"The Artificial Feeding of Infants"

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The Artificial feeding of Infants

Each year the number of women who are either unable to nurse their young, whether from deficiency of milk, the result of heredity, or debility, or on account of their suffering from some hereditary transmissible disease, as phthisis, cancer and syphilis, or are unwilling because it blinds them to their children's calls, and interferes with their pleasures, is increasing so that the subject of the "Artificial feeding of Infants" is one of the greatest importance. Mothers view a more serious responsibility when for the indulgence of some petty pleasure, they deprive their offspring of its natural food, and make it dependent.
upon some imperfect substitute, imbibe from that venomous fountain the feeding bottle; but there is a class of mothers who are compelled to relinquish this natural duty of supplying their young with food, and who deserve sympathy, I refer to those who are obliged to be absent from their homes, to earn a livelihood or support a family; this class is largely represented in Maidstone, where large numbers of women are engaged at the Papermills, rag-cutting. The infants are left under the care of neighbours, to be fed with condensed milk, tepid stomach pap or Brighton biscuits, generally imperfectly prepared and carelessly administered, whilst the mother's milk is reserved for night feeding.
In Alsace there is a law forbidding the employment of moths in factories, for six weeks before and after confinement. It is a wise provision and a great pity our legislature cannot do fit to introduce a similar measure into this country.

In looking over the literature upon Children, we find that their feeding and the diseases resulting from has attracted the attention of Physicians from the earliest period in the history of Medicine. Thus we find, that Hippocrates devoted one of his treatises to the Pathology of Children, and it contains aphorisms on the common disorders of children who are teething, vomiting & diarrhoea &c.
In the middle ages Secundus Summarchianus published a Latin poem called Paedotrophicia, that is to say, the rearing of children. The 1st Book relates to the foetus, the 2nd to the management of sucklings, and the 3rd to their diseases. Again Luigi Janelli about 1560 A.D. wrote an Italian poem called La Bacia, or The Nurse, the author denounces wet nurses, and schools Italian ladies to suckle their children themselves.

Lately the literature has been most prolific and the most diversified opinions are inculcated by authorities on pediatrics, each one claiming success for the method of feeding he recommends.

The great mortality among hand fed infants results from diseases of the digestive organs,
and points to the improper quality of the food. Mr. Rochard, member of the Academy of Medicine in a lecture on the depopulation of France, says that contrary to the opinion held by Darwinians, it was not the worst constituted children that died, but rather those who were improperly fed. Calculated from the Registrar General's report, we find that one-fourth of the deaths among children under five years, is due to diseases of the digestive organs, and that mortality is considerably greater under one year. It doubt the terms Atrophy, Debility, and Marasmus, which are frequently used with in death certificates, really mean defects in feeding and upon analysis and inquiry would be found chiefly occurring
Among artificially reared children, in the Infant Hospital, New York, in 1873, the mothers of 579 of the infants were admitted to nurse and aid in the care of their own offspring, and only 70 out of the 579 died, or 12.5 per cent, while of 519 true orphans and foundlings, 240 or upwards of 58.5 per cent died. Thus we see that these foundlings had not one third the chance of surviving of the infants who enjoyed their mother's care.

Again, the late Dr. Slisha Harris in 1874 stated that "the three great private charities in New York City that receive newly born infants, admit in one year about 1900 the rate of mortality in the groups of infants whose mothers try to nurse their offspring, has been during the past four years about..."
14 per cent, while in the hired wet nurse class the death rate averages about 27 per cent, and in the strictly foundling class that are bottle or spoonfed, the rate is 70 per cent dead in the first year, and 90 per cent before the end of two years.

In Berlin, Baginsky found in the four years from 1879-82 in the children dying from diarrheal diseases, in the periods of January and February and June and July respectively, the following figures, being the average of the four years:

<table>
<thead>
<tr>
<th>Jan &amp; Feb</th>
<th>June &amp; July</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast fed</td>
<td>Breast fed</td>
</tr>
<tr>
<td>19.7</td>
<td>69.5</td>
</tr>
</tbody>
</table>

From these observations of Baginsky, it is well seen what a terrible risk hand fed infants
run at all times, but especially during the hot summer months. Of course the risk is much greater in large cities where the other conditions of life are more unfavourable than in the country.

Dr. Ballard in a paper read before the British Medical Association states that at Leicester in 1883, the infant mortality from summer diarrhoea numbered 341, and of these only two per cent. were breast-fed, and cow's milk formed the nourishment of 60 per cent. of them. There is no doubt that an elevated temperature is an efficient factor in the production of this disease, as it also fosters emanations from sewers, and other sources of decomposition, but the feeding bottle is more strongly incriminated than any other cause.
Dr. Dyosdale in the British Medical Journal Sept. 18, 1850 gives the following death rates of infants under one year in European Countries, Ireland and Wales (Ansell) Richer Classes 80 per 1000

General population 150 - -

Austria-Hungary 262 - -
Belgium 171 - -
France 170 - -
Sweden 138 - -
Denmark 156 - -
Iceland Artificial feeding Universal 330 - -
Russia (Bertillon) 243 - -
Italy 370 - -

Norway (Sinkelburg) Breast feeding almost invariable 106 - -

Ansell summing up said that illegitimacy, ignorance of syphilis and bad climates, were frequent causes of infantile mortality and to
these must be added neglect of maternal lactation. But besides the high death caused by artificial feeding there is another most serious result, which must not be overlooked, namely, its influence on the development, future health and usefulness of children so fed. Rickets is a very prevalent disease amongst the hand fed.

Milk is the natural food of mammals during the earliest term of life, and it is a well-established fact that speaking generally of the mammalians the longer the period during which the new born obtain maternal sustenance, the better fitted are they for the struggle for existence. M. Guenier in a report presented in 1874 to the Director of Public Assistance says: "That to
bring up infants successfully without breast-milk constituted a true art, for the practice of which true artists were not always to be found. No food will ever be found so efficient as that which a healthy mother is able to give her child, but when this supply fails (and I will not enter into the various causes which prevent mother nursing) what is the first and last substitute? The consensus of opinion will decide in favour of the wet nurse, although there are many opposed to their employment. Do not that "care and devotion" which goes to make up true maternity, are very different from the "duty" which prompts the wet nurse to attend to her foster child. Certain it is that a grave responsibility rests upon those who make the selection. But
independently of other objections it is not always within the means of parents to provide a wet nurse, and we are obliged to resort either to the employment of that variety of milk which most closely resembles human in the whole range of essential ingredients viz. that obtained from the cow, mare or goat (the casein of the milk of equine animals exists in a different form from that in which it does in the milk of mammals being imperfectly coagulated by acids, a property possessed by the casein of human milk) or cow's milk, and this latter by its abundance, and cheapness, its nutritive and digestive qualities, must hold its place as the general food for infants. The following table shows the analysis of the milk of these animals, & contains also that
of human milk for comparison.

Constituents of milk (in 100 parts)

<table>
<thead>
<tr>
<th></th>
<th>Ass</th>
<th>Mare</th>
<th>Goat</th>
<th>Human</th>
<th>Cow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>88.7</td>
<td>89.8</td>
<td>86.4</td>
<td>89.5</td>
<td>86.3</td>
</tr>
<tr>
<td>Casein</td>
<td>2.4</td>
<td>2.1</td>
<td>4.8</td>
<td>1.6</td>
<td>4.1</td>
</tr>
<tr>
<td>Milk fat</td>
<td>1.5</td>
<td>1.6</td>
<td>4.2</td>
<td>2.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Milk Sugar</td>
<td>7.1</td>
<td>6.1</td>
<td>4.1</td>
<td>6.9</td>
<td>5.1</td>
</tr>
<tr>
<td>Mineral Malt</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1034.57</td>
<td>1033.53</td>
<td>1032.67</td>
<td>1033.38</td>
<td></td>
</tr>
</tbody>
</table>

Goat's milk requires to be mixed with an equal quantity of water, and a small quantity of sugar of milk, for an infant under three months in order to bring the Casein, Bette, and Sugar into the proper proportions.

Recognizing then that cows milk is the most
universal substitute for human milk, it will be necessary to examine and compare their composition, before it will be possible to formulate a food which approximates as nearly as possible the natural food, for an infant theoretically and clinically.

Failures hitherto have resulted owing to the want of uniformity in the analysis of milks by different investigators, partly caused by errors in the methods employed, and in their taking too few specimens as typical, when human milk varies greatly in different women according to their constitution, habits, development, food, and period of lactation. I append here an analysis of human milk made at different periods of lactation by Pflüffer.
### Analysis of Milk (Pfeiffer)

<table>
<thead>
<tr>
<th></th>
<th>Human</th>
<th>Cow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8½th day</td>
<td>65th day</td>
</tr>
<tr>
<td>Water</td>
<td>89.62</td>
<td>89.72</td>
</tr>
<tr>
<td>Solids</td>
<td>10.38</td>
<td>10.28</td>
</tr>
<tr>
<td>Casein</td>
<td>1.665</td>
<td>.844</td>
</tr>
<tr>
<td>Albumen</td>
<td>7.00</td>
<td>.652</td>
</tr>
<tr>
<td>Fat</td>
<td>3.345</td>
<td>1.827</td>
</tr>
<tr>
<td>Sugar</td>
<td>3.274</td>
<td>6.22</td>
</tr>
<tr>
<td>Salts</td>
<td>.446</td>
<td>.180</td>
</tr>
</tbody>
</table>

This variability, at different periods of lactation if not pathological, is a wise provision of nature to allow for the exigencies of each month of advancing age.

In the following table prepared by Mr. Veronius & Seccrudel after an analysis of the milk of
68 cases of robust and 25 of weak constitution, from which it will be seen that the weakly constituted are inferior in milk-producing power to the more vigorous.

<table>
<thead>
<tr>
<th></th>
<th>Strong Constitution</th>
<th>Weak Constitution</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp. gr.</td>
<td>1032.97</td>
<td>1031.90</td>
<td>1032.67</td>
</tr>
<tr>
<td>Water</td>
<td>911.19</td>
<td>887.59</td>
<td>889.08</td>
</tr>
<tr>
<td>Solids</td>
<td>88.81</td>
<td>112.41</td>
<td>110.92</td>
</tr>
<tr>
<td>Sugar</td>
<td>32.55</td>
<td>42.88</td>
<td>43.64</td>
</tr>
<tr>
<td>Casein</td>
<td>28.98</td>
<td>39.21</td>
<td>39.24</td>
</tr>
<tr>
<td>Protein</td>
<td>25.96</td>
<td>28.78</td>
<td>26.66</td>
</tr>
<tr>
<td>Salts</td>
<td>1.32</td>
<td>1.54</td>
<td>1.38</td>
</tr>
</tbody>
</table>

Prof. Leeds says “The most striking peculiarity in woman's milk is not the constancy but the great variability in its composition.”
Again Wankelyn says with regard to cow's milk
chemists all arrive at nearly uniform
conclusions, but much is not the case with human
milk, and especially with reference to the Casein
Sugar, there is the widest divergence of opinion,
as may be seen by the following table

<table>
<thead>
<tr>
<th></th>
<th>Vernors and Besson</th>
<th>Simon</th>
<th>Henry and Chevalier</th>
<th>Ostein &amp; Wood</th>
<th>Haider</th>
<th>D. Heider</th>
<th>Draper</th>
<th>Cleman</th>
<th>Joly</th>
<th>Prissp</th>
<th>Payen</th>
<th>Brotzmann</th>
<th>Regnaulti</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casein</td>
<td>3.94</td>
<td>3.43</td>
<td>1.52</td>
<td>7.005</td>
<td>3.1</td>
<td>1.80</td>
<td>0.85</td>
<td>3.535</td>
<td>3.535</td>
<td>1046</td>
<td>0.215</td>
<td>1.05</td>
<td>3.9%</td>
</tr>
<tr>
<td>Sugar</td>
<td>4.364</td>
<td>4.82</td>
<td>6.50</td>
<td>1.921</td>
<td>4.13</td>
<td>7.80</td>
<td>7.31</td>
<td>4.188</td>
<td>4.624</td>
<td>7.047</td>
<td>8.805</td>
<td>3.71</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

The estimates Haider, d’Heritier, Dorez & Cleman are taken from a
table in the Physiologische Chemie of Borup. Berens, those of Vernors
Besson, Payen & Regnaulti from the Traité de Chimie Pathologique
par Besson et Rodier, and the others from the original sources.
There are many important points of difference in the composition of human and cows' milk, and we must have a precise knowledge of these before it is possible to construct from the latter, a food whose proximate principles are in the same relative proportions as they are found in human milk.

<table>
<thead>
<tr>
<th></th>
<th>Human Milk</th>
<th>Water</th>
<th>Solids</th>
<th>Sugar</th>
<th>Casein</th>
<th>Butter</th>
<th>Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Milk</td>
<td>1032.67</td>
<td>887.08</td>
<td>110.92</td>
<td>43.64</td>
<td>39.24</td>
<td>76.66</td>
<td>1.38</td>
</tr>
<tr>
<td>Cows' Milk</td>
<td>1030.38</td>
<td>864.38</td>
<td>135.94</td>
<td>38.03</td>
<td>55.15</td>
<td>36.12</td>
<td>6.64</td>
</tr>
</tbody>
</table>

By comparing this analysis it will be seen that these two milks differ in specific gravity, that cows' milk contains more solids, chiefly owing to the Casein and fat, but less sugar
than human milk. In infants there is but little muscular exertion, but the bodily heat must be preserved, hence the necessity for an excess of hydrocarbons. The ratio of flesh forms to heat-givers, in human milk is as 1 to 4.5, whilst the ratio in average cow milk is as 1 to 3.5. Human milk has an alkaline reaction, which persists for a prolonged period, according to Dr. Albert Leeds the alkalinity remained for 24 hours. This alkaline reaction is very valuable since it serves to convert the casein which coagulates in the presence of acid into small flaky particles, into soluble albumenoids, which in the course of development are indispensable to the growth of the different tissues. Cow milk is almost always acid except as it is now days when perfectly fresh
from a pasture fed animal, when it may be neutral or alkaline. It is to this acid reaction probably that the difficulty in infants digesting cows casein is due, for it coagulates under the influence of the gastric juice into large hard dense masses. Biedal found that "cow casein treated with alkali is in many respects much more like human casein than the original cow casein, yet it always shows unmistakable differences." The casein coagulum of acid cows milk is much denser and larger than that of the same milk treated with an alkali. Dehnman says "I believe the jelly like coagulum of women's milk is more dependent on the alkaline state of the fluid, than on any peculiarity in the casein, at all events I have found that women's milk when acid
yields a much thicker coagulum than when alkaline.

The main difference in human and cow milk lies in the digestibility of the Casein. Biedert says the pure Casein of human milk is in both its physical and chemical nature different from that of cow milk. This is seen from their respective behaviour with gastric juice. The Casein of human milk is coagulated by gastric juice but an excess of the same dissolves the coagulum, an excess of gastric juice has no such effect upon the coagulum of Casein from cow milk.

There is an important negative property of milk which requires mentioning, namely that it does not contain any Starch. Starch must be converted into glucose by the action of the digestive enzymes.
before it is rendered capable of absorption, and in the infant, the function of the salivary, buccal, and pancreatic glands, has not been established for some months after birth. According to Bideri, salivary makes its appearance with the cutting of the first tooth. Stahn says the secretion of the salivary and pancreatic juices is not fully established till the fourth month, and Morovini of St. Petersburg says that the great organ of Starch conversion the pancreas, matures its function at a later period than the salivary glands, for while the latter has a facilitative action at birth the former is absolutely functionless in this direction till the second month of infant life. From this it may be inferred that famineous
food, is unsuitable for infants and the use of
the various amyloaceous diets so largely
employed by ignorant nurses ought to be
abandoned. Of course was necessary
to the proper development of infants human
milk would not be wanting in it.
But there is another point about starchy
foods which shows their unsuitability for
infants, namely, that they do not contain
the nitrogenous and hydro-carbon elements
in the proper ratio, for as we have seen in
human milk this ratio is 1.34 whilst in
mannose for instance it is 1.6 to. No
doubt crust of bread, biscuits, some of the
starchy prepared infant foods, are preferable
to anything as the process of baking pro-duce a considerable amount of desinate.
This being more soluble and easily digested, proprietary foods such as weet-bix or Bidis contain about 70 per cent of starch.

There appears to be some foundation for the belief that the buccal and intestinal juices have a feasible power in digesting starch even at birth, and this may account for the fact that some infants appear to thrive on starchy foods.

The chief evils resulting from the indigestion of starch are lactic acid fermentation, and irritation of the gastro-intestinal mucous membrane, leading to colic, and a hyper secretion of mucus.

The Colostrum or milk first secreted differs from that subsequently secreted, by being incoagulable by heat, having a higher specific
gravity, by containing a large quantity of albumen and salts every little sugar.

In order then to produce from cows' milk an imitation of human milk, it must be diluted in the proportion of two parts of water or barley water to one of cows' milk; barley water is especially useful, on account of its mechanical effect in causing deposition of the particles of casein, to this add a small quantity of soda bicarbonate, to render its reaction slightly alkaline, a pinch of chloride of sodium for this is one of the principal elements of the acid of the gastric juice. The influence of the mineral constituents in nutrition appears to be too little considered in the artificial feeding of infants. It is also necessary to add...
some corn sugar or better sugar of milk, and as the mixture is slightly deficient in fat, some cream. The milk of Jersey and Alderman cows is not the best for use it is too rich in fat. I am opposed to the use of one cow's milk, the mixture of several cows' milks is much more likely to be of uniform composition.

The food must be given at a temperature of 95° F. from a nursing bottle preferably without rubber tubing for as Jacobi has shown the act of sucking stimulates the digestive glands to more thorough action, causes a more intimate admixture of the food with the buccal secretion.

While it is impossible for a woman to nurse her child entirely, she can generally
supply nourishment in part, the deficiency being made up by hand feeding. It is a totally erroneous popular idea, that breast and bottle feeding should not be alternated or combined.

Quantities of food required. Total in 24 hrs.
1st month. 3 xiv to 3 xvi
2 1/3-- 3 xiv
4 1/3 12-- 3 xxx to 3 xl (Star)

Diet during 1st month and to end of 6 1/2 week
Milk 3 1/2 Sugar of milk 3 xxv
Water 3 1/2 Soda Bicarb. 3 1/2
2 1/2 given every two hours
If Casein appears in the motions substitute barley water for the water. If the bowels are
balanced give three units züü instead of the soda & if confined giveamines fluid magnesia.

Diet from 6th week till 3rd month
Milk züü Susan of milk zr xxx
Water züü Cream züü
Chloride of iodine zr z
To be given every three hours except at night when five hours may elapse.

Diet for 3rd month
Milk züü Susan of milk zr
Water züü Cream z³
Chloride of iodine zr z

Diet for 4th, 5th, 16th months
Milk züü Cream z³
Water zr Susan of milk zr
Chloride of iodine zr z
It is well at the 6th month to begin giving real tea about 3 oz in 24 hours, with some well
soaked stale bread. The increased development
leading to the eruption of the teeth, calls for
increased nourishment.

At 6 months also, one teaspoonful of one of
the milked foods, may be added to each
bottle of milk, unless its laxative action
on the bowels should be too much, when
it might be given twice daily.

Dr. Arthur Phelps recommends the following
mixture for infants from birth:

Two tablespoonfuls of cream
One tablespoonful of milk
Two tablespoonfuls of lime water
Three tablespoonfuls of sugar water.

The sugar water is made by dissolving 17% sugar.
Pour sugar of milk, in a pint of water. As the infant grows older, the quantity of the mixture should be increased, but the proportion are to remain the same until the child is 6 or 9 months old.

The bringing up by hand of robust children the offspring of healthy parents and under good conditions as to air, light, and surroundings gives excellent results; it is the rearing of delicate children born of unhealthy parents, and surrounded by bad hygienic conditions that difficulties are encountered. No food has ever been made that will agree with all children. It is impossible to feed all infants by the same rules for often an apparently inferior food succeeds.
Where the breast constitutes our fails, this artificial feeding sometimes succeeds where maternal nursing has produced nothing but pain, sickness, and emaciation, notwithstanding that the utmost attention has been paid by the mother, as to her habits, diet, etc. Enslaved Smith has shown in the Brit. Med. Jour. June 1881 that it is not with the digestion of the Casein of cows milk only that difficulty arises, he says human milk occasionally disappears and the fault no doubt most generally lies with the infant's digestive organs, a fact the colostrum being set up, but occasionally it is only to improper diet on the mother part, as from indulging in too rich food, leading to an alteration in the composition of the milk.
Where milk is found to disagree, the casein passing undigested into the motion, I am in the habit of giving a mixture composed of the white of an egg, sugar of milk and barley water, sometimes with the addition of a little cream, and have found it answer very well.

Condensed milk is frequently found irritable in the diet of infants. It is especially useful during hot weather, when it is found difficult to prevent cows milk undergoing fermentation and also on account of its being of an uniform strength and quality, but as a routine diet I am opposed to its use, for by dilution the infant is deprived of its proper quantity of casein and fat.
elements, and if it is diluted only sufficient to bring these solids into the proportion it contains far too much sugar to be wholesome food. It is deficient in flesh-forming materials as may be seen by the following table.

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Condensed</th>
<th>With seven parts of water</th>
<th>With fourteen parts of water</th>
<th>Mean</th>
<th>Human milk</th>
<th>Cow's milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casein</td>
<td>8.79</td>
<td>1.10</td>
<td>0.58</td>
<td>0.88</td>
<td>2.07</td>
<td>4.56</td>
</tr>
<tr>
<td>Milk Sugar</td>
<td>54.29</td>
<td>6.77</td>
<td>3.62</td>
<td>5.19</td>
<td>5.00</td>
<td>4.30</td>
</tr>
<tr>
<td>Fat</td>
<td>10.45</td>
<td>1.38</td>
<td>0.70</td>
<td>1.00</td>
<td>3.50</td>
<td>3.57</td>
</tr>
<tr>
<td>Salts</td>
<td>1.75</td>
<td>0.22</td>
<td>0.12</td>
<td>0.17</td>
<td>0.20</td>
<td>0.65</td>
</tr>
</tbody>
</table>

The above table is prepared from analyses of Dr. Kötzsch's Condensed milk with dilutions, analyses of human and cow's milk are introduced for comparison.
Probably the best dilution of condensed milk for the first month, is one teaspoonful of milk to eight or ten of water, or barley water, and add two teaspoonfuls of cream. No doubt in many cases where its use has proved unsatisfactory the fault lies in preparing the food by done too strongly by diluting too largely diluted.

Children fed on condensed milk frequently have a puffy appearance, the sugar producing a deposit of fat, and delude their parents into the belief that they are robust taking, but many observers have noticed that their bones are apt to become rickety, eruptions most frequently occurring are affect the skin and when affected with a severe illness they succumb easily. Condensed milk is especially unsuitable
If there is any tendency to diarrhoea, owing to the large quantity of cane sugar it contains viz. from 38 to 40 per cent., the sugar sets up acid fermentation and promotes diarrhoea. According to Otto Kehlma 9 C. S. the proportion of nitrogenous matter to carbonaceous in human milk is 15.4.3 whilst in condensed milk it is only 15.7.1 which is far too small a proportion of flesh forming materials to serve as a substitute for mother milk.

W. J. Riew in a Lecture delivered at the International Health Exhibition says "he entirely failed to see how condensed milk could form a more wholesome diet for infants, than the fresh article. He could no more believe this than that the adult could thrive better on canned American meat than on a fresh sinewin".
The conclusion I have arrived at is that condensed milk containing sugar, diluted with water according to the age of the infant and cream added may be used to form a part of the daily nourishment of an infant, but it is only partially nutritious and it would be inadvisable to use it alone.

Numerous proprietary infants' food have from time to time been presented to the public, and each has been vaunted under the title of a perfect substitute for mother's milk, but until comparatively recently these all contained starch which as I have endeavored to show is an unsuitable food for infants under four months. In 1845 Milche read a paper before the French Academy suggesting the employment
I shall to combat the starch in farmacous foods into dextrose and glucose, and in 1860 Baron Dicke, the famed chemist, introduced it into practice. He showed that the artificial digestion of infant foods was possible, so as in great measure to relieve their tender digestive functions. His formula consisted of milk, wheat flour, malt, bicarbonate of potash, and water. The example set by him has been followed successfully by Mellin, Horlick, Hardy's, More Yealman, and others do that the market now contains many good foods, which are nutritious and easily assimilated. All these foods are milled, the starch being converted into glucose and dextrose. This getting rid of one great source of fermentation and irritation to the infants in the intestinal canal, but they must...
not be used to the exclusion or diminution of cow's milk, but only in small quantities and added to fresh milk, in order to assist in the digestion of the casein by causing "alteration of the curd". They must never be considered substitutes for milk.

A very good malted food may be prepared for an infant of six months old in the following way: Take four teaspoonfuls of barley flour and add it to one pint of water, boil ten minutes with constant stirring, cool to blood heat, then add half a teaspoonful of malt as prepared by Repton or the Maltine Manufacturing Company; it immediately becomes thin from the conversion of the starch into a more digestible form, possibly also a slight
Conversion into glucose is difficult. It ought now to be mixed with milk in equal proportions. For an infant of three months half the quantity is sufficient. Dr. Haver of Boston says the best foods for infants where the hygienic surroundings are good are the malted foods or barley milk, barley starch is readily transformed into sugar, indeed there is some ground for believing that the barley grain itself contains the necessary diastase to make it so.

Some years ago Dr. Frankland the chemist devised a method of preparing artificial human milk for one of his own children. I have occasionally employed it and found it to answer well when an alternative food was required. It is prepared now by...
the Aylesbury Dairy Company from his formula, which is as follows: "Let \( \frac{1}{3} \) of a pint of new cow milk stand 12 hours, then remove the cream, and add it to \( \frac{1}{3} \) of a pint of new milk as fresh from the cow as possible. So that \( \frac{1}{3} \) of a pint of the or skim milk left after taking away the cream, add a piece of (or essence of) rennet about one square inch in size which after it has served its purpose can be taken out and used daily for a month or two, and allow the vessel holding the skim milk to be placed in warm water, then remain for from 5 to 15 minutes until curdling is effected. Break up the curd repeatedly and carefully, separate the whole of the whey which should then be heated rapidly to boiling in a small tin pan, placed over a spirit lamp or gas lamp
During this heating a further quantity of casein separates too obtaining after this through six
muslin is then required. Now dissolve 110 grains of powdered sugar of milk in the hot water
brine it with the 4/5 of a pint of new milk as before prepared with extra cream. This
yields 1 oz. one pint of artificially humanised milk which should be used within 12 hours
composition is absolutely identical with that of human milk, and under its use the risks
of its advantages of bottle feeding of infants are reduced to a minimum." I look upon it as
immeasurably superior to cow's milk than which it is much cheaper by this valuable preparation
was more generally known.
illness in the case of children who cannot be brought up at the breast would be avoided."

Of the various methods of preparing cow's milk for infant feeding that suggested by Prof. Pfaffner of Wiesbaden and introduced to the notice of the profession in this country by Dr. Robert of Manchester in 1879 namely the peptonized, seems the form which is most easily assimilated. This is a process of fermentation, by means of which the casein is converted into a soluble peptone, and instead of coagulating upon the addition of an acid into caseinous curds, it assumes the form of small soft feathery flakes, which are easily broken down and closely resemble human milk. Pfaffner pointed out that when peptonized milk is used "the face
showed absolutely no trace of white cheese.

Milk cannot be completely peptonized without
rendering it unfit for human food, whereas if
it is only fractionally done so as to convert
3/4 or 4/5 of its casein into peptone it will not
materially diminish its agreeable qualities as
an article of food. Dr. Ross gives the
following formula: "To half a pint of cold milk
in a covered jug add half a pint of well boiled
and boiling gruel, this gives a temperature of
170° to 180°. To this add a dessert spoonful of
the liquor pancreatica, and a dessert spoonful
of a saturated solution of bicarbonate of soda
(which contains about 10 grains). Put under a
cozy shelter to boiling at the expiration of one
hour. By this means the trypsin of the
pancreatic extract acts on the casein of the milk.
and on the gluten contained in the gruel
the diacase of the extract also acts on the Starch
of the gruel, converts it into sugar. This
method gives a preparation similar in design
to bibrip's food for infants but by this means
the proteids as well as the Amylaceae are
subjected to digestion.

The chief objection to this preparation is that
unless great care is taken it is apt to have a
bitter taste from the peptonizing process having
been carried too far. To prevent this, when
the fluid has acquired a highly yellowish
gray colour, it shows that digestion has
progressed far enough and the bottle must be
immediately placed in ice or into a vessel of
boiling water long enough to scald its contents
for it has been proved that cold a great-
heat will stop the digestive action. Putting on ice is the preferable method for cooling as chilling destroys the ferment whilst yeast-lead renders it only inactive but does not destroy it, so that the ferment will continue to act when swallowed. During its preparation it is well frequently to taste the milk and the moment the slightest bitter taste is noticed to stop the digestion. Fairchild has introduced peptonising powders each containing 5 grains of Bile-extractum Pancreaticum + 15 grains of Bicarbonate of Soda; one of these is dissolved in 1/4 of a pint of water and added to a pint of milk. Let it stand for 20 minutes. When the digestion ought to be stopped they can very convenient in the feeding of infants if mothers are easily instructed how to use them.
During the first three months each meal should consist of peptonised milk, 3 fl. oz. (81 g.),
water, 3 fl. oz. (81 g.), sugar of milk, 6 g.
In this it is sometimes advantageous to add
cream, 3 fl. oz. (81 g.).

Probably during the first four weeks half these quantities will suffice. As normal
calibration proceeds the proportion of casein increases,
so the water added requires to be lessened gradually, and the milk to be increased. Milk
thus prepared quickly spoils, so that it is
wise to peptonise small quantities frequently.
Peptonised milk seems to be one of the best-
substitutes for human milk as it contains the
peptoid in an easily assimilated soluble form
while it still contains all the nutritive ingredients.
An examination of the faces is very essential in the rearing of infants but especially so when they are hand fed. During the early months of life frequent evacuation ought not to be more than two or three times in 24 hours; no doubt this is rarely attained. But healthy nutrition to be sufficient and satisfactory ought not to require a more frequent evacuation of excrementitious material. A healthy breast-fed infant's skin colour is a uniform light yellow, free from freckles and generally from matted out particles of casein, and these are the conditions we ought to seek for in artificial feeding. There ought not be any blood, slime or mucus, present in the motions and not any pain or straining during their evacuation.
Where the motions are clay coloured brownish or of a green spinach like appearance, indigestion is present, the brownish motions are usually very watery and are due to intestinal putridation haemorrhage; the green colour is produced by the action of the acid motions on the biliverdin, the acid being caused by fermentation. In most cases of indigestion the motions are extremely acid setting up irritation about the buttocks. At times the casein of the milk is passed totally undigested causing the motions to be very copious and offensive.

The increase of weight of the infant is a pretty sure indication of the developmental process, hence it is a good plan to weigh the infant every
week to see whether it is gaining or losing flesh. An infant ought to increase 3 oz or 4 oz. every week. I have for the last few years persuaded some intelligent mothers, to weight their infants regularly and to record the results in "Gallow's Life History Albums" and I have found this the average gain. The increase in weight is under some circumstances liable to be fallacious as for instance, infants fed exclusively on condensed milk or closely packed foods are often very fat, and there is a great weight of evidence to show that they are very prone to become afflicted with rickets and scurvy.

I will conclude this thesis by alluding to
Certain important points, which ought to be strictly adhered to, in order that the dangers resulting from the artificial feeding of infants may be avoided, and the most successful results obtained.

1. The best bottle is the old fashioned boat-shaped pattern, with rubber nipple stopper, one great advantage about this bottle is that it requires the infant to be held in the arms whilst feeding, by this means the infant is kept warm and irregularities in sucking are obviated. If tubes are used the joints ought to be of earthenware. Strict attention must be paid to the cleanliness of the bottle, tubes, nipple &c. At least three bottles are required, after using each bottle must be
Thoroughly washed & scalded, the tubs & nipple cleansed with a brush, then they ought to be placed in a basin of cold water, in which common washing soda or bicarbonate of soda has been dissolved, in which they are to lie till required for use, when they are taken out & well rinsed in cold spring water, so that all trace of the soda is removed.

2. The ingredients must be carefully mixed the milk, water, sugar of milk, and alkali in the proper proportions. The milk must be fresh, fresh milk is an excellent antiseptic, it must be unadulterated and ought to be tested with Citrus paper, as a guide to the quantity of soda or time water to be added. All milk especially in summer ought to
be boiled, Reichmann found that the digestion of boiled milk is more rapidly accomplished than that of unboiled milk. (Medical Chronicle June 1886). The water might also be boiled to sterilize it. The addition of the alkaline is most important, it prevents fermentative changes, it neutralizes the acid of the intestines, it renders the coagulation of the Casein less dense and it stimulates the secretion of the gastric juice.

3. The child must be prevented from sucking too fast, from taking too large a quantity at a feed. It must not be fed too frequently. Artificially fed children ought not to be fed as often as breast-reared infants, probably every third hour is often enough, the food requires a longer time for digestion than
human milk. When the infant is done feeding what remains in the bottle ought to be thrown away. After the baby has been fed place it upon its right side or back and let it be kept perfectly quiet, if placed upon its left side the weight of its head pressing upon its full stomach is liable to cause vomiting. Solid food must be strictly prohibited.

The feeding of cows might not be considered proper to be introduced into this paper but I have often fancied I have traced arrangements in the digestive functions of infants to this cause. I am therefore of opinion that cows kept for nursery purposes ought to be fed on any fodder
Clover, Roots, and green food, alter the qualities of the milk and render it variable, some brewers grains are much used by some dairymen, the result being that the milk is more albuminous and therefore more prone to undergo putrefactive changes. The cows ought to be prevented eating poisonous weeds and drinking poisonous stagnant water, a plentiful supply of good clean water ought to be allowed.

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