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THE CALCULATION AND PRESCRIBING OF INFANTS' FEEDS

I. AFTER THE NEONATAL PERIOD: THE USE OF STANDARD MIXTURES

BY

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The evacuation of babies from cities results in infants on all sorts of feeds arriving in country towns and villages or outlying hospitals, and among the many causes of the drift back to evacuation areas of mothers and babies is difficulty in obtaining help with problems in infant feeding. When so many doctors and nurses whose previous experience has been in other fields of medicine are being called upon to deal with infants in overcrowded clinics, it is hoped that a paper such as this may be of service to some practitioners who have to give instruction in a subject with which they are not thoroughly familiar.

Far the commonest of the gross errors in infant feeding are quantitative; these often arise from difficulties in calculating the calorie value of individual feeds, from failure to estimate the whole twenty-four-hour intake, and from errors in measuring. The object of this paper is to suggest how some of the common problems in infant feeding may be met, and labour minimized, by making up all infant feeds in dilutions to provide 20 calories per fluid ounce—the calorie value of breast milk. Breast-feeding is, of course, to be preferred to artificial feeding, but the management of breast-feeding is not here considered.

Instruction of Nurses in Calorie Requirements

It is necessary for all nurses concerned with infant feeding to know something of calorie values and of how to calculate a baby's approximate quantitative needs, and this they will quickly learn to do if put on the right track. It is helpful to provide nurses with some tabulated information, to be hung up in the ward kitchen, day nursery, or infant consultation room, as the case may be. Tables are here given with this end in view; they can be considerably shortened by those doctors proposing to use only a few foodstuffs for infants.

Table I shows the calorie value in round figures of some of the foodstuffs commonly used for infants in this country. The figures are approximate only, as shown by the following examples: (a) The average calorie value per ounce of human milk or cows' milk is probably nearer 19 than 20, but to simplify calculations 20 is generally used for practical work. (b) The solids in dairy milk amount to approximately 12½%, and to reconstitute milk on this basis 56 grains of milk powder are required with enough water to make 1 fl. oz. of mixture. However, in this table round figures are again inserted, and 60 grains or 1 drachm (troy) of milk powder is given the calorie value of 20. (If, in fact, 19 is the average calorie value of 1 fl. oz. of dairy milk or of 56 grains of powder, then the calorie value of 60 grains of powder would be 20.4. Thus on this basis the approximate figure 20 given in the table is correct to the nearest whole number.) (c) The average caloric value of 1 fl. oz. of sweetened

condensed milk is very variable, but is over 100 calories; however, for practical purposes the round figure of 100 is near enough. (d) One must remember that domestic measures used for the measurement of feeds are subject

TABLE I.—Calorie Values (approximate) of Foodstuffs for Infants

Foodstuff	Calorie Value
Human milk	20 calories per fl. oz., ¹ 400 calories per pint
Cows' milk	20 ¹ 400
Dried milk:	
Full-cream milk	20 calories per drachm (troy) or per level measure ²
Half-cream milk, unsweetened	16 ²
Half-cream milk, sweetened	16 ²
Skimmed milk	13 ²
Protein milk	Usually about the same as full-cream dried milk
"Humanized" milk	 ²
Condensed milk:	
Sweetened	100 calories (or more) per fl. oz.—say, 20 calories approximately per level teaspoonful ³
Unsweetened	60 calories (very variable) per fl. oz.—say, 12 calories approximately per level teaspoonful ³
Dried whey	12 calories per drachm (troy) (very variable)
Sugar	15 calories per drachm (troy)
Castor or granulated	15 calories per level teaspoonful ³
Fats and oils	35 calories per drachm (troy) 50 calories approximately per level teaspoonful ³
Cereals	12 calories per drachm (troy)
Benger's	60 calories per drachm (troy) 30 calories approximately per level dessertspoonful ⁴

¹ For measuring fluid milk or water when no proper graduated measure is available, use the baby's bottle. Do not use tablespoons.

² For measuring dried milk the measure supplied for that particular milk powder by the makers should always be used.

³ For measuring condensed milk (when no graduated measure is available) or for measuring castor and granulated sugar, use a large domestic teaspoon holding just over 1½ drachms (1.6 fl. dr.) by volume.

⁴ For measuring Benger's food, use a dessertspoon, holding 1/2 fl. oz. by volume.

also to a considerable margin of error. The use of domestic measures is further considered in a later section.

Table II gives some simple instructions to nurses for calculating calorie requirements. In essentials it amounts to starting a baby newly under observation on the calorie equivalent of 1½ to 2 oz. of breast milk per pound of body weight per day, and increasing to 2½ oz. or more according to the baby's appetite and progress. Scales of approximate calorie requirements are essential in infant feeding, but naturally any scale must be used with due regard to the individual baby. For the normal baby, appetite and rate of gain in weight form very good criteria of whether or not he is receiving about the right quantity of food, and mothers should be instructed not to press infants to take more than they want. No directions are given in the table concerning the quantitative requirements of the newborn, as this is a subject which cannot profitably be dealt with in a few sentences; it is considered in Part II of this paper.

TABLE II.—Calorie Requirements per Pound Body Weight in 24 Hours

Babies of normal weight:
1 week to 5 months old: 50 calories (2½ oz. breast milk or "standard mixture") per lb. body weight.
5 months to 7 months old: about 50 calories, decreasing to, say, 45 calories per lb. body weight.

Thin babies and premature babies:
These require more—say, 55 to 65 calories (2½ to 3½ oz. breast milk) per lb. body weight, if they can digest it. Premature babies may temporarily need still more, but should always be started on small feeds.

Fat babies:
These require rather less per lb. body weight than babies of normal weight.

Newborn babies:
The figures given above do not apply to newborn babies, whose food intake in the first days of life is small and increases gradually.

Example of calculation of feed:
A baby weighing 10 lb. is to be given 50 calories per lb. body weight in 24 hours, or 10×50—i.e., 500—calories in the day. If this is made up in the strength of 20 calories per fl. oz. he will require 500÷20—i.e., 25—oz. per day, or five feeds of 5 oz. each, or six feeds of about 4 oz. each.

It is usually wise to start a baby newly under observation on perhaps two-thirds of his full requirement, and work up to the full amount gradually by the end of two or three days if he is taking satisfactorily: sudden large increases in the calorie intake are always risky.

Normal rate of gain:
Babies making satisfactory progress should gain as follows: Under 5 months old, about 6 oz. weekly; 5 to 12 months old, about 4 oz. weekly.

Advantage of Standardizing the Calorie Concentration of Feeds at 20 Calories per Fluid Ounce

If large numbers of babies have to be dealt with the difficulties of supervising feeds are for most of us insuperable without some standardization. By consistently using standard mixtures or solutions, each providing, like breast milk, approximately 20 calories to the fluid ounce, the whole problem can be enormously simplified and labour reduced.

Table III shows the quantities of various foodstuffs, with water, required to provide approximately 20 calories per

TABLE III.—Standard Mixtures and Solutions containing approximately 20 Calories per Fluid Ounce

Dried milk, full-cream ¹	1 dr. (troy) or 1 level measure	
With water to	1 fl. oz. (measured with graduated measure or feeding bottle)	
Dried full-cream lactic acid milk ¹	Ditto	
Dried protein milk ¹	Ditto	
Dried humanized milk ¹	Ditto	
Dried milk, half-cream ¹	1½ dr. (troy) or 1½ level measures	
With water to	1 fl. oz. (as above)	
Condensed milk, sweetened ² 4	1 fl. oz. } or { 1 level teaspoonful	
With water to	5 fl. oz. } or { 1 fl. oz.	
Condensed milk, unsweetened ²	1 fl. oz. } or { 1½ level teaspoonfuls	
With water to	3 fl. oz. } or { 1 fl. oz.	
Sugar, cane ²	1½ level teaspoonfuls	
With water to	1 fl. oz.	
Sugar, lactose ²	2 level teaspoonfuls	
With water to	1 fl. oz.	
Cows' milk	10 fl. oz.	
Sugar (cane) ²	8 level teaspoonfuls	
33% fat emulsion	1 fl. oz.	
With water to	20 fl. oz.	

¹ Roller-process-dried milk should be freshly mixed for each feed. Ladle the milk into the makers' measure and level it off without compressing it. Never measure it with a teaspoon. Half-cream unsweetened dried milk and the so-called half-cream milk powder to which lactose has been added by the makers are of about the same calorie value, and 1½ level measures in a fl. oz. provides about 20 calories per fl. oz.

² The teaspoon used for measuring sugar should hold just over 1½ fl. dr.—the same-sized spoon will serve for condensed milk if no suitable graduated measure is available.

³ A 1-lb. packet of full-cream milk powder per week provides daily about 17 measures, or 17 fl. oz. of reconstituted milk. A 20-oz. (avoird.) tin of milk powder per week provides daily about 20 measures, or 20 fl. oz. of reconstituted milk.

⁴ A tin of sweetened condensed milk holding approximately 1½ pint provides about 2½ pints of standard 1-in-5 mixture.

fluid ounce—the so-called "standard" mixtures of this paper. When feeds have to be made up for a number of babies in a ward they can conveniently be ordered as "standard" mixtures or solutions (see Table IV, last column). Sugar solutions can be mixed once daily and measured out as required for each feed in the day. Dried milk or condensed milk can be mixed at feeding times in one bowl for several babies, and from the "standard" mixture so prepared the necessary volume measured for each infant. On the other hand, if directions are given to the mother the use of the term "standard" mixture is

merely confusing to her: she should be told to make up each feed as it is required by her baby, and to give such and such an amount of each constituent, with water to the required number of ounces (as shown in Table IV, third column).

If all the feeds ordered provide 20 calories per fluid ounce the calorie intake for the day is easily estimated, and if the feed is altered from full-cream dried milk to half-cream dried milk or sweetened condensed milk no intricate arithmetic is involved, as this simply means the exchange of one "standard" mixture for another, ounce for ounce (see Table IV). Without some such basis a

TABLE IV.—Examples of Feeds containing approximately 20 Calories per Fluid Ounce

Volume of Feed	Foodstuff	Quantity	As Standard Mixtures or Solution
			fl. oz.
2 fl. oz.	Full-cream dried milk	1 level measure	1
	Sugar	1½ level teaspoonfuls	1
	Water to	2 fl. oz.	
	Full-cream dried milk	1½ level measures	1½
	Sugar	1 level teaspoonful	½
	Water to	2 fl. oz.	
	Half-cream dried milk	1½ level measures	1
	Sugar	1½ level teaspoonfuls	1
	Water to	2 fl. oz.	
	Half-cream dried milk, sweetened	2½ level measures	2
	Water to	2 fl. oz.	
	Dairy milk	1 fl. oz.	1
3 fl. oz.	Sugar	1½ level teaspoonfuls	1
	Water to	2 fl. oz.	
	Sweetened condensed milk	2 level teaspoonfuls	2
	Water to	2 fl. oz.	
	Full-cream dried milk	2 level measures	2
	Sugar	1½ level teaspoonfuls	1
5 fl. oz.	Water to	3 fl. oz.	
	Dairy milk	2 fl. oz.	2
	Sugar	1½ level teaspoonfuls	1
	Water to	3 fl. oz.	
5 fl. oz.	Full-cream dried milk	4 level measures	4
	Sugar	1½ level teaspoonfuls	1
	Water to	5 fl. oz.	

baby's feed may be unintentionally doubled or halved in calorie value, with the ill results one would expect. Other reasons, besides simplicity, for giving food of the same calorie concentration as breast milk are that a concentrated feed may lead to overfeeding as a result of thirst, and a dilute feed may be vomited on account of its large bulk. Again, a small or feeble baby offered a dilute feed is likely to weary and to take less than he needs. It is often supposed that by diluting with water so as to provide, say, 10 calories instead of 20 calories to one fluid ounce the feed is made more easily tolerated, but this view is not supported by experience; in fact, a baby inclined to vomit is more likely to keep down the more concentrated feed if both provide the same total calorie value. When nurses have charge of a number of babies on bottle feeds a considerable reduction in labour results from standardizing feeds. Occasionally a dilute feed or a concentrated feed is indicated for some special purpose—for example, concentrated feeds are useful for some babies who vomit from habit, but this does not detract from the usefulness of "standard" mixtures for general use.

Measurement of Feeds

Errors in measuring are a constant source of difficulty. For example, fluids (dairy milk or water) are often ordered and measured in tablespoonfuls, each tablespoon being reckoned as half a fluid ounce, whereas most tablespoons actually hold three-quarters to one fluid ounce, so that this may introduce a 100% error. A dessertspoonful is nearer half an ounce than is a tablespoonful, and many London mothers call a dessertspoon a tablespoon. Naturally, proper graduated measures should be used when available.

Even the poorest mother usually possesses a feeding-bottle graduated in ounces, which, if not an accurate measure, is at least much better than a tablespoon. The method of measuring water requires to be explained to a mother. She should be told to mix the feed (dried milk and sugar, or condensed milk) with a small quantity of water, to pour it into the bottle, and add water to the required mark.

Dried milk and sugar are habitually ordered by weight (in drachms troy) and measured by volume. Since the bulk of the same weight of different milk powders varies widely, the amount of each particular milk powder should be gauged by the measure provided by the makers. The powder should be poured into the measure with a spoon and levelled off without compression. The common practice of dipping the measure into the packet and flattening it off against the side results in considerable compression, and hence in overfeeding. Heaped teaspoonfuls are hopelessly inaccurate measures for milk powder. When all care is taken there is still a large personal error; hence in hospital it is desirable that from time to time nurses should check their measurements by actual weighing of measured quantities. Mothers who have no suitable scales can check their measurement by noting how long a packet of known weight lasts. A 1-lb. packet of full-cream dried milk provides in round figures 6 pints of reconstituted milk (more exactly, 5.82 pints containing 60 grains in each fluid ounce); thus one packet a week provides about 17 fl. oz. (more exactly, 16.6 fl. oz.) of milk daily. A 20-oz. (avoir.) tin of national dried milk provides about 7 pints of reconstituted milk (or more exactly, on the same basis as above, 7.29 pints, and a tin a week 20.8 fl. oz. daily). Thus a daily intake of 20 measures of powder—i.e., 20 oz. of reconstituted milk—is equivalent to a weekly intake of about $1\frac{1}{4}$ packets of the ordinary 1-lb. size, or one tin of national dried milk size. A daily intake of 25 measures is equivalent to a weekly intake of about $1\frac{1}{2}$ packets of the smaller size, or about $1\frac{1}{4}$ tins of the larger size, and so on. If a baby is not progressing normally on a theoretically adequate feed the quantity of dried milk used in a week should always be checked.

For sugar no measure is usually provided. A large teaspoon may be used. For granulated or castor sugar the teaspoon should hold just over $1\frac{1}{2}$ fl. dr., and a teaspoon of this size should be shown to the mother or, better still, her own spoon be checked. One level teaspoonful of sugar will then be approximately 1 drachm (troy). Lactose varies in weight of a given bulk, but usually a teaspoonful (using the same large teaspoon) is considerably less than 1 drachm.

Condensed milk should, when possible, be measured with a graduated measure. A feeding-bottle is not a satisfactory measure for condensed milk on account of the relatively small volume to be measured. Both sweetened and unsweetened condensed varieties vary widely in calorie value. If the sweetened is reckoned as 100 calories per fluid ounce (an under-estimate in most cases), then 1 in 5 by volume provides a mixture with 20 calories to each fluid ounce. Hence for each fluid ounce of mixture 1.6 fl. dr. of this milk is required—i.e., say one large teaspoonful (level) with water to one fluid ounce. A teaspoonful in an ounce is often called a 1 in 8 dilution, forgetting that a teaspoonful and a drachm are far from synonymous. If the unsweetened condensed milk is reckoned as 60 calories per fluid ounce, then 1 in 3 by volume, or, say, $1\frac{1}{2}$ large teaspoonfuls (level) in 1 fl. oz., provides nearly 20 calories per fluid ounce. The calorie value supplied in condensed milk feeds is apt to be somewhat uncertain on account of the various sources of error, but nevertheless condensed milk feeds are very valuable for premature and feeble infants as well as for newborn babies for whom breast milk is not available. Sweetened

condensed milk supplied in a tin holding about half a pint and diluted 1 in 5 provides about $2\frac{1}{2}$ pints of "standard" mixture with 20 calories to each ounce, and calculation of the amount required in a week is an important check on teaspoon measures.

Type of Feeding

The use of "standard" mixtures as here advocated does not tie one down to any one type of feeding: dairy milk, dried milks, or condensed milks can be used with the desired proportions of sugar or with added fat emulsion and sugar (see Tables III and IV). Under the Government scheme for the supply of milk at a cheap rate for infants, at present milk in only two forms is available—i.e., either dairy milk at 2d. per pint or national dried milk (full-cream roller-process-dried milk) at 2d. per reconstituted pint—or free for those parents under a certain income level. It seems likely that the majority of bottle-fed babies in the country will before long be fed on fluid milk or on this powder, more especially as difficulty is already being experienced by mothers in obtaining proprietary processed milks. In common with the majority of paediatricians and infant welfare medical officers in this country I prefer dried milk to dairy milk for routine use for babies in working-class homes on account of its greater safety. Full-cream dried milk carefully used, with varying additions of sugar, will be tolerated satisfactorily by most babies of *normal digestive capacity*, at least after the first few weeks of life. But for babies of poor digestive capacity other processed milks are required if lives are not to be lost unnecessarily. Sweetened condensed milk is needed for premature or feeble infants, for babies in the neonatal period, and for other babies who readily vomit. So-called half-cream dried milk to which lactose has been added in liberal amount by the manufacturers is much used for young and feeble infants, and should usually be given without added sugar, since it already contains a liberal amount. Half-cream dried milk to which no sugar has been added by the makers and dried protein milk are desirable for the treatment of many cases of diarrhoea. Whether or not these will be available in the coming months seems uncertain.*

Vitamin D and iron are supplements which should be provided for all babies. The cheapest and most efficient method of giving these as a routine to artificially fed babies would be by using on a large scale dried milk in which both have been incorporated in adequate amount. But since an iron-fortified milk powder is not quite as easily tolerated as the same milk without added iron, it is wise to begin its administration gradually, as described below. So used, there is no difficulty in getting any baby who is not already upset or suffering from diarrhoea to tolerate it. Unfortunately dried milks fortified with vitamin D and iron are not available under the National Milk Scheme, and proprietary milks (many of which are so fortified) cost 80% to 24% more.

My usual routine when using dried milk, either full-cream or unsweetened half-cream, is to give in each feed approximately 20 calories in added sugar (i.e., 1 oz. of "standard" sugar solution, or $1\frac{1}{2}$ level teaspoonfuls of cane sugar in 1 oz. of water) and the rest of the feed in "standard" dried-milk mixture. Thus if a baby has a $2\frac{1}{2}$ -oz. feed he will have $1\frac{1}{2}$ fl. oz. of dried-milk mixture (half- or full-cream) and 1 oz. of sugar solution, or if he has a 7-oz. feed he will get 6 oz. of dried-milk mixture (full-cream) and still 1 oz. of sugar solution. Babies on small feeds thus get a much larger proportion of the feed in added sugar, the most easily digested part of the diet. More than half the total calories, however, should not be given in added sugar; hence in feeds of under 2 fl. oz. the

* Since this article was written the Ministry of Food have undertaken to issue a national half-cream dried milk (unsweetened) for infants.

amount of "standard" sugar solution will necessarily be less than 1 oz. For many tiny and feeble babies a high sugar feed, temporarily, is desirable, though it must be remembered that babies with loose stools often tolerate a high proportion of sugar badly. If a diet in which only half the calories are supplied as milk is long continued the risk of deficiency disease developing is considerable; therefore as soon as possible the proportion of milk in the feed should be increased and vitamins and iron supplements should be added. If more than 50% of the total calorie intake is given as added carbohydrate there is serious risk of carbohydrate dyspepsia, and loss of weight may be rapid, with irritating frothy fluid stools. As regards choice of sugar, lactose is more expensive than cane sugar and probably has no advantage over it. Sweetened condensed milk provides a feed in which about 40% of the total calories are in added cane sugar, and the commonly used sweetened half-cream dried milk a feed in which, say, 27% of the calories are in added lactose.

Supplementary Feeds

Mothers arriving in reception areas with their babies are likely to be tired, and many will have had a harassing time; as a result their lactation will often prove temporarily insufficient, and if the baby is hungry and cries much of the night his mother's milk will quickly fail, and he and his mother will not be welcome additions to any household. In such cases there should be no hesitation in supplementing one or more feeds each day. If the situation is explained to the mother and her co-operation sought it should often be possible gradually to diminish and cut out the artificial feeding when the mother has been able to settle down in new quarters. By finding those feeds following which the baby cries one can gain a fair idea which feeds it is necessary to supplement, and a co-operative and sensible mother should always be given latitude in adjusting the quantity to the baby's needs. When it is not possible to carry out many test feeds the baby's appetite, together with his rate of gain in weight, usually provides a good indication of the amount of bottle-feeding required.

Symptoms of Underfeeding and of Overfeeding

Underfeeding, however, very often goes unrecognized for many weeks. This is attributable to two main causes: (a) many are not familiar with the symptoms, and (b) the baby's estimated calorie intake is not compared with his calculated needs. The underfed vigorous full-term baby 4 weeks old and upwards will probably take his feeds eagerly, cry when the feed is finished, and cry before the next one is due—and of course either gain weight at a slow rate or lose in weight. If breast-fed he will suck for a few minutes and then turn away crying, so that the mother often concludes that he refuses to suck because he is in pain and that "her milk disagrees"; sometimes she volunteers that he has pain on micturition because he passes urine about the same time. The feeble or very young baby who is underfed, however, often shows no evidence of hunger, but becomes progressively more lethargic. The stools of the underfed baby may be infrequent or may be excessive in number, and typically are small and greenish brown, with excess of mucus, and sometimes looser than normal, though the quantity passed in twenty-four hours is always small; this distinguishes underfeeding stools from diarrhoea stools. Underfed babies are often brought to the doctor with a complaint of "diarrhoea"—and when in doubt one may have to treat the case as diarrhoea, with a preliminary starve, followed by a steady increase in food, on account of the risk involved in feeding a child who has enteritis. Occasionally vomiting is a symptom of underfeeding: the baby screams, and vomits apparently as a result; but, naturally, caution is necessary

in attributing vomiting to underfeeding. Sometimes underfeeding results from inability to get the milk through the teat either because the hole is too small or because the teat is blocked by a badly mixed and lumpy feed, and in such cases one must beware of a history that the baby refuses his bottle.

If overfed the vigorous baby 4 weeks old and upwards usually gets rid of some of the food he does not require by vomiting after feeds, and shows no other symptoms. If, however, he is upset by the overfeeding (a much more frequent event in the bottle-fed than in the breast-fed, and in very young babies than in older ones) he will probably show evidence of discomfort, perhaps have a distended abdomen, and, besides vomiting, he will probably pass an excessive number of rather loose stools, the quantity in the twenty-four hours being also greater than normal. If upset the baby's normal increase in weight will be disturbed, sometimes seriously.

In practice it is common to find that a baby suffering from underfeeding has been diagnosed as overfed; when in doubt, estimation of the food intake is usually the quickest way of reaching the true diagnosis. If there are no facilities for carrying out test feeds the expression and measurement of the whole of one feed may indicate the diagnosis for a breast-fed baby.

Vitamin and Mineral Supplements.—The administration of a supplementary ration of vitamin D, vitamin C, and iron is advised for all babies—breast-fed and bottle-fed. At the present time with shortages of citrus fruits and fish-liver oils instruction is required as to possible substitutes. It seems that in Germany the Government is supplying vitamin D and ascorbic acid for all infants.

Alterations in Feeds

Upsets are often caused by sudden increases in the calorie intake, by sudden changes in the character of the feeds, or by sudden administration of a full dose of iron or even sometimes of cod-liver oil. Nurses and mothers should always be warned to increase food gradually; the average full-term baby, if hungry, can have an increase of, say, 1/2 oz. per feed at a time, and seldom more than 1 oz. increase per feed in a day. Changes from dairy milk or from dried milk containing iron to dried milk without iron, from full-cream to half-cream dried milk, or from any of these to sweetened condensed milk, can safely be made suddenly (provided there is no sudden change in the calorie value or volume of the feed), because ease of digestion increases in this order. Changes in the opposite direction require to be made gradually—e.g., directions to a mother for a change from a sweetened condensed milk feed to a feed of full-cream dried milk might be given as follows, four days being taken over the changes:

Days:	1st	2nd	3rd	4th	
Sweetened condensed milk	4	3	2	1	0 level teaspoonfuls } measures } Four-hourly: } 5 feeds in } 24 hours
Full-cream dried milk	0	1	1½	2	
Sugar	0	0	½	1½	
Water to	4	4	4	4	

For in-patient work the change over can be made by substituting, half to one ounce at a time, "standard" full-cream dried milk and sugar solution, for "standard" sweetened condensed milk mixture, again taking four days over the change as follows:

Days:	1st	2nd	3rd	4th	
Sweetened condensed milk, "standard"	4	3	2	1	0 fl. oz. } 3 } 1 } Four-hourly: } 5 feeds in } 24 hours
Full-cream dried milk, "standard"	0	1	1½	2	
Sugar solution, "standard"	0	0	½	1	

Summary

Practical points in the ordering, regulation, and measurement of feeds for bottle-fed babies are discussed, and methods of minimizing the risk of quantitative errors are indicated. The employment of feeds providing 20 calories per fluid ounce for all infants, unless there is some special contraindication, is strongly urged on the ground that thereby (a) there is a much-reduced risk of quantitative mistakes for the infant, (b) feeding is greatly simplified for doctors and nurses, and (c) labour is lessened in children's wards or day nurseries.

Tables are given for the instruction of nurses in infant feeding. These can be adapted and shortened by the doctor in accordance with the type of feeding he habitually uses. It is hoped that feeding standardized to the extent here suggested may be widely adopted at the present time, for it offers a way of coping with the difficulty of ordering feeds for large numbers of babies brought into reception areas on feeds of every description.

[The concluding part of this paper—giving practical points in the regulation of feeds during the neonatal period—will appear next week.]

AETIOLOGY OF DA COSTA'S
SYNDROME*

BY

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We have seen that the symptoms and signs of Da Costa's syndrome are produced by central stimulation; that hyperventilation and hyperadrenalism, though they may be sometimes concerned with the mechanism of symptom production, are not aetiological diagnoses. There remains to be considered the real nature of the syndrome, the origin of the central stimulation. It must be emphasized that the condition is as common in civilians as in soldiers, as was known to Da Costa, and that even when it occurs in soldiers it was present before enlistment more often than not (Table XIII). This disposes of the idea that the essential

TABLE XIII.—Onset in Relation to Army Life

	Parkinson, 1916	Lewis, 1918	Hume, 1918	Barlow, 1920	Wood, 1941
No. of cases ..	40	558	1,000	382	225
New (since enlistment) ..					26.6%
Recurrent (relapse since enlistment) ..					6.6%
Lifelong ..					18.6%
Total pre-war ..	72.5%	43%	54%	51%	73.3%

cause of Da Costa's syndrome is specially related to war service or to Army life.

Most authors agree that in any patient so many things have combined to produce the syndrome that it is very difficult to pick on one. For this reason the incidence of the various aetiological factors recorded in the literature is confusing (Table XIV). It is clear, however, that trauma, high explosive, wounds, and gas poisoning are relatively unimportant. The chief factors seem to be the family history, constitutional incapacity, infection, neurosis, and undue mental or physical strain. In order to assess their significance and to search for a common basis, I have made a detailed study of the histories of 100 unselected cases. At once two things were obvious. First, severe mental or physical strain was no more important than rough conditions, discipline, the change from an individual with private rights to a number on an index card, fear of having to kill

TABLE XIV.—Incidence % of Apparent Aetiological Factors

	Da Costa, 1917	Parkinson, 1916	Lewis, 1918	Hume, 1918	Venning, 1919	Barlow, 1920	Krogh et al., 1920	Craig and White, 1934
No. of cases ..	200	40	558	1,000	7,803	382		
Constitutional ..					9-12			9
Infective ..	47.5	42.5	33 Factor 55	21.5	20-22	53	41.4	Factor 61
Neurotic ..					5-13.6	3.4	2.3	Factor 80
Severe mental or physical strain	38.5	10	11	11.3	19-36		Few	Factor 10
Trauma without injury	+			2.1				Factor 61
Exposure to high explosive				3.6			2.5	
Wounds ..	Very few			1.1		2.5		
Gas ..				1.8	1-10.6	5	Very few	
Multiple ..	Usual		56	54.3	16-27			Usual
Unknown gradual onset								

or of being killed, and the everlasting anticipation of the worst—in short, fear of and dislike for Army life. This attitude was a factor in the majority. Secondly, a psychiatric diagnosis could nearly always be made—e.g., depressive state, anxiety neurosis, hysteria, hypochondriasis, etc. I am not competent to discuss this aspect, which is being ably handled by my colleagues Dr. Aubrey Lewis and Dr. Maxwell Jones, but I shall try to describe the more obvious emotions, misinterpretations, and psychological twists which lie behind the somatic manifestations of this syndrome. It is not enough to unearth psychopathology: it is necessary to explain the incapacity for effort.

Family History

Oppenheimer and Rothschild (1918a, 1918b) found a family history of nervousness, insanity, or epilepsy in 56% of 100 unselected cases. Swan (1921) recorded undue nervousness in the parents of 51.7% of 58 cases. The incidence of these traits in the family histories of patients with recognized psychoneurosis is a little higher—e.g., 74% (Wolfsohn, 1918a, 1918b), 57.7% (Salmon, 1929), 60% (Yaskin, 1936), and 75% (Kozol, 1940). In 100 controls reported by Wolfsohn there was a family history of nervousness in 15%, but insanity and epilepsy did not occur. Table XV shows my own findings in 210

TABLE XV.—Percentage with Family History

	210 Militiamen			175 E.M.S. Patients
	50 Normal	75 Organic Heart Disease	85 Da Costa's Syndrome	
Probable organic heart disease	8	8	5	8
Probable "cardiac neurosis"	0	4	25	42
"Nerves"—heart not accused	4	4	23	19
Total with neurosis or "nerves"	4	8	48	51

militiamen and in 175 patients at the Emergency Hospital. The high incidence of nervousness and "cardiac neurosis" in the families of patients, compared with those of controls, is confirmed; of equal importance, perhaps, is the fact that the incidence of organic heart disease was the same in all groups, showing that nervousness is the important factor, not its disguise as heart disease. Either or both parents were afflicted. It was rare to find brothers or sisters with similar complaints unless these were also found in a parent. Whether the parental factor has a hereditary, congenital, or environmental influence has yet to be learned.

* The last of three Goulstonian Lectures to the Royal College of Physicians of London, 1941. The first and second lectures appeared in our two preceding issues.