Haematemesis due to acute ulcer seldom requires operative interference. Rest, medical treatment, and, if necessary, blood transfusion, has, in our experience, been sufficient to arrest the condition and recovery has followed; but with a chronic ulcer it is often otherwise. In spite of rest and blood transfusion the haemorrhages may continue with fatal result. In an increasing number of this class of patient we have been able to operate with success.

I have seen one case of syphilitic ulceration—a patient under the care of Dr. J. H. Drysdale. The patient suffered from gastric symptoms, and x-ray examination revealed the presence of a gastric ulcer. The Wassermann test was positive, and the symptoms cleared up with appropriate treatment.

In another case the diagnosis is not yet absolutely settled. In Fig. 15 a sacculus opening into the stomach close to the cardiac orifice is shown filled with barium emulsion. Inset is shown the cavity still filled with barium after the stomach had emptied. Severe haematemesis had occurred, presumably from this, and I had been asked to take in the patient. Dr. Hurst believes the condition to be ulceration in a diverticulum of the stomach. The patient was subsequently found to be suffering from phthisis—from which she is recovering, so that further opportunity for x-ray examination will probably be possible.

Five cases of gastro-jejunal ulcer have come under my care. Of these, one was the patient mentioned above, upon whom I operated after repeated severe duodenal haemorrhages extending over a month and increasing in severity. He was therefore very much debilitated when the operation was performed, and recovery was slow; whether this influenced the formation of the gastro-jejunal ulcer I am not prepared to say. Another case followed an operation which I performed for a perforated duodenal ulcer. The perforation was closed and a posterior gastro-jejunostomy made. Two years later an ulcer at the site of the stoma perforated. As far as I know these are the only two which have followed my own operations. In one other case I found strands of infected silk hanging into the lumen of the stoma from several ulcerated areas, and the whole circumference was thickened by the infection and granulation tissue surrounding the buried part of the silk. Operation for this condition is very difficult. There is always an inflammatory mass in the mesocolon surrounding the base of the ulcer. Often it is closely adherent to the colon, and separation of this is never easy. The stoma is freed from the mesocolon and the jejunum separated from the stomach; the opening in the jejunum may be closed and some variation of the Polya operation performed, or the jejunum may be divided and the operation completed as described by Sir Berkeley Moynihan.

X-ray examination with a barium meal has become a valuable procedure. Some years ago we were glad when positive evidence was obtained, but we did not expect too much from the method. If the surgeon and radiologist work together, evidence is obtained by a screen examination which is not always recorded on films or plates, and operation is now not often performed if there is no x-ray evidence of ulcer. Some patients are too ill for the examination to be made. If it is done by an unskilled radiologist the findings may be worse than useless, because inaccurate evidence is actually misleading. If ulceration is present, distortion of the outline of the viscus is sometimes seen (Figs. 1 and 2); a deposit of barium may remain in an ulcer crater (Figs. 5 and 13b). X-ray examination not only establishes the diagnosis, but also shows the position of the lesion, and knowledge is obtained of how much of the viscus appears to be normal, so that the type of operation may be considered, and perhaps definitely planned before the abdomen is opened. If a dual condition is present, as in Fig. 4 (duodenal ulcer with tuberculous glands) or Fig. 12 (gastric and duodenal ulcer), the surgeon is forewarned.

Of these skiagrams some have been reduced to a size appropriate for publication by Miss Vaughan in the Dunn Laboratories of the Professorial Units at St. Bartholomew's Hospital, and some by Kodak, Limited.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, February 10th, 1923.

A COMPARISON OF DRIED, EVAPORATED, AND FRESH COW'S MILK: AN EXPERIMENTAL STUDY.

BY

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At the present time there are many varieties of dried, evaporated, and condensed milks on the market. As it seemed possible that there might be fundamental differences between various sorts of dried and evaporated milks, a series of feeding experiments on animals have been made.

Sherman, Rowe, Allen, and Woods,¹ experimenting with rats, observed that "with bread and milk there was continued growth at a normal rate to full adult size." It seemed possible, therefore, to compare the different kinds of evaporated milk by feeding rats on each kind of milk and bread as the sole diet. According to a report of the Medical Research Council (1924) on the presence of vitamins in different varieties of milk, vitamins A and B are quite well represented, but vitamin C may be absent, or only traces present, in evaporated (condensed unsweetened) and dried milks.

Simmonds² concluded that the rat does not need the antiscorbutic factor for normal development, and that a diet of milk and bread might be expected to contain all the essential constituents of a complete diet for this animal. The experiments here described were started when the rats were just weaned (three weeks old), and were continued for twenty-two weeks, during which time several litters were born and reared. I regard it as a more searching test of the adequacy of a diet if gestation and lactation are included, and the experiment made not merely for the actual growth period. Mitchell,³ in his article on the nutritive value of proteins, pointed out that the demands of growth, gestation, and lactation are all separate problems as far as the biological value of protein is concerned, and it is highly probable that this applies equally to all food factors.

EXPERIMENTAL.

The experiments were made on the following lines:

(a) Animals and Method of Experiment.

Rats were used in these experiments. They were all bred in the laboratory⁴ and were all in equally good condition at the beginning of the experiment. Twelve animals, six males and six females, were fed on each diet. They were kept in a large cage together, so that breeding could take place as soon as the rats reached maturity. Each animal was weighed every day (except Saturday and Sunday) for the first few weeks, and after that, when growth was less rapid, only once a week. They were fed once a day. The females were removed to separate cages before the birth of the young. As far as possible, the method we adopt is to remove a doe from the large cage two or three days before the birth of the litter. She suckles her young for twenty-one days, after which she is returned to the large cage. If the young do not survive (as may happen when the diet is poor) the doe is returned to the large cage again when all her young have died. Rats have large litters, and our custom is to reduce the number of young to six on the second day, in order to prevent any undue strain on the mother rat, and to make the growth curves of the young comparable. The combined weight of even six babies towards the end of lactation may exceed that of the mother rat, but on a suitable diet she is capable of rearing her offspring without detriment to herself. From the second day onwards, the mother and her young are weighed daily; she is given ample food, all constituents of the diet being well mixed in the form of a paste.

(b) Foods.

1. White bread bought from a baker was used, no crust being given. The bread was weighed one day old.

2. *Milks.*—The fresh cow's milk used was of good quality, was delivered in a bottle, and on standing always showed a large amount of cream. It was heated to 70° C. before being given to the animals. Of dried milks a well known brand (referred to as sample A in a previous paper⁵) was chosen as being a variety largely used by the general public. The brand of evaporated, non-sweetened milk chosen was selected because it appeared to be a popular article.

3. *Proportions.*—The evaporated milk was diluted according to the directions on the tin, and the specific gravity of this reconstructed food was approximately that of fresh cow's milk. With the dried milk 12 grams of solid were mixed with 100 c.cm. of water. This is approximately the amount of solid required to imitate 100 c.cm. of whole milk. My object was to use such amounts as would be used by the general public, following the directions given on the tin. Thus, when told to measure one

tablespoonful, etc., different people select different quantities—for example, some people give a generously heaped spoonful, while others will only fill it level. To avoid this difficulty, about twenty people were asked to measure the prescribed quantity, and these amounts were weighed. The average figure obtained in this way gave 12 grams of solid per 100 c.cm. of liquid.

Actual Foods.—The proportion given was 15 grams of white bread (crumb only) to 36 c.cm. of liquid, this being the amount of liquid which is conveniently soaked up by that amount of bread; also such a diet has been used with marked success during lactation. The animals were given plenty of food, the ration being increased whenever necessary.

RESULTS.

All the animals grew well and the females produced litters at the normal time, but throughout the experiment it

Fig. 1.—Chart showing the growth curves of young rats (just weaned) fed on different diets.

was obvious that the rats fed on the evaporated milk were less fit than those fed on fresh cow's milk, or the dried milk. They were less firm to the feel and did not grow quite so rapidly; neither were their coats quite so thick. There was little to choose between the rats fed on the dried milk and the fresh cow's milk; but, if anything, those fed on the dried milk fared a little better—their coats were slightly thicker and more silky. A possible explanation may be that the milk used for the dried preparation was of better quality than the fresh supply, for Luce⁶ has pointed out that the diet of the cow appears to be the main factor in determining the growth-promoting value of the milk. On the other hand, the experiment lasted for twenty-two weeks, and as one sample of milk was not used throughout any variation in composition might be found equally in any one of the three samples used.

Growth.

Two series of experiments were made with regard to growth. The first were only continued for nine weeks, but the results were so striking that it was thought advisable to repeat them and continue them for a longer period in order to have data about gestation and lactation as well.

The composite growth curve of the male animals is shown in Fig. 1. It is impossible to give a composite growth curve for the females, owing to the rats becoming pregnant at different times.

All the rats grew well, but more rapid growth was exhibited by those which received the dried milk diet. Finally, those fed on the dried milk and those fed on cow's milk were of equal weight, while those fed on the evaporated milk did not attain to quite such a good weight. These rats received a mixed diet of bread and fresh cow's milk, supplemented by kitchen scraps.

It is not the object of this paper to show that the final weights of animals fed on bread and milk is not up to that of the control animals which were fed on a more varied diet, but to compare dried and evaporated milks with fresh cow's milk. It is, however, a point of interest to note that for the first few weeks the growth of the milk-fed rats is equal to that of the control animals receiving a good mixed diet—that is to say, for the first few weeks the rate of growth was maximal. It is also of interest that the first

Fig. 2.—Chart showing the weights of litters the mothers of which were fed on different diets.

curve to deviate from the normal standard is that of the animals fed on bread and evaporated milk.

Reproduction.

Breeding took place at the normal time, and during the experiment fifteen litters were born to animals fed on bread and fresh cow's milk, fifteen litters also to those fed on bread and dried milk, and eighteen litters to those rats which received bread and evaporated milk. The greater number of litters born amongst animals on the third diet is probably due to the fact that fewer litters survived, and therefore the does returned to the males sooner than if they had suckled their young.

Thus all three diets must be regarded as suitable for the attainment of maturity and for fertilization.

Gestation.

The average weight of the young at birth was not up to that of the stock animals. The average weight of a rat on the second day of life is 5.79 grams (figure taken from records in the laboratory). As will be seen from the accompanying table, none of the young of the experimental rats came up to this weight. It is interesting that, in this respect, the dried milk gives slightly better results (5.26 grams) than the fresh cow's milk (5.049 grams). Again, the failure to rear any babies of some litters is more marked among the mother rats fed on bread and cow's

milk and bread and evaporated milk (see table). Possibly this is due to the young being less fit, as well as of lower weight, at birth.

Lactation.

Lactation cannot be studied satisfactorily from this series of experiments. If the young are of low weight at birth, and the mother rat fails to rear them all, it is incorrect to assume that the diet is responsible. Obviously two factors are involved: the diet may be unsuitable for lactation, or the primary factor may lie in the poor condition of the young at birth—that is, a faulty diet during gestation. Since the young were all below average weight at birth, it is possible that the fault lay in the condition of the young, and not in the mother's milk supply. As will be seen from the table, some of the young were successfully reared, but not all.

To compare the three diets from the point of view of lactation, other experiments were made, as follows:

Stock does were selected and were given a good mixed diet during gestation. The milk diets were started as soon as possible after the birth of the litter; three mother rats were given each diet, and all were able to rear six young per litter. Examples of the growth curves of the young are given in Fig. 2.

It will be seen that the young whose mothers had the evaporated milk did not grow so rapidly as the others. Also, these babies were less fit—they were limp to the feel, and their coats were less good. However, they were all successfully weaned at the usual time.

Statistical Comparison of the Three Milks as Food during Lactation.

	Dried Milk (Sample A).	Fresh Cow's Milk.	Evaporated Milk (Sample G).
Average weight of one baby rat on second day	5.26 grams	5.04 grams	4.91 grams
Failures in rearing any one litter	2 failures out of 15 litters	6 failures out of 15 litters	7 failures out of 18 litters
Number of times all six young reared	6	3	4
Highest weight of one baby at 21 days	47 grams	42.75 grams	38.5 grams
Lowest weight of one baby at 21 days	30.33 grams	28.8 grams	26.0 grams

COMMENTS AND CONCLUSIONS.

From the experiments described in this paper it is obvious that dried and evaporated milks possess quite different dietetic values, and that the dried milk approximates more closely to fresh cow's milk than does the evaporated variety. Although only one sample of each kind of milk was used in this work, experiments previously reported prove that dried milks are superior to the evaporated ones as regards vitamin B content. To sum up—

1. The dried milk (Sample A)* compared with fresh cow's milk:

(a) The initial rate of growth of the young rats was more rapid, but the final weight attained was practically the same.

(b) The weight of the young on the second day was slightly better—that is, dried milk appears to be a better food for gestation.

(c) The suckling rats had thicker and silkier coats if the mothers were fed on the milk diet throughout their lives, but when the milk diet was only fed during lactation (that is, a good mixed diet given during gestation) there was no apparent difference in the sucklings.

2. The evaporated milk (Sample G)* as compared with cow's milk:

(a) The rate of growth of the young rats was less rapid and the final weight attained was less.

(b) The weight of the young at birth was less satisfactory.

(c) The weight of the young at weaning was lower. This applied equally to the baby rats of mothers fed on a good mixed diet during the gestation period, or on the milk diet throughout their lives.

Thus, the dried milk (Sample A) appeared to be quite equal in dietetic value to fresh cow's milk; if there was any advantage, it was in favour of the dried variety.

The evaporated milk (Sample G), however, compared less favourably with the fresh cow's milk.

It must be remembered, however, that a restricted diet, such as bread and any form of milk, is not as good as a mixed and more varied diet.

REFERENCES.

- ¹ *Biochem. Journ.*, 1921, 45, 503. ² *Amer. Journ. of Hygiene*, Supplement, September, 1924, p. 15. ³ *Physiological Reviews*, 1924, vol. 4, p. 424. ⁴ Hartwell, Mottram, and Mottram, *Biochem. Journ.*, 1923, 17, p. 208. ⁵ *Ibid.*, 1925, 19, p. 226. ⁶ *Ibid.*, 1924, 18, 716.

THE ETIOLOGY OF PERNICIOUS ANAEMIA.

BY

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SINCE Addison in 1849, in a paper read before the London Medical Society, described idiopathic anaemia, later called pernicious anaemia, a large number of theories have been advanced relative to its etiology. Hunter's hypothesis is that it results from oral sepsis with subsequent streptococcal infection of the stomach, and there can be no doubt that pyorrhoea is at least a contributory cause. It may account for the toxin to which the combined lateral and posterior degeneration of the cord, occurring in about half the cases, is due. The latter is a true degeneration of nerve fibres affecting both the axis cylinders and the myelin sheaths, and not a sclerosis such as occurs in disseminated sclerosis. The fact that this degenerative change in the posterior and lateral columns occurs in other wasting diseases and may antedate the anaemia or be unaccompanied by the anaemia, lends weight to James Collier's argument that the toxin affecting the cord is not necessarily the cause of the anaemia, but that the anaemia and the cord changes may be the results of a pathological process responsible for more than one toxin. Other investigators are of opinion that pernicious anaemia is due to intestinal toxæmia. Herter blames the *Bacillus welchii*, while Adami suspects the *Bacillus coli*.

Hurst¹ says that it is now generally agreed that Addison's anaemia is caused by a haemolytic toxin produced by some infection in the alimentary canal, and states his belief "that this infection cannot take place unless free hydrochloric acid is completely absent from the gastric contents." He claims that the achlorhydria is neither caused by the same toxin which produces the anaemia nor is it secondary to the anaemia, but that it is an essential predisposing factor. He quotes Ryle and Bennett² to show that 4 per cent. of healthy young men have achlorhydria. It will be interesting to see whether these men in due time develop pernicious anaemia. Hurst sums up his views as follows: "The achlorhydria allows the bacteria which produce the haemolytic toxin, and which probably have their primary focus in the mouth, to pass through the intestines without being destroyed by the HCl which ought to be present."

I have endeavoured to approach the subject of pernicious anaemia from a new standpoint. I agree that an unknown toxin is probably the cause, but can find no proof of this. Therefore I have tried to postulate a theory with a non-toxic basis. It is possible that in this disease two independent processes are at work—an abnormal blood regeneration by the bone marrow and an increased blood destruction. Which of these processes is the primary one?

The general opinion seems to be that the main factor is the toxic effect upon the bone marrow, resulting in the production of immature cells, which are unable to resist the forces of blood destruction and become disintegrated in the blood stream or destroyed by the phagocytic cells in the liver, kidneys, and other organs. The hypothesis I prefer is that the primary factor is the phagocytic action of the liver and kidneys, and that the bone marrow change is secondary, the latter being due to an increased and urgent