the responsibility of the physician is much lightened. Certified milk means cleanliness in the cows, barns, utensils and milkers, freedom from disease in the cows and consequently a clean, safe milk. In the absence of a milk commission it is incumbent on the physician to look into these matters as closely as may be, visiting the dairies if possible. It is far better to use a raw, dirt-free and therefore germ-free milk than to take a dirty milk and destroy its vitality in endeavoring to cleanse it by centrifugal force or by Pasteurization. Both processes are undesirable. The latter process does not destroy the dangerous butyric acid and peptonizing bacteria, but it does affect the lactic acid group, which, when active, serve to check the more dangerous bacteria.

CENTRIFUGAL CREAM AND GRAVITY CREAM.

As the dilution of whole milk in order to diminish the percentage of albuminoids will cut down the fat too low, it is necessary to begin with a cream as the basis of our modifications. By the dilution of a 10 or 12 per cent. cream and the addition of sugar of milk we can make up a mixture fairly comparable to woman's milk. To obtain the cream several practical methods are open to us. Centrifugal cream can be obtained at dairies, but it is undesirable owing to the changes that have taken place in its physical or vital characteristics. This cream, as sold at most dairies, does not have even the merit of accuracy of percentage. Gravity cream may be obtained by siphonage. This is rather a complicated and delicate process and the siphon is a difficult instrument to clean. Dipping off the top milk with Chapin's dipper is a good method, but here also is an instrument to be kept clean. Pouring off the top milk is the simplest method and is perhaps looked down on by some on account of its very simplicity. There are no instruments to be kept clean. The results by this method are very uniform, as I have shown by numerous analyses.¹

1. "Cream for the Home Modification of Milk," Boston Med. and Surg. Jour., vol. cxlviii, 1903, p. 414.

DILUTIONS.

The richness of the cream can easily be varied by pouring off more or less of the top milk. Although the exact amount of fat can not be told without analysis, the latter is rarely necessary, as a certain amount of experimentation is required for every infant. As a rough rule, one may remember that the upper eight ounces poured from a quart of milk after it has stood at least four hours contains about 10 per cent. of fat; the upper twelve ounces about 8 per cent., the upper sixteen ounces about 6 per cent. and the upper six ounces about 14 per cent.

The physician must be guided by symptoms and the appearance of the stools and regulate the amount of fat accordingly. It is easier and better, as there is less manipulation required, to dilute this top milk with water than to combine a rich cream, a lower or fat-free milk and water. This latter method involves an unnecessary splitting up and recombination of ingredients.

Instead of using water as a diluent or modifier, a cereal water—barley, oats, rice or wheat—can be used even in the youngest infants. There is no doubt that the cereal renders the milk more digestible by lessening the size of the clots, and also that a small amount of starch is digested even by the newly born. This return to an older method, used empirically for ages, has now a scientific foundation. Most babies do perfectly well with water as a diluent, but some have difficulty in digestion unless a cereal is used. After the age of six months all babies, with but few exceptions, are better with cereal modifications.

HOW TO FEED AN INFANT.

In beginning to feed an infant, whether it be a new-born or an older one that has suffered from improper feeding, the safest rule is to begin with a mixture weak in all its ingredients, and by slow degrees gradually increase the strength. The mistake is often made of beginning too strong and in making frequent and purposeless changes. Thus a new-born baby can be put on a mixture in which there are only three ounces of the upper eight ounces of top milk in twenty ounces, and the strength gradually increased by the addition every second day of half an ounce more top milk and the subtraction of half an ounce of water until eight ounces of top milk are given in a twenty-ounce mixture.

It is gratifying to find that many infants who have struggled unsuccessfully on much modified milk mixtures will often respond at once when these simple, but, it seems to me, all important principles are borne in mind.

NOTE.—In this article I have purposely avoided all reference to the calculation of percentages, knowing by experience what a paralyzing effect such reference has on most physicians' minds. For those who care to venture on this subject, which is not necessarily difficult, the following simple rule will be found easy of application:

Rule.—Each ounce of 10 per cent. cream in a 20-ounce mixture represents .50 per cent. of fat, .20 per cent. of albuminoids and .20 per cent. of sugar, and each even tablespoonful of sugar of milk added to this mixture raises the percentage of sugar 2.

In the example given above, in which the infant is started on 3 ounces of the upper 8-ounce top milk in a 20-ounce mixture, the formula would be written as follows:

Top milk	3 ounces
Water	16 ounces
Limewater	1 ounce
Sugar of milk.....	2½ even tablespoonfuls

Assuming that the top milk contained 10 per cent. of fat,

this would mean, approximately: Fat, 1.50; sugar, 5.60; albuminoids, .60.

The final formula of

Top milk	8 ounces
Water	11 ounces
Limewater	1 ounce
Sugar of milk	2½ level tablespoonfuls

would mean, approximately: Fat, 4.00; sugar, 6.60; albuminoids, 1.60.

The percentage of fat in the top milk can be gradually diminished by pouring off more of this top milk from day to day. In this way the strength of the albuminoids can be gradually increased in the mixture without increasing the fat beyond 4 per cent. When a cereal water is used in place of water, only one-half as much sugar of milk is necessary and no limewater is needed. The value of limewater in the water mixture is somewhat doubtful.

CERTIFIED MILK IN SMALL CITIES.*

C. W. M BROWN, M.D.

ELMIRA, N. Y.

Forty-nine states and territories have laws applying to the production and care of milk and its products, while a large number of municipalities have ordinances governing its quality, transit, care and sale. All these laws and ordinances, with possibly one exception, apply chiefly to the amount of butter-fat and total solids the milk must contain and not to the quantity of extraneous matters or to the bacterial count.

Interest in and knowledge of milk and foods is increasing both in the medical profession and among the laity, if the numerous articles of scientific and popular interest in the medical and lay journals can be adduced as evidence. But in spite of this interest and increase of knowledge, the fact remains that ordinary milk, while of almost universal use, is the most uncleanly article of food on our tables.

STERILIZATION AND PASTEURIZATION.

That the average milk is unclean and many times unfit for food, especially for infants, has long been known and has given rise to its heating or cooking in order to lessen its unfitness and lengthen its keeping quality. This process we call sterilization.

A few years later it was found that this process was fraught with danger and that practically a lower degree of heat and a shorter period of heating served as well. Pasteurization was then the vogue for a time. Now it is safe to estimate "that all forms of sterilization do impair, although possibly to a slight degree, the nutritive properties" of milk. That commercially Pasteurized milk is more unsafe and less to be trusted than ordinary milk is abundantly proven by the investigations of Pennington and McClintock, of Philadelphia. What is true in Philadelphia is probably true of Pasteurized milk sold in other cities.

We would naturally anticipate that hospitals would be furnished with good milk, yet Edsall found many of them in Philadelphia served with milk of "shocking quality," some of it containing millions of bacteria to the cubic centimeter.

I need not say that when it can be obtained the desideratum is fresh, clean milk, so fresh and clean that it can be safely used raw, either for the food of infants or sick adults. The best milk can now be procured

chiefly in the large cities. The Walker-Gordon Laboratory Company, a commercial enterprise, supplies a high-grade milk to eleven of the largest cities in the United States and two in Canada.

MILK COMMISSIONS.

The first medical milk commission was that of Essex County, N. J., formed and pushed to success by Dr. Henry L. Coit, of Newark. It issued its first certificate in 1893, only thirteen years ago. Others which have started since are the Milk Commission of the Medical Society of the County of New York, the Milk Commission of the County of Kings, New York, the Milk Commission of the Philadelphia Pediatric Society, the Milk Commission of the Children's Hospital Society of Chicago, the Milk Commission of the Milwaukee Medical Society, the Milk Commission of the Rochester Academy of Medicine, the Milk Commission of Cleveland, Ohio, the Milk Commission of the Syracuse Academy of Medicine, Syracuse, N. Y., the Milk Commission of the Medical Society of the District of Columbia, the Milk Commission of the Medical Society of St. Louis, Mo., and the Milk Commission of the Elmira Academy of Medicine, Elmira, N. Y. One or two others have been started, but have been discontinued. All of these milk commissions are in cities of the first and second class except the last one, Elmira, which has a population of about 35,000.

THE ELMIRA MILK COMMISSION.

In the list of 136 cities in the United States having a population of 30,000 or over, Elmira stands one hundred and thirty-third. Because of the successful accomplishment of the work of our commission in a small city, an ex-president of this Section suggested that its story be told here, and that is why I presume to stand before you to-day that others among the smaller cities may be stimulated to begin to secure the production of clean milk.

Six years ago an eminent pediatricist of New York City said, in a clinical lecture, "that if five or six physicians in any town wanted clean milk it could be had." That was a suggestion. In due time a paper was read before the Elmira Academy of Medicine on "Clinical Milk: What It Is and What It Should Be." Much interest was aroused. Six men who were interested in the subject were selected and later were appointed the Milk Commission of the Elmira Academy of Medicine. Then the search for the farmer began. A circular letter was sent by the commission to about half of the ninety milk dealers of the city, those who either produced their own milk or were responsible, calling a joint meeting of the dealers and the commission. Not more than twenty responded. They listened curiously, respectfully, but that was all.

We next began to visit the better class of dealers at their farms, with negative results, until we found one who was already trying to do better than the average milk dealer as to cleanliness and good fat content. This one, a woman, had visited near one of the most famous milk farms in the country and had already a general knowledge of the benefit of clean milk and the requirements to produce it. After consideration she took up the work, built a new barn, had her herd tested for tuberculosis, the commission selected its experts and we issued our first certificate April 15, 1903. We established as our standard a 10,000 bacterial count. This has been exceeded but twice in three years. Butter-fat,

* Read in the Section on Diseases of Children of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.