THESIS

INFANT FEEDING

With an Analytical and Microscopical Examination of Human Milk in thirteen illustrative cases.

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Dr. Robert Hutchison, in delivering a course of lectures on Diseases of Children, used these words:- "We approach today a subject which exceeds in importance any to which I shall have occasion to direct your attention,- I mean the subject of Infant Feeding", and Holt, in his Diseases of Children, says:- "At no time of life does prophylaxis give such results as in Infancy, and no part of prophylaxis is worthy of more attention than the conditions of nutrition. The problem is not simply to save the child's life during the perilous first year, but to adopt those means which shall, during the plastic period of Infancy, tend to the healthy and normal growth of the child, so that all the organs of the body shall have their normal development instead of impaired structure and deranged function, the effects of which may last throughout childhood or even throughout life. The question whether a child shall be strong and robust or a weakling is often decided by its food during the first three months. The largest part of the immense mortality of the first year is traceable directly to disorders of nutrition. The child must be fed so as to avoid not only the immediate dangers of acute indigestion, diarrhoea, and marasmus but the more remote ones of chronic indigestion, rickets, scurvy and general malnutrition with all its varied manifestations, since these conditions are the most important predisposing causes of acute diseases in infancy".

Never were these words more appropriate than today. Whatever the cause, there is a tendency, either on account of want of ability or want of inclination on the part of mothers, to

deny their offspring the benefit of maternal nursing. In many cases this is done through no fault of the mother, who seems incapable of providing the necessary sustenance for the proper growth of her child. This occurred to me on discovering the frequency with which the suggestion was made by mothers who consulted me regarding the health of their children:— "I think my milk is not agreeing with the child". Recognising that in the absence of other causes a deficient or imperfect milk supply might account for the condition of the child, samples in some cases were obtained and the result of my analysis justified in many cases my suspicions, and forced upon me the conclusion that the line of treatment should not commence with the child but with the mother. In my collection of cases I have only taken those milks which gave a probability of pathological composition, and when I say that those cases were collected within a period of three months, one is forced to the conclusion that the source of the child's milk supply, in cases of natural feeding, requires more attention than is generally given to it. I am aware that it is a general practice, where the mother thinks her milk is not agreeing with the child, to put it "on the bottle", a course in which she is often encouraged by her doctor; especially if the digestive troubles for which the child is being treated, do not respond to treatment. But here its latter condition is often worse than its first, and as a result of improper artificial feeding you either have the child hastened to an early grave or handicapped with some bodily defect, which clings to it through life. Recognising the advantages of natural feeding, it seems to me that

the only proper and scientific course to pursue is, having decided that the source of the trouble is not with the child, but with the mother's milk, first to ascertain its composition by analysis; and having done so and found it at fault, if circumstances will permit, next to correct the defect either by diet, exercise, alteration of the habits, or by a change of the environment of the mother, to convert an improper into a proper milk supply. Not till such means have failed are we justified in encouraging a mother to substitute for her own milk artificial methods of sustaining her child.

uman Milk. In discussing Infant Feeding it is necessary to refer to the various means used in doing so; and naturally our first reference will be to the supply provided by nature for that purpose. Woman's milk is of a bluish white colour with a slightly sweetish taste, and, when freshly drawn, its reaction to Litmus paper is slightly alkaline or neutral. Examined microscopically there are seen numerous fat globules of uniform size and some granular matter, while occasionally there are present epithelial cells from the milk ducts or the nipple. The Specific Gravity varies from 1028 to 1032, a point which has received some attention from observers on account of its importance as indicating to some extent the character of the milk. Vanderpoel and J.S. Adriance name 1030 as the average figure. Holt gives it as between 1029 and 1032, Monte 1030 and 1034, Richmond 1030 and 1031. In my own case, it ranged from 1026 to 1035; but here it is to be pointed out that the cases quoted gave prospect of being atypical in character. The variation, within normal limits, of the specific gravity is of great importance in enabling us to estimate quickly, though approximately, the character of the nutrition given to the child. The Specific Gravity is lowered by the fat and increased by the ~~et~~

other solids, of which the albuminoids alone are important in relation to gravity. The percentage of mineral salts present is too small and the percentage of lactose so remarkably constant, that variations due to these causes are comparatively minute. Low specific gravity, therefore, indicates excess of fat and deficiency of albuminoids; a mean specific gravity indicates a normal amount of each, and a high specific gravity excess of albuminoids with deficiency of fat. While this gives a rough estimate, cases may occur where the observer may be led astray, such as when there is an excess of fats and albuminoids. Here, however, a knowledge of the percentage of either of these constituents and the specific gravity would guide him in the direction of a proper estimate of the character of the milk.

Composition of the Milk.

A trustworthy estimate of the average composition of healthy human milk is most desirable for two reasons. Firstly, it affords a standard by which we may judge the quality of a mother's milk in cases where such milk disagrees with her infant, and secondly, it provides us with a standard by which we may adjust the composition of an artificial or substitute food for an infant during the suckling period. Human Milk consists of Fats, Proteids, Albuminoids, Nitrogen Extractives, Mineral Salts & Water. The product of the mammary gland varies in different women and in the same woman from month to month and day to day, consequently it is difficult to arrive at a standard composition which may be recognized as a typical milk. Added to this is the question, what is to be regarded as a normal variation? Here, as in other things, the personal equation comes in, for cases may be found of a child thriving on a milk of a particular composition while another may be going back on a milk showing a similar analysis. Schlossman, as a

result of 218 analyses, gave the following average,

Lactose	6.95 %
Fats	4.83 %
Albuminoids	1.56 %

Carter and Richmond as a result of 94 analyses of milk taken from the Lying-in Department of the Workhouse Infirmary, Birmingham, gave the following.

1. Average constituents of milk that disagreed with the infants.

Lactose	6.28 %
Fats	2.95 %
Proteids	2.36 %
Ash	0.31 %
Water	88.10 %

2. Average of Milk that agreed with the infants,

Lactose	6.70 %
Fats	3.11 %
Proteids	1.83 %
Ash	0.24 %
Water	88.12 %

It will be noticed that the average agreeing with the children is similar to that obtained by Pfeiffer 1894,

Lactose	6.30 %
Fats	3.11 %
Proteids	1.94 %
Ash	0.19 %
Water	88.22 %

It has been observed that the composition of the Milk varies with the period of lactation, showing an excess of Proteids in the early weeks and a gradual decrease in the later part of lactation. In Carter & Richmond's analyses this was avoided by

having almost all the samples taken within the puerperal month.

In my own cases the average composition is as follows

Fat	2.00 %
Lactose	5.96 %
Proteids	1.472%
Ash	0.157%
Water	90.329%

Regarding the several constituents, the fat is a compound of Palmatin and Stearin with small quantities Butyrin & Caproin & fatty acids. Lactose is a particular form of sugar, characteristic of milk, having the following composition $C_{12}H_{22}O_{11}H_2O$; and the Proteids consist of Caseinogen with a smaller percentage of Lactalbumin & Lactoglobulin; while the Mineral Salts are chiefly Potassium, Sodium, Calcium & Magnesium Phosphates and Chlorides.

Conditions affecting the quality of the Milk. The age of the nurse. This has no constant influence. Other things being equal the milk of very young nurses and of those over 35 years of age, according to Holt, is likely to be lower in fat than betweem 20 & 35 years. The Number of Pregnancies is likely to affect the milk in so far as it affects the general health of the nurse. Acute illness, especially of a severe febrile type, has a marked effect, reducing the quantity of the milk, with a low fat and high proteid percentage.

Diet. This has an important bearing on the quantity and character of the milk especially in relation to the Fats and Proteids. A diet of a nitrogenous character increases uniformly both the fats and proteids, while a vegetable diet diminishes both, and a a starvation diet diminishes the fats, while the Proteids may be

diminished or increased, if the latter they are generally changed in character.

Alcohol. Here there is a diversity of opinion. Vincent says,-In regard to Lactation itself Alcohol is of no value. Holt maintains that it has an important effect and gives examples showing the analysis of milk before, during, and after the cessation of the administration of an alcoholic extract of malt, which goes to prove that it had the marked effect of increasing the Fat & Proteid constituents of the milk to a marked degree, with which increase was associated an increase in the weight of the children being nursed.

Pregnancy. The milk is generally small in quantity and poor in quality.

Nervous Impressions. These, when of a marked character, have a very decided effect upon the milk. Fatigue, exhaustion, grief, fright, or passion, are likely to affect the secretion of the milk to a marked degree. While there may be no striking difference in the character of the milk the child may exhibit signs of digestive disturbance, high temperature, prostration, or even convulsions. What change has taken place we cannot tell, but the probability is that the Proteids have been so affected as to have conferred upon them properties of a toxic character.

Irregular Nursing. When the Mother nurses her child at too short intervals the proportion of total solids in her milk is increased, and when the intervals are unduly lengthened, the amount of water renders the milk insufficiently nutritious, so that she is supplying the child with food too diluted and at too long intervals. Thus it is possible to convert a perfectly good milk into one wholly

unfitted for the infant's digestion.

Cow's Milk. Having referred to the natural method of infant feeding, it now becomes necessary, when for some cause substitute-feeding has to be resorted to, to refer to what is really our only substitute so far as animal milks are concerned, namely cow's milk. In Physical character ~~it~~ Cow's milk resembles human milk, is amphoteric in reaction, quickly becoming acid, with a specific gravity of 1032, and a composition as follows,

Fat	3.90
Lactose	4.75
Casinogen	3.00
Albuménoids	0.40
Ash	0.75
Water	87.15

The composition given here is the result of 200,000 analyses made by Richmond, and may be regarded as fairly representative of the typical composition of Cows' milk. Where the cows have been carefully selected and their diet and environment adapted to give a milk of fine quality, the fat and proteids stand at a higher figure. This difference is also to be considered when the breed of cows is taken into account. Like human milk, that of the cow is subject to variation, both quantity and quality variations depending on diet and environment, nervous influences and seasons, and periods of milking. I have said that in physical character cow's milk and human milk resemble each other, but this cannot be said of its composition. Here the greatest variation occurs in the proteids. Not only are they greater in quantity but they differ also in their character. The two chief proteids are Caseinogen and Lactalbumin,

the former being present in great amount and constituting about 75 % of the total proteids. The presence of Caseinogen in such large quantity affects to a great degree the coagulability of cows' milk. This is most strikingly illustrated by the Physiological test, its digestibility by the infant's stomach. Cow's milk is coagulated into large firm clots which dissolve slowly, while human milk forms loose flocculent curds which dissolve easily. So far as we at present know, the character of the fat in cow's milk is not different from that in human milk. The salts present in cows' milk are greater in quantity than those of human milk and differ in the relatively larger proportion of calcium phosphate and sodium chloride.

he Bacteriology of Milk.

In the feeding of children, the presence of Bacteria in the food-supply is a consideration that cannot be overlooked. In the case of breast-fed children one would expect that this danger would be reduced to a minimum if not altogether absent; and while this may be so, it has been observed that a very large percentage of human milks shows the presence of Bacilli in greater or less quantities.
In 43 out of 48 specimens of human milk examined by Cohn and Neuman, micro-organisms were found. Honiggmann found Human Milk sterile in only 4 out of 76 cases. Marfan states that we may conclude that the milk of healthy mothers obtained under aseptic conditions contains micro-organisms in 19 cases out of 20. In 10 of my own cases, 7 of the milk samples showed the presence of Bacteria, in some cases in large quantities. It is to be noted, however, that the organisms are those usually found on the skin and may have come probably from the opening of the lactiferous ducts with the first flow of milk.

The difficulties encountered in trying to obtain a sterile sample are consequently great, and the demand is perhaps after all a questionable one. It is not so much in the case of Human as in Cows Milk that the Bacterial presence assumes its full measure of importance. In the case of the Cow the possibility of contamination from external sources is enormously increased, and while Bacteria are present in the milk received directly by the child from its mother there are two factors which are not present;—the further contamination of the milk after it has left the mammary gland, and the formation of toxins as a result of that contamination.

Recognizing the great part played in substitute-feeding by cows milk it is to this aspect of the question we must devote some attention, because, by its character, it lends itself to Bacterial production, and because of the procedure connected with its production, storage, and transference to the consumer. Like Human Milk, Cows Milk contains many organisms that are harmless, and, in some instances their presence is a necessity; but it is the presence of others, the result of contamination, that must be avoided. Blackhaus carried out a series of investigations which demonstrated the extreme importance of attention to every detail in connection with the handling of Milk. The effect of the Precise Methods of the collection of Milk upon its Bacterial content.

	Per Cubic Centimetre.
Dry Milking	5.600 germs
Wet Milking	9.600
First Milk	10.400
Last Milk	Sterile
When the Cow is cleaned	20.600
When the Cow is not cleaned	170.000
Udder washed	2.200
Udder not washed	3.800

If Cow is milked in open air	7.500
If Cow is milked in clean stall	29.250
If Cow is milked in unclean stall	69.000
Enamelled Vessels	1.105
Tin Vessels	1.690
Wooden Vessels	279.000
Sterilized Vessels	1.300
Washed Vessels	28.600
Milk passed through Six Vessels	97.600
Turf	40.000
Good Straw	150.000
Dirty Straw	200.000
Fresh Water	.322
Trough Water	228.200
Milk supplied from good Dairy Farm	25.000
Milk supplied to Königsberg Market	2000000

Besides the collection of the Milk, another matter of importance is its delivery to the consumer. Cohn observed that a specimen of milk containing 153,000 Bacteria per Cub. Cent. contained 85,000,000 twenty-four hours later. Cnoph and Escherich illustrated this rapid development by the annexed table

	2 Hours	3 Hours	4 Hours	5 Hours	6 Hours
40 deg. Fah.	4	6	8	26	435
97 deg. Fah	23	60	215	1830	3800

It will thus be seen that the greatest development takes place at a temperature similar to that at the time of milking.

In the Report of the Medical Officer of Health of Glasgow for 1903. Dr Buchanan, the Corporation Bacteriologist, gives the results of some observations on the Bacterial Content of Milk for which samples of milk were taken on its arrival at the railway stations, care being exercised that no further contamination took place subsequent to the time of sampling.

The following is the table:-

1. As the Milk arrives at the Railway Station from the Farm.

2. At time of distribution from Town Dairy.

3. After remaining in Dwelling-house for a few hours.

4. After remaining corresponding period in the Laboratory.

Sample	Date 1903	At Station A.M.	In Dairy PM.	Dwelling House PM.	Lab. Control PM.
A.	July 22	9.10 3904000			
B.	22	9.20 420000			
C.	22	9.30 12000			
D.	23	9.20 292000	12.10 5160	3.55 12160000	
				12.10 1000000	
					3.55 5620000
E.	23	9.10 No Gr.	12.10 No Gr.	3.45 No Gr.	
				12.10 No Gr.	
					3.45 No Growth
F.	27	9.10 3504000	12.30 11200000		
				3.20 13600000	
				12.30 1784000	
					3.20 18160000
G.	28	8.45 232000	12.15 4260000	3.35 4560000	
				12.15 1680000	3.35 3220000
H.	29	9.45 4600	12.24 40000	3.20 880000	
				12.20 60000	
					3.30 20000

The Report continues :- "It must be understood that although a certain degree of significance attaches to the actual number, (chiefly as indicating age of milk or careless handling) many of these Bacteria are probably innocuous in character.— Probably Lactic Acid Bacteria, — and suggest, ~~that~~ where ~~there~~ the number is large, that the milk arriving in the morning is from the previous evening's milking. Bearing this in mind, the significance of the rapid increase in micro-organisms at various places, shown by comparing the numbers contained in the dairy & dwelling-house samples with those taken at the Station, will be fairly appreciated. It means growth of normal Bacteria of Milk, plus growth of those added by bacterially unclean utensils etc. There remains much to be done in dairy administration before we have reached a condition when milk, which is free from the elements of putrefaction almost from the time of its production , is within the reach of the consumer".

It is, therefore, as I have already indicated, with reference to substitute feeding that we have to secure that the milk shall be pure, and, as regards Bacteria, as near as possible to its condition when received by the calf direct from the cow.

Cases illustrative of the effects of improper feeding with analytical and microscopic examination of the Mothers' Milk.

Before discussing the question of substitute feeding, I wish to refer to Children whose conditions of health suggested to my mind the probability of their not being supplied with a milk of proper character, and where, after attempts were made, unsuccessfully in most cases, to improve the quality of the milk, it became necessary to adopt substitute feeding, which, in the majority of cases, was

modified Cows' milk.

Case 1. I was called to see the child, in this case, for vomiting and general malnutrition. At birth it was not weighed, but at three months it did not seem to have grown as it should have done, notwithstanding the fact that, while apparently healthy when born, it was below normal size. I got a history of fretfulness, irregular action of the bowels, with green coloured stools. A sample of the mother's milk gave the following analysis:-

Fat	2.199
Proteids	1.847
Lactose	5.654
Salts	0.210
Water	90.09

Total Solids by evaporation 9.06 %.

Litmus Reaction - Alkaline.

In this case, the supply of milk was deficient, and some difficulty was experienced in obtaining a good sample. It will be noted that it is poor in fat and to a greater degree in proteids, and, judging from the small amount of total solids, also in carbohydrates. The child was so far down that all attempts to get it well again were unsuccessful and in a week it died. The mother was not strong and the conditions under which the child lived were unfavourable, the house being dirty and the ventilation very imperfectly attended to.

Case 2. This child was seen for digestive trouble, vomiting, constipation alternating with diarrhoea, and fits of crying for hours at a time. Its growth was not commensurate with its age, although not so

marked as in Case 1. A sample of milk gave the following analysis,

Fat	2.773
Proteids	2.340
Lactose	6.302
Salts	0.215
Water	87.225

Reaction to Litmus Acid

Total Solids by evaporation 12.76 %.

Here the milk supply was also deficient, and as the child was showing the effects of inferior nursing in loss of weight, irritability and intestinal trouble, it was deemed advisable, especially in view of the acid reaction of the milk, to wean the child and substitute modified cows' milk. This was done with satisfactory results. The untoward symptoms were relieved and the child commenced to gain in weight, which has since been progressive.

Case 3. This child, when born, was above the normal weight. The labour was a difficult one, from which the mother made a somewhat protracted recovery. Two months after birth he had gained only slightly in weight. At this time the mother, who had a tendency to obesity, exhibited signs of anaemia. There was no indication of digestive troubles, except that the child seemed dissatisfied with his milk. Analysis of the mother's milk gave the following:-

Litmus Reaction:- Alkaline.

Fat	1.06
Proteids	1.29
Lactose	6.93
Salts	0.26
Water	90.46

The analysis here showed that the child was receiving a milk totally unsuited to his requirements. It is markedly deficient in

Fat and Proteids. On this account, and in view of the mother's condition of health, nursing was stopped, and modified Cows' Milk substituted, with satisfactory results. The hygienic conditions of the home were only fair.

Case 4.

Here, the hygienic conditions of the home were all that could be desired. The mother of the child was in good health and the health of the child satisfactory until two months after birth, when growth became less marked. This was accompanied by slight attacks of vomiting, fits of crying and green stools of frequent occurrence. The analysis of milk showed the composition to be:-

Fat	1.29
Proteids	1.9
Sugar	6.04
Salts	0.1
Water	90.67

It was thus discovered that the nourishment given to the child was deficient both in fats and proteids, and attempts to alter the constituents were made with the following result, one month later. In this second sample examination was more complete, in that it was submitted to microscopical examination as well

Fat	1.016
Proteids	1.247
Lactose	6.235
Salts	0.156
Water	91.346

Reaction to Litmus Amphoteric

Microscopic exam. of sediment after centrifugalising.

(a) Stained Methylene Blue. } Large amount of Epithelium fragments. Few micro-organisms.

(B) do for acid fat organisms. — Negative

Case 4 (continued). The specific gravity was 10.33. The total solids by evaporation 9.90 %.

It will be seen that the condition of the milk at the second analysis was no better, but rather worse than at the first analysis, and the mother was advised to wean the child. This advice was not acted upon on account of the fear of another pregnancy occurring. She proposed to combine breast feeding with substitute feeding, giving modified Cows' milk during the day and the breast during the night - this arrangement obviating the necessity of getting up during the night to prepare bottles for the child. At seven months the child is still below the normal standard of weight, cannot be vaccinated because of skin eruption, and continues to have periodical attacks of digestive disturbance..

Case 5. In this case the child was born healthy at a normal labour, and after a few weeks showed signs of digestive trouble, followed by an erythematous eruption on the buttocks and legs which responded well to treatment. His growth was slow, and it was deemed advisable to get a sample of milk for the purpose of analysis. As this was being done the mother developed acute Tonsillitis, and the milk taken during the attack showed the following:-

Fat	1.37
Proteids	1.6
Lactose	5.05
Salts	0.1
Water	91.98

showing a deficiency in all constituents.

Sample No. 2 was taken after the acute symptoms had passed off and the mother was able to move about again.

Case 5 (continued).

Fat	1.775
Proteids	1.264
Sugar	5.460
Salts	0.170
Water	91.331

Specific gravity 1029.

Microscopic exam. of Sediment & Methy Blue stain — Few microcossi and Bacilli. Very few other elements.

During the Tonsillitis the breasts were emptied periodically with a view to restarting nursing after the attack had passed off. It will be noticed that the second sample shows a slight improvement in the nutritive value of the milk. This improvement was maintained under a proper dietary, with the result that the child is now in good health, has been vaccinated, and has not been seen by me for any sickness for four months. The double analysis is incorporated in the series as showing, in a slight degree, the effect of acute illness on mother's milk.

Case 6. Is another example, not growing as it should have done, and with attacks of vomiting, constipation alternating with diarrhoea, and fits of crying. The supply of milk supplied by the mother showed signs of decreasing and a sample gave the following analysis,

Fat	1.687
Proteids	1.259
Lactose	6.022
Salts	0.127
Water	90.905

Total solids by evaporation 10.10%.

Specific Gravity 1027.

Litmus re-action. Strongly acid, with a strong and unpleasant odour intensified on heating.

Microscopic exam.

Stained Methy Blue — Very large number of Bacilli, Many short chains of Streptococci and a very large intensely staining micro-organism.

do for acid fast Bacilli ~~Bacilli~~. Negative.

Here all the conditions for favourable nursing were absent. Besides a milk of low nutritive value, the source of supply was badly infected, as shown by the microscopic examination. Weaning was advised and substitute feeding by modified Cow's milk adopted, with the cessation of the symptoms referred to. The hygienic conditions were only moderately good, the diet of the mother not altogether satisfactory, and information since obtained leads me to suppose she had formed habits of intemperance.

Case 7. The child of healthy parents living in good hygienic conditions. The mother had previously nursed a child successfully. The present one, after the onset of a small cellular abscess, showed signs of digestive disturbance, which only partly responded to treatment. The analysis of the milk gave the following.

Fat	1.538
Proteids	1.415
Lactose	6.345
Salts	0.189
Water	90.513

Litmus Re-action. Alkaline. Specific Gravity 1033.5

Microscopic Exam. Deposit consisting of caseous particles

Methy. Blue Stain. deeply coloured. Very few Bacteria and Micrococci.

This was a very yellow coloured milk with a deposit of Ochre-like grains. Here the deficiency was in Fat and Proteids. On substitute feeding being suggested, the mother made choice of Mellins' Food. This being done, instructions were given as to its preparation with Milk and Cream, to bring the mixture up to standard. The results were satisfactory so far as the digestive disturbance was concerned, but as to the further progress of the child I am in ignorance, as the parents have since left the district.

Case 8. Another child about which I was consulted, the subject of digestive trouble, vomiting, diarrhoea and fretfulness. His rate of growth had been slow. Menstruation had recommenced three months after the child's birth. Analysis of milk sample was as follows,

Fat	2.48	
Proteids	1.10	
Lactose	5.55	
Salts	0.126	
Water	90.744	Specific Gravity 1025

Litmus Reaction, Alkaline.

Microscopic Exam. Number of Nucliated cells; fat globules very numerous. No other form elements.

Stained Meth. Blue. Bacterial Content large, chiefly micrococci, few chains of Streptococci &c.

Stained for acid Fast Bacilli. Absent.

This milk had a white blue tinge with a slight deposit of casein on standing for a day or two. A second sample taken during the menstrual period showed very little difference in the nutritive constituents and no difference in the microscopic examination, and it was deemed advisable, in view of the unsatisfactory number of the foreign elements, notwithstanding that the milk was of fair nutritive value and might have been improved by dieting etc., to substitute modified Cows' Milk. This was done and was followed by satisfactory results in the case of the child.

Case 9. Following upon Case 8, I was asked by a mother whether she should continue to nurse her child since she had commenced to menstruate. The child was in good health, and had been since birth, and the growth was all that could be desired. The health of the mother was good and the supply of milk sufficient. Its nutritive value

is shown by the following analysis:-

Fat	3.530
Proteids	1.405
Lactose	6.780
Salts	0.153
Water	88.132

Specific Gravity 1030.1

Total Solids 12.0%.

Litmus Reaction Alkaline,

Microscopic Exam. Very few foreign elements.

Stained Methy Blue. Very few short Bacilli.

Thick cream on standing.

A second sample taken during the menstrual period showed practically no variation from the above. As the child was five months old and the mother strong and healthy I suggested that nursing should be continued. This has been done for two months: the child continues to progress, the mother's health continues good, and I propose to allow the practice to go on for two months longer, especially as the substitute feeding would not be carried on satisfactorily on account of the home conditions.

Case 10. Another case of retarded growth with slight digestive disturbance. The mother has given birth to 13 children, and the present child was somewhat small when born. The milk gave the following analysis:-

Fat	4.725
Proteids	1.427
Lactose	6.612
Salts	0.130
Water	87.106

Total Solids 13.0%.

Litmus Reaction, Faintly Alkaline.

Microscopic Examination. Foreign elements very scarce.

A. Stained Methy. Blue, Few isolated Bacteria.

B. do for acid fast Bacilli, Absent.

Here we had a milk very rich in fat, the richest of my series, yet the child was making slower progress than some of the children nursed on milk with half the above quantity of fat. I was of opinion that he was receiving a milk, the richness of which was beyond his digestive capacity. Attempts made to increase the quantity, on the principle of dilution, being unsatisfactory, modified Cows' milk was substituted with results that promise to be satisfactory.

Cases 11, 12 and 13. In the cases of these three children the symptoms were almost identical. In Case 13 the child was actually thriving, while in the other two cases this could not be said to the same extent. The mothers were strong and healthy and the hygienic conditions in which the children were living, all that could be desired. The mother of Case 11 was in temperament nervous, irritable and easily excited, and her experience of nursing a previous child very unsatisfactory. It was ultimately artificially fed. In Case 13 the mother had given promise of successfully nursing a previous child which died from a cause not associated with defective or improper feeding. In Case 12 the mother failed to nurse a former child. Samples of milk in each case gave the following analysis:-

	11.	12.	13.
Fat	1.420	1.90.	1.343
Proteids	1.145	1.356	1.487
Lactose	5.260	5.700	5.520
Water	91.995	90.900	91.441
Reaction	Alkaline,	Alkaline.	Strongly alkaline.
Other characteristics,	Very bluish & poor looking.	Watery appearance.	Watery appearance.
Specific Gravity,	1026.5	1035.5	1035.6
Total Solids,	8.05%.	9.0%.	8.6%.

Microscopic examination of these showed no Bacteria or other bodies of importance.

It will be seen that all these milks are deficient in all constituents. In view of the previous experience in Cases 11 and 12 artificial feeding was at once substituted, Cows Milk in Case 12, and Condensed Milk made up to Standard human Milk in Case 11. This was preferred by the mother because of her former experience, When modified Cows Milk and a number of patent foods were tried with no benefit; but whenever condensed milk was used comfort at once followed. The child is now strong and healthy, and the present child gives promise of becoming so. In Case 13, modified Cows Milk is being partly used in combination with breast feeding. Here, the necessity for immediate change is not so paramount. The child is growing, not in my opinion so much on account of the quality of the milk, but of the quantity he is receiving. It is proposed to increase the nutritive value by altering the diet of the mother and, if possible, discontinue the substitute feeding and allow him to get his supply from the maternal font.

There is not much to add to the remarks appended to each of the foregoing cases. My attention was chiefly drawn to them on account of digestive disturbance, and, as showing the importance of attending to the milk, in almost every case it was found to be defective. Regarding the methods of examination, the Microscopic Examination was made of the Centrifugalised Sediment, the stains being Methyline Blue and Ziehl Neilsen Stain for acid fast Bacilli. The analytical results were obtained by the following methods which were to some extent determined by the smallness of the samples obtainable.

Method of Examination.

1. TOTAL SOLIDS. 5cc. of the milk was pipetted into a platinum basin and weighed. The water was then evaporated on a water bath, the skin which formed on the surface being occasionally broken with a Pt. wire When all moisture had been driven off, the dish was transferred to the water oven at 100 degrees C. for two hours, cooled in dessicator, and finally rapidly weighed. The dried residue was the total solids in the weight taken (i.e., the weight of 5 cc. of milk), and the percentage was obtained by simple proportion.

2. ASH. The residue of total solids was now gently heated over a Bunsen burner until only a white ash remained. Overheating was carefully guarded against, so as to prevent loss of ~~Hard~~ Chlorides The dish and residue , after cooling in dessicator, were again weighed, and the weight of ash in 5 cc. of milk obtained. This figure was also converted into percentage by weight, as in the

former case.

3. FAT. This was determined by the Werner-Schmidt method, thus: 5 cc. of milk were pipetted into a Schmidt tube, and about 8 cc. conc. H.Cl. added; the mixture was then heated to boiling for three minutes in the Bunsen flame, and stood aside until the mixture was black. The tube was then cooled and filled up to 50 cc. mark with ether; corked, shaken thoroughly, and allowed to settle. A known volume was then pipetted off from the supernatant ethereal solution, and brought into a previously tared Pt. basin. The ether evaporated and the dish was dried in the water bath, cooled and weighed. The weight of fat in the volume of ether abstracted was thus found. The residual volume of ether in the fat tube was next read off, and the fat contained in it found by simple proportion.

Adding the fat found by evaporation to that still remaining in the residual ether, as found by calculation, gives the total fat in the 5 cc. taken. Then multiplying this result by 20 and dividing by the specific gravity gives the percentage of fat by weight.

4. PROTEIDS. (Determined by Kjeldahl's method). 5 cc. of milk were pipetted into a Jena flask of 300 cc. capacity, and the water evaporated off on the water bath, the last traces being driven off in the water oven. To the dry solids 20 cc. of pure conc. H_2SO_4 were added, together with 10 grammes of K_2SO_4. The flask was placed in a slanting position over a Bunsen flame, and the mixture heated until the liquid was colourless. The flask was then cooled, and about 200 cc. of distilled water added. The whole liquid was transferred to a distilling flask, the Jena flask being well rinsed out with distilled water and the washings added to the distillation

flask. The flask was provided with a tap funnel and an anti-splash head, and connected to a vertical condenser.

An excess of strong Na OH was then poured into the distilling flask, the funnel cock was closed, and heat applied. The distillate was received in 50 cc. of $\frac{N}{10}$ H_2SO_4, and the distillation continued until about 250 cc. had been collected. The distillate, after cooling, was made exactly 250 cc. of $\frac{N}{10}$ Na OH, using methyl orange as indicator. Three separate titrations were made, which agreed to 0.05 cc.

The volume of Na OH used corresponded to the amount of H_2SO_4 remaining free in the solution, and hence, by subtraction, the H_2SO_4 neutralised by NH_3 was found. Each cc. of $\frac{N}{10}$ H_2SO_4 - .0014 gramme of N, and N x 6.33 gives the proteids.

By this means the proteids in 5 cc. of milk were found, and since the weight of 5 cc. was determined in (/), the percentage by weight was found by proportion.

5. SUGARS. (Determined by Polarimeter.) 5 cc. of milk were pipetted into a small beaker, and 1 cc. of mercuric nitrate added. The liquid was then filtered through a small moist filter, and the residue washed with frequent quantities of fresh distilled water, the bulk being finally made up to 25 cc. The optical rotation was then determined, using the 2-dcm. tube. The specific rotation of Lactose at 20 degrees C. is + 52.5 , and the strength of the solution in grammes per 100 cc. is found by the formula $C = \frac{100a}{Lx(a)d}$: C being the number of grammes per 100 cc.; a, the observed rotation; L, the length of observation tube used; and (a)d being the specific rotatory power of the substance under observation.

From the figure thus obtained the number of grammes in 25 cc. was deduced (i.e., in 5 cc. of original milk), and this number was converted into per cent by weight as in the previous instances.

Substitute Feeding.

In approaching this aspect of child feeding, it is to be remarked that its practice has become a greater necessity at the present time than in the past. From whatever cause the ability to successfully nurse her child as nature meant her to do, is, in a great proportion of our maternal population, being lost. Holt says; "In New York at least three children out of every four born into the homes of the well-to-do classes must be fed at some other font than the maternal breast. It ~~has~~ not, as has been so often asserted that the modern mother will not nurse, as, in my experience, nearly all would be glad to do so if they could, but they simply cannot." While some may have met with this unwillingness I am slow to believe that it is the experience of the majority. My own observation leads me to think that this inability is governed to a large extent by the social environment of the mother, and that while the majority of women in the higher circles of life, and those in towns, where female labour is prevalent, may be unable or unwilling to nurse their children, the middle and lower classes do so successfully. Out of 100 children born last year I find, on consulting my list, that only in 17 cases was the child fed by other means than the breast. These cases are not "picked" but taken as they appear in the usual order, and include all classes from the well-to-do to the very poor. It is true that in some of these cases

I am now of opinion that the quality of the milk may not have been all that could be desired, but it was sufficient to carry the children through the period allotted to that form of feeding.
This comparatively satisfactory average of my cases notwithstanding, and while disclaiming all desire to discourage nature's method of feeding a child, I am of opinion that many mothers nursetheir children who should not do so, and that from the fact that they are supplying the child with a food unsuited to its requirements. The necessity for substitute feeding having arisen it becomes imperative that we should employ the best substitute we can find, and here our choice falls upon the milk of the cow. As already pointed out, while this is the most perfect substitute amongst animal milks, its composition, and the nature of some of its constituent parts, are so different from human milk, that to substitute it without modification, would, in the majority of cases, place the child in the position of being "out of the frying pan into the fire", and again, the source of supply is of such a nature that special protective measures are imperative if that supply is to remain "above reproach".

In choosing Cows' Milk we satisfy what Holt characterizes as the fundamental principles to be observed in substitute feeding, viz.

(1) The food must contain the same constituents as human milk.

(2) These constituents must be present in about the same proportion as in good woman's milk.

(3) As nearly as possible the different constituents should

resemble those of woman's milk both in their chemical composition and in their behaviour to the digestive glands.

(4) The addition to the food of very young infants of substances not present in woman's milk (e.g. starch) is unnecessary, and, if used in any considerable quantity, may be positively harmful.

In the modification of Cows' Milk, as generally practised, it is to be feared that in the minds of many women there is much darkness. The young mother is entirely at the mercy of the nearest "old woman" who has her own pet mixture which has for its basis, dilution. The importance of a properly prepared modified milk is now being recognized not only by physicians but by municipalities, and it is to Rotch of Boston that we owe the institution of a method enabling the physician to precisely adapt the food of the infant to its peculiar requirements, and at the same time affording him every opportunity of judging the part played by the various constituents of the diet. It has thus been summarized:-

"Recognizing the essentially unscientific character of the traditional methods, he devoted his attention to the real factors of the problem which had for so long been neglected, with the object of arriving at a system by which a milk mixture could be prepared, in the constitution of which the comparative importance of every essential element received due recognition. The great and lasting value of his work lies in the abolition of all didactic rules

and in the provision of an instrument combining clinical elasticity with scientific precision. By the percentage method which he devised any desired milk mixture can be prescribed so as to contain the various constituents in any proportion required. If the prescribed mixture prove in any way unsatisfactory it can be adjusted with the greatest delicacy and precision to the needs of the infant". In short, the milk has to be modified at the laboratory and supplied in the same manner as the chemist dispenses and supplies the bottle of medicine. While this is the ideal method towards which we are striving and from which we are still a great way off, it is satisfactory to know that some municipalities, recognizing the importance of providing a good modified milk, are establishing centres from which such supplies may be had. At present it is not possible to provide a milk which is germ-free, consequently their efforts are directed towards providing a substitute which has been sterilized and modified. It will explain the method adopted by most municipalities if I incorporate at this point the report of a deputation on Infant Milk Depots submitted to the Corporation of Glasgow and contained in the M. O. H's report for the year 1903. After discussing the conditions under which the milk is collected, the sources of its contamination, and the means taken to prevent the effects of such contamination, namely the addition of preservatives, e.g. Formaline, Salicylic Acid, Boric Acid, etc., the report says :-

"In the municipal scheme presently in operation, and in some commercial companies, the prepared milk is sold in sealed bottles which are not intended to be opened until the time of consumption,

so that the addition of any impurity subsequent to sterilization is avoided. In addition to sterilizing, the milk sold at the municipal depot is adapted for the infants by dilution and the addition of sugar and cream in proportion, varying with the age for which it is intended". Then follows a description of the various depots visited, with a description of the methods employed at Battersea, which are considered typical of the others. "The milk is supplied by a local dairyman and arrives in the early morning. It is guaranteed free from clinical preservatives and to contain not less than 3.25% butter fat. The first process is the modification or humanization. Three modifications are employed. The first contains one part milk to two of water, 7 ounces of cream and 7 ounces of lactose being added to each gallon of the mixture. This modification is given to infants under three months old. The second modification, which is given to infants between 3 and 6 months, consists of equal parts of milk and water with 5 ounces each of lactose and cream added per gallon. The third consists of two parts milk and one of water with 3 ounces of cream and lactose added per gallon, and is given to infants over six months old. The milk having been modified, it is bottled and the number of bottles and the quantities contained are set out as follows:-

	Age.	Number of Bottles per Day.	Amount per Bottle.	Amount per Day.
1.	Below 2 weeks old,	9	1½ oz.	13½ oz.
2.	Between 2 weeks & 2 months,	9	2½ oz.	22½ oz.
3.	do 2 and 3 months,	8	3	24 oz.
4.	do 3 and 4 months,	7	4	28 oz.
5.	do 4 and 5 months,	7	4½ oz.	31½ oz.
6.	do 5 and 6 months,	7	5 oz.	35 oz.

Age.	Number of Bottles per Day.	Amount per Bottle.	Amount per Day.
7. Between 6 and 8 months	6	6	36
8. do 8 and 12 months	6	7	42

After bottling, the stoppers are closed and the bottled milk is heated by steam and kept in a temperature of 212 degrees F. for from five to ten minutes. It is allowed to cool and then is supplied to consumers. Instructions are given with each supply as to the method of use. When feeding time arrives, the mother places the bottle unopened in some warm water till the milk has reached body temperature. The bottle is then opened, a small teat put on the mouth, and the baby takes its food from the sterilized bottle direct"

Such is the method employed in many large towns, and while it comes far short of the method adopted by Rotch, which implies a control of the cows, ~~their~~ their selection, housing, diet and environment, also a body of skilled assistants to collect and modify the milk, it is one step forward in helping the public mind to realize the importance of having a proper food supply for the children. Since the majority are at present outwith the benefits to be derived from such method, it behoves the physician to see that the child's milk is modified by the mother in the best manner that circumstances will permit, always keeping in view the principles already mentioned as to the composition of the milk and the child's requirements.

Infant Mortality in relation to Infant Feeding.

In this thesis, while reference has already been made to the general effect of improper or imperfect feeding on the health of the child, it is not my intention to refer to it further than showing the relation it bears to the death-rate in children, especially during the early months of life, a fact which for some years has been recognized by Medical Officers of Health, and which is also pressing itself upon the attention of the members of our governing bodies with greater force than ever. Not only have we a large proportion of children who survive this precarious period weakened in health, and who are the bearers of a severe handicap in the struggle for existence, but we know there are thousands overcome in the early days of their fight, and that while the rate of mortality for Adults shows a steady decrease, that for infants is not lessened. It is a noteworthy fact, proved again and again, that progressive Sanitation and improved hygienic conditions have encouraged this condition of adult life, while in the case of children the results have been inappreciable, showing that the cause of infant mortality is something more than mere environment.

In Glasgow, in the year 1903, 3563 deaths under one year occurred, representing a death rate, per 1000 born, of 142. In Edinburgh the rate was 142, Dundee 177, Aberdeen 145, London 158, Liverpool 189, Manchester and Birmingham 188.

Dr. Chalmers of Glasgow, in his annual report for 1903, gives a table showing the number of deaths of children under 12 months

~~gives a table~~ showing ~~the number of deaths of children under 12 months~~, in groups of causes of deaths, with the group percentages, the following being the results:- Males: Immaturity 31.8; Diseases of Respiration 23.6; Digestion 14.3; Disease of Nervous System 10.2. Females: for the same groups, 32.2, 22.2, 14.7, 10.1 When it is remembered that nervous diseases may include causes of death which are consequences of improper feeding, and that the lowered vitality renders ~~it~~ the child liable to develop respiratory disease, it will be seen that the direct and indirect effects of improper feeding are responsible for a large percentage of our Infantile Death Rate.

In his report for the year 1904, Dr. Templeman, M.O.H., Dundee, gives some interesting details in relation to Infant Mortality in that city, showing how important the nature of feeding is to the life of the child. The note is as follows:-

"The infantile death rate of Dundee, for the past year was 174 per 1000 births, or 23.8 per cent of the total mortality in the city, the total number of deaths of children in the first year of life being 788. The deaths under five years numbered 1273, or 38.4 per cent of the total mortality. The greatest factor of the production of the zymotic death-rate had been zymotic diarrhoea, causing 88 deaths, and in 85 cases investigated it was found that only 9 were breast-fed, 28 were partly fed by breast and partly by bottle, and 48 were entirely brought up by hand. Of 65 infants who died from diseases of the stomach and bowels 9 were breast-fed and 44 were artificially fed. The total number of children under

two years who had died from diarrhoea or disease of the digestive system and whose cases were inquired into was 186, and of these 21 were breast-fed, 52 partly breast-fed, and 113 were brought up by hand, while 115 of the mothers were at work."

Dr. Hope, Medical Officer of Health, Liverpool, referring to Zymotic Diarrhoea, says:- "Investigation proves incontestably that the deaths of infants from this cause are closely associated with the method of feeding, putrefying food being the medium by which the specific poison is commonly introduced. The deaths amongst children under three months of age either wholly or partially fed on artificial foods, are fifteen times as great as they are amongst an equal number of infants fed upon breast milk, i.e. out of every 1000 infants naturally fed upon breast milk 20 die of Autumnal Choleraic Disease, but if the same number at the same age are artificially fed 300 will die of the same cause".

Dr. Hill, Birmingham, says:- "The improper feeding of children is practically slow starvation. It is the cause in some cases of the death of all the children of a family, and frequently of the greater proportion of them. Privation of breast milk and improper feeding are not only answerable for untold sickness and death, but their effects are seen in after life in imperfect development and impaired physique".

Dr. E. Sergeant, M. O. H., County of Lancaster, says:- "The high infant mortality in some districts indicates that much has yet to be accomplished before this disgrace to civilization is remove

A death-rate of 200 out of every 1000 children born, was attained in 16 districts during the year under report (1901)". While Dr. Chalmers, Glasgow, has shown the importance of this subject by giving the future expectation of which survival to the end of the first year implies. At birth the expectation of life to a male child may be stated at 35.18 years, and the addition thereto at the end of each of the four years which follow, thus:-

Age.	Expectation of life.	Plus Difference.
0	35.18 years	-----
1	41.54 do	6.36 years
2	45.25 do	3.71 do
3	46.55 do	1.30 do
4	47.03 do	.48 do

Increased expectation after five years, 11.85 years,

A child who has completed his four years has thus an expectation of future life which exceeds that at birth by almost 12 years, but it is to be observed that <u>six</u> of these have already been gained if he completes his <u>first</u> year". It will thus be recognized that the relation between the nutrition of the child and Infant Mortality is of ~~the most~~ paramount importance not only on <u>individual</u> but on <u>national</u> grounds, as here we have the source of a weakness which is slowly but surely lowering the vitality of the nation.

<u>Conclusion</u>. In concluding, I wish shortly to refer less to the opinions of other observers in this field than to the results of my own observations in connection with infant feeding. In forming an opinion regarding the efficacy of any particular method of feeding,

the chief factor must be the growth of the child. When we find a child sleeping well, good-natured, and apparently contented with his lot, and these conditions associated with a progressive and natural growth, we have every justification for concluding that his food is supplying all his physiological requirements; but should any of these favourable symptoms be wanting, and the absence of any other cause be proved, it will generally be discovered that the nutritive supply is at fault. Let me divide the reference to these into their two natural heads.

Breast Feeding.

In discussing the question of breast feeding, we must consider it from an ante-natal as well as a post-natal point of view. Many children are born in an ill-nourished and unhealthy condition due to the state of the mother's health, and it is therefore desirable that prospective mothers should be encouraged to seek advice as to the management of their health, so that they may endow their offspring with good constitutions and prepare themselves to suckle their infants. It is after birth, however, that the advice and services of the physician are most often requested when the child has shown distinct evidence of malnutrition. It has ceased to grow, or, combined with this want of growth, there are symptoms of digestive trouble indicating that the child has been receiving a food unequal or unsuitable to his requirements, or both. In such a case, having excluded the possibility of disease in the child, our first business must be to enquire as to the character of the milk which the mother is providing. It will probably be found that there is some alteration in its constituents,

in which case, it is the duty of the physician to guide the mother. It may be necessary to at once stop nursing and wean the child, but more often it will be possible to modify the method of feeding, and, by putting the mother through a course of dieting or changing her environment so to alter the character of her milk that it assumes the nature of a food capable of satisfying all the requirements of the child. One of these causes chiefly contributing to alter the character of a mother's milk is the method of nursing. It is my invariable practice when I give permission to put the new born child to the breast, to advise the mother as to the number of times the child should be fed during the day and night, and especially to see that the nursings are given at regular intervals. For it is no uncommon thing to find that a child is allowed the breast at all times, and under any circumstances, and this, as I have already pointed out, alters the character of the milk in a marked degree. This is specially so where the mother is ill-nourished to begin with, and, where her way of living and dieting is such as to make it difficult for her to satisfy her own physiological requirements, let alone those of her offspring. Sensible mothers usually appreciate the importance of this advice, but, in the case of others, it enters deaf ears, very much because they do not appreciate the importance of a proper dietary in their own life and are ignorant of food values. One way of remedying this condition of affairs, which deserves much attention, has been suggested, namely, that Registrars should be asked to supply to the Municipal Authorities the names of children within a few days after their registration, and that Lady Inspectors should then visit at their homes and give advice to the

mothers in the hygiene of nursing, and, where necessary, direct them to apply for such counsel and assistance as may be urgently required in order to maintain breast feeding. This would apply more especially to certain districts of our large cities which would be mapped out for ~~that~~ the purpose. In this way, much might ultimately be done to remove the ignorance that at present exists, to implant in the minds of the mothers some idea of the importance of breast feeding; and, in many instances, it would lead to the advice of the physician being sought at such an early period that the health of the child would be re-established.

Another factor in this same connection and which is more peculiar to some towns than others, especially where female labour is common, are the cases where the mother is employed earning her living and nursing her child at the same time. This is a practice not to be commended. In the majority of instances, the conditions of life are such that the mother is more than likely to supply an unsuitable dietary, and the nursing of the child can only take place at long intervals when it is liable to receive too large a meal and that hurriedly, the other meals being by substitute feeding. It would be wise in cases of this kind, to adopt substitute feeding entirely, but, where it is at all possible, it should be impressed on a mother that it is undesirable that she should be separated from her child, except for reasons of ill-health and under medical advice. I am therefore of opinion that this method of irregular nursing bears an important relation to infant malnutrition and the mortality amongst children, and ~~these~~ that, whilst everything should be done to encourage breast feeding, only those mothers should suckle their children who are in a

condition to supply a satisfactory milk. In all cases where our suspicions are directed towards the nutritive value of a mother's milk, our duty is first to make an analysis of it, and let the results of that analysis govern the future dieting of the child.

Substitute Feeding. It will often be found that the mother is incapable of nursing her child, and that for this or some other reason, substitute feeding should be adopted, and it is here that the patience and temper of the physician are often sorely tried. Most extraordinary things are done. Every week brings to light some new modification which only serves to show how little some mothers know of the digestive capabilities of their child. What, for example, is to be said for a mother who feeds a child two weeks old on biscuits soaked in water, or another who gives a baby, 5 months old, a bottle containing ¾ of a teaspoonful of condensed milk diluted with 28 teaspoonfuls of water, or of a third, who considers that when the child's bottle is empty, it should be at once refilled? These are examples which have come under my own notice and they prove how necessary guidance is as to proper methods of feeding. The practice of substitute feeding has now become so common, and, as already shown, capable of producing consequences of such serious import, that every effort must be put forth to make the conditions, under which it is practised, as favourable for the child as possible. In most cases of substitute feeding, it will be found that the best subst itute is cows' milk, and it is to it, consequently, that our attention will be mainly directed. The ideal method is that of Rotch, already referred to, in which the separate constituents of the milk are graduated in quantities to suit

the requirements of the child, and the source of supply so carefully attended to, that the milk is collected under conditions which practically make it germ free and render external contamination impossible. While the cost of this is for the major part of our population, prohibitive, municipalities are now providing a fair substitute for it in a modified milk, collected under favourable conditions, and, after preparation, sent out to the children in such a way that the dangers of contamination are practically nil. The result of this has been better health and a reduced death rate amongst the children fed with it. The process producing this modified milk entails a certain amount of sterilizing by heat, and, as to the effect of this, difference of opinion exists amongst medical men. It is maintained by some that the heating alters the character of the milk and that scurvy is apt to follow in children fed upon it; and by others, that when children so reared are for some reason deprived of it, they immediately begin to pine and die. While in a few cases this may be true, it has been demonstrated that improved health and a lowering of the death rate have followed the institution of the system. One method that might be adopted to obviate the necessity of heating is as follows:- The cows' milk intended for hand fed infants should be milked, transported and distributed under special precautions. These should include not only care in the selection, testing, feeding, sheltering and tending of the cows, but extreme cleanliness in milking; also rigid aseptic measures, accompanied by immediate refrigeration to be maintained during transport, and by prompt dispatch. The number of the micro-organisms and the lactic acid in the milk would thus be reduced to a minimum at the time of delivery. Then, to prevent the further con-

contamination of the milk, it should be protected in stoppered bottles ready for feeding, with instructions as to the frequency and manner of feeding. This method makes heating unnecessary, but it implies the existence of an amount of control over the milk producer which we at present do not possess and also an increase of cost, which would practically be prohibitive. Until this control has been obtained and subsidies provided to lessen the cost, the present experimental methods must suffice. Contamination is most to be feared in large towns where the source of supply is usually far removed from the consumer, and when, by reason of various handlings in transit, the risk of it is proportionately increased. In the country and smaller towns, this risk is not so great, and, consequently, a purer milk is more likely to be obtainable. My practice has been to impress upon the mother the importance of regular feeding; that the child requires intervals of digestive rest just as she herself does; that only a certain quantity should be given each day, and that the milk must be modified so as to resemble that which it ought to be getting from her own breast. This modification should be effected by means of the addition of cream, sugar, and water according to the age of the child, and attention should be given to the cleanliness of the bottle as well as to its contents, and reports ought to be made regularly as to the health and weight of the child. I have found it convenient to call in the aid of condensed milk, but usually only for temporary purposes. Often when the child has been put upon cows' milk or is suffering from acute gastric disturbance, accompanied by vomiting and diarrhoea, its value is great, inasmuch as it provides a substitute food during a precarious period. I have, in some instances, advised

its constant use instead of cows' milk, especially where the home conditions were such that the latter was likely to be in great measure contaminated; and, while success has usually followed its use, this method has to be employed with caution and the child carefully watched. In such cases the milk was brought up to the fat standard by the addition of cream. As to the ~~many~~ many artificial foods that force themselves upon our attention, I would simply remark, in concluding, that, as they profess to be substitutes for cows' milk, where the latter is properly attended to, such substitutes should be resorted to only in rare cases and under exceptional conditions and for short periods.

Appendix.

Cows' Milk Modifications.

Elements required.

(1). 12% Cream = Two parts skimmed Cream and One Part of Plain Milk.

(2). Solutions of Milk Sugar, 5, 6, 7, 8 & 10% strength.

Formulae obtained by diluting 12% Cream.

Diluting 5 times with 6% Sugar Sol.- 2. Fat 2%, Sugar 6%, Proteids 0.60%

do 4 " " 6% " " - 3 2.5%, " 6% " 0.80%

do 3 " " 7% " " - 4 3.0%, " 6%, " 1.00%

do 2½ " " 7% " " - 5 3.5%, " 6%, " 1.20%

do 2 " " 7% " " - 6 4.0%, " 6% " 1.30%

Where it is desirable to use a lower percentage of fat without reducing the proteids plain milk with sugar solution may be used.

Table showing results of this formulae.

No.	Formula.	Ingredients.	Quantity of each ingredient requir to prepare the following amounts of food.			
2.	Fat 2.0%	Milk	24 oz.	32 oz.	40 oz.	48 oz.
			1½ "	1¾ "	2¼ "	2¾ "
		Cream (skimmed)	2½ "	3½ "	4¼ "	5¼ "
	Sugar 6%.	Water	20 "	26⅔ "	33½ "	40 "
	Proteids 0.6%	Milk Sugar	1 1/5 "	1⅗ "	2 "	2⅖ "
4.	Fat 3.0%	Milk	2 oz	2¾ oz	3 ⅓ oz	4 oz
	Sugar 6.0%	Cream (skimmed)	4 "	5¼ "	6⅔ "	8 "
		Water	18 "	24 "	30 "	36 "
	Proteids 1.0%	Milk Sugar	1 1/5 "	1⅗ "	2 "	2⅖ "
7.	Fat 4.0%	Milk	8 oz	10½ oz	13½ oz	16 oz
	Sugar 7.0%	Cream (skimmed)	4 "	5½ "	6⅔ "	18 "
		Water	12 "	16 "	20 "	24 "
	Proteids 2.0%	Milk Sugar	1 1/5 "	1⅗ "	2 "	2⅖ "

Modification used by me.

Where plain milk is used with water dilution and cream added to bring up to fat standard, the following proportions are used, viz.

Mixture:- 1 part milk, 2 parts water,; 14 oz. of this mixture would equal 4 oz. milk, 8 oz. water, 1 oz. cream, 1 oz. milk sugar.

Mixture of 1 part milk and 1 part water; 18 oz. of this mixture would contain 8 oz. milk, 8 oz. water, 1 oz. sugar, 1 oz. cream. These milks are modified to suit the age of the child. As the child grows older the proportion of water is decreased, as also are the fat and sugar.

Rotch used a tin measure to hold 3⅛ drachms milk sugar, and made a mixture as follows,

20% Cream,	1½	oz.
Milk,	1	oz.
Water,	5	oz.
Milk Sugar	1	measure.

Boil or steam, and when cool, add lime water ½ oz.

This gives a composition equal to Fat 4.0%, Proteids 1.1%, Sugar 6.2%, Salts 0.2%.

Holt recommends the following schedule to ensure regularity of feeding, viz.

Age.	No. of feedings 24 Hours.	Intervals between Meals by Day. Hours.	Night feeds 10 pm to 7 am.	Quantity for one feeding. Oz.	Quantity for 24 Hours Oz.
3-7th Day	10	2	2	1-1½	10-15
2-3 weeks	10	2	2	1½-3	15-30
4-5 weeks	9	2	1	2½-3½	22-32
6-12 weeks	8	2½	1	3 -4½	24-36

Age	No. of feedings 24 hours	Intervals between meals by day.	Night feeds 10 p.m. to 7 a.m.	Quantity for one feeding	Quantity for 24 hours
3-5th month	7	3 hours	1	4 -5½ oz.	28-38 oz.
5-9th month	6	3 ...	0	5½-7	33-42
9-12th month	5	3½ ..	0	7½-9	37-45

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