THE RELATION OF MEAT-EATING TO THE INCIDENCE
AND SEVERITY OF SPRUE AND THE RELATION OF SPRUE
TO DIARRHOEA IN THE UNITED KINGDOM

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SPRUE IS one of the most important diseases in the world. It probably disables thousands of adults each year, and it also occurs in children. With the recession of malaria, bowel diseases bulk bigger in tropical health. If money is available to pay for them, there are effective treatments for bacillary dysentery, amoebic dysentery, cholera, typhoid, and intestinal tuberculosis. Worm infestations were never more easily and safely treated. Sprue, however, remains the same difficult disease. The numbers are so great, and the treatment so tedious and imperfect, that the application of some general preventive principle is very desirable.

This note is written with India sprue in mind, mainly in Indian soldiers. Caribbean sprue apparently is different in some respects, and, like Indian sprue in Europeans, may be more easily treated. The response to folic acid is better. Sprue is said not to occur in Africa, but Trowell (1960) speaks of protein malnutrition in adults causing loose stools, anorexia and oedema. This may be related, as we see later.

We may provisionally define sprue as a disease manifested mainly in the small intestine, with a protracted course, little tendency to natural cure, and a strong tendency to get worse. There is intestinal malabsorption, more or less severe, with anorexia, wasting, loss of strength, anaemia, ankle oedema and glossitis. Apathy and lack of drive are notable. There is usually no fever. The disease is very disabling and may end in death. It is not solely or mainly a disease of Europeans in the tropics. It attacks Indians and Pakistanis too. It is a disease not only of adults, but also of children (Hurst, 1942; Mathew et al., 1964). It is not merely sporadic. It occurs in epidemics. Since it can be epidemic, it must be environmental, and not due to an innate abnormality of the small intestine.

The epidemic of sprue in the 14th Army during its campaigns on the Indo-Burman frontier, particularly in 1944, was specially instructive. Thousands of Indian troops (young men recently healthy, be it remembered) were evacuated to hospitals because of disabling sprue. Europeans were attacked, but in a smaller number. These events established that sprue could be epidemic, and epidemic in Indians.

Further light was thrown on the disease by the observation that the incidence was worse in troops deprived of meat. The difficulties of supply were great. British troops could be supplied with tinned beef and that was done. Indian troops, Musalman and Hindu, had to be supplied with living goats and sheep. These were killed in the unit just before being cooked and eaten. Those for Musalman use are killed by Musalmans by a method prescribed by their religion. Procurement in India, transport to the field and distribution to units of the number of live animals needed was impossible. The extra ration of milk authorised for issue to meat-eaters when the meat ration was deficient, or to non-meat-eaters regularly,
was seldom or never available. Meat protein deficiency therefore was severe and common in those willing to eat meat.

In those Hindus, who never ate meat in any case because of caste rules, the situation was worse. In normal times and in their homeland they relied on large quantities of milk and milk products, especially dahi. These were unobtainable in the field. In these troops sprue was specially severe. The writer observed an epidemic of sprue in the 3/4 Bombay Grenadiers in Imphal in 1944. Almost to a man the Jat company, who never ate meat, went to hospital with sprue. Of the Musalmans company only two got sprue. The Musalmans had received and eaten a little meat and they had always been meat eaters. The Jats, because of their caste rules, could not be treated with injections of liver extract nor with the usual high meat protein diet, and had to be evacuated to base.

Walters (1947) reported a very similar experience in another Indian infantry battalion. In this unit too, the Jats being non-meat-eaters and receiving negligible quantities of milk, were seriously affected with sprue. In contrast the Musalmans, who were meat-eaters and who had received a little meat, were minimally affected. Of the 42 worst cases, 39 were Jats and 3 Musalmans.

It will be seen that the class composition of Indian infantry battalions (the companies being recruited from different religions and castes) provided in each battalion reported above, two groups, matched in age, sex, occupation, dress, mode of life, income, and environment, and differing only in food habits. The food habits also were matched, except in meat-eating, because the Jats and Musalmans ate the same unleavened wheaten bread, ghi, vegetables, salt and spices. These troops were not rice-eaters. A further advantage of studying the cases in the 3/4 Bombay Grenadiers was that no food was available to them other than their rations, the composition of which was known. They could obtain no other food item locally.

Similar observations were made by Ayrey (1948). He calculated that an Indian artillery regiment, severely affected with sprue, had been receiving 62 grams of protein per man per day, of which 7 grams was milk protein and the rest vegetable. The unit had had three issues of meat in six months.

The experience of Taylor and Chhuttani (1945) of the contrast in health between non-meat-eating troops and meat-eaters is relevant, though it is stated mainly in terms of anaemia. At the time the troops were in a hot desert country with a low incidence of disease and hospital admission. The meat-eaters received 20 ounces a week of meat without bone. Many of the non-meat-eaters had not received milk in lieu of meat. There was a population of adult Indian males consisting of 17,000 meat-eaters and 1,888 non-meat-eaters. In 4¹⁄₂ months of study there were 50 cases of anaemia. Of the 50 cases 29 were non-meat-eaters and 21 meat-eaters, so the rate of anaemia was relatively enormous in the non-meat-eaters. In 26 of the 29 non-meat-eaters the anaemia was macrocytic, one of the 26 having sprue. In 4 of the 21 meat-eaters the anaemia was macrocytic, and all 4 had sprue. Whether we include or exclude the cases of sprue, the rate for macrocytic anaemia in the non-meat-eaters is very large, compared to the meat-eaters.

Stefanini (1948) was able to contrast the incidence of sprue in Italian prisoners of war, Indian troops and British troops in an Indian hill station, and to relate the varying incidence to the varying protein intakes. The following figures are extracted from Stefanini's paper:
This can be interpreted as showing that the high animal protein intake of the British troops went far to protect them from sprue. The Italians with less protein were less protected and were much affected by sprue. The Indians with the least animal protein of all had the worst experience of sprue in 1943. In 1944, while still bad enough, they were not so bad as the Italians.

Since then epidemics of sprue in south India in Indian civilians have been reported (Baker et al., 1962; Mathan et al., 1966; Mathan and Baker, 1968; Baker and Mathan, 1968). The Indians affected obtain their scanty protein intake almost exclusively from vegetable sources. What milk there is goes mainly to the children. Sprue occurred in women and children as well as men. These southern Indians are rice-eaters, and not eaters of wholemeal wheaten bread as the northern Indians are. If the sprue of the northern Indian soldiers described above is the same sprue as the south Indian sprue described by Baker, then we need not suppose that wheat proteins played any part in producing it.

A distinction should be made between sprue in troops who, however deficient in meat, had had enough calories, and the famine disease seen in troops (e.g., long-range penetration groups) who had also been starved of calories. The Jats of the 3/4 Bombay Grenadiers described above had had sufficient calories, mainly in the shape of whole-meal wheaten bread. They made no improvement when their calorie intake was increased by special cooking of extra issues of atta, ghi and pulses. No extra animal protein was available. Because of the sunlight, anti-rachitic synthesis in the skin was probably sufficient and tetany was not seen. Because the troops were taking 100 mg. of mepacrine daily as a malarial suppressive, it is not likely that giardiasis was responsible for the small intestine disease. No doubt, however, other parasites were commonly present.

In 1944 there was still a reluctance to diagnose sprue in Indians, and a diagnosis of “anaemia”, “diarrhoea”, “diarrhoea with glossitis”, “malnutrition” or the “marasmus syndrome” often concealed the true incidence of sprue. Although the Army commander (Slim, 1956a) recorded malabsorption in his account of the
campaign, neither sprue nor malabsorption are mentioned in the official medical history (Crew, 1966). Presumably such cases are included in “dysentery and diarrhoea.”

The part played by the deficiency of meat was sometimes obscure by the reluctance of commanders and staffs to speak openly of malnutrition in the army. The use of the word was considered bad for morale. It is true too that medical officers studying sprue in base hospitals in India could not be acquainted with the environment in which the disease was acquired, and they did not understand the meat deficiency which had occurred. However Marriott (1945), Ayrey (1947) and the army commander (Slim, 1956b) confirm that meat was deficient. Marriott considered that “the anaemia seen in Indian troops appears to be related to inadequacy of meat in the diet”. Ayrey considered the sprue was due to deficiency of “$B_2$ complex vitamins” due to dietary inadequacy. His cases did well on special issues of meat, milk, Marmite and nicotinic acid.

These impressions that normal meat-eating prevents or modifies sprue are supported by the observed value of high meat diets in the treatment of the disease. The meat diet used for many years, and advocated by Fairley (1946) has been accepted generally as significantly helpful, if not totally curative (Leishman, 1945; Woodruff, 1949; Chuttani, 1968).

There are recent observations relating protein-deficiency to small intestine disease. Tandon et al. (1968) described abnormality in the small intestine in protein deficient persons and its cure with protein repletion. Mayoral et al. (1967a) reported evidence of protein deficiency causing intestinal malabsorption. Klipstein and Baker (1970) have discussed the possible existence of “hypoproteinaemic enteropathy”. This is a perhaps unjustified extension of the hypothesis of dietary protein-deficiency enteropathy, or, as the present writer would have it, dietary meat-deficiency enteropathy. Mayoral et al. (1967b) drew attention to the close resemblance of tropical sprue (rare in Columbia they say) and chronic protein-malnutrition-induced malabsorption. They attempted to distinguish the two by the response to protein feeding alone, the presence or absence of megaloblastic marrow, and the necessity to administer folic acid, or otherwise. It is doubtful if these really are two separate groups. If one accepts that classical tropical sprue is in main part due to protein malnutrition, then one can discard the distinction.

Althausen et al. (1962) observing sprue in Puerto Rico noted the protein deficiency in their cases of sprue, and also in cases of macrocytic anaemia in females. In 86 patients with sprue the average total daily protein intake was 52 grams, of which 29 grams were “complete protein”. In females with sprue the average total daily intake of protein was 51 grams, of “complete protein” 29. In females with megaloblastic anaemia of pregnancy the total daily intake of protein was 50 grams, of which 21 grams were “complete”. Althausen et al. recognised that these cases were deficient in meat and milk intake but felt unable to blame the meat and milk deficiency alone for the disease, partly because they took a low figure (40 grams in males and 25 grams in females) as an acceptable minimum of “complete” protein, but also because sprue does occur sometimes, if relatively rarely, in people in a normal state of meat nutrition. They invoked a second factor, a hypothetical genetic tendency to sprue, and considered that the coincidence of protein deficiency and the genetic tendency might produce clinical sprue. They were
probably right that besides protein deficiency (the factor that makes the small intestine vulnerable) another factor is necessary. However the epidemic character of sprue, and its occurrence in insanitary areas, and its inability to become or remain endemic in highly sanitary areas, lead the present writer to think that the second factor is a communicable bowel infection.

Florid sprue in the United Kingdom is rare, though it is within the experience of most physicians that cases occur which cannot be distinguished from sprue (Drummond and Montgomery, 1970). That may be because meat is plentiful and cheap enough for all to have it. Sprue is said to have diminished in Hong Kong and Singapore since refrigeration became common. That may be because the retailing of meat and domestic storage are now easier, and meat more available. It is likely that the lower incidence of sprue in Europeans in the 14th Army was due to the adequate ration of acceptable canned beef.

It seems therefore that while some communicable agent, presumably an infection (though not bacillary or amoebic dysentery), initiates the small intestine disease, it is rare for the enteropathy to proceed to florid sprue in people in a normal state of meat nutrition. In such people only infrequent sporadic cases may be expected. We can prevent sprue in meat-eaters by ensuring them a daily supply of meat - say 140 grams of meat with bone. Something can be done for those who do not eat meat by supplying daily milk and milk proteins. One litre of cow's milk a day would supply 33 grams of protein. That would not be enough to give protection. The proteins of at least two litres a day would be necessary.

If we seldom see florid sprue in the United Kingdom, perhaps partly because of our meat eating, do we see the incomplete or abortive disease? Is sprue so modified by our good nutrition that it only shows as a mild subacute diarrhoea? Is our sanitation so good that the communicable agent is limited in its spread, as have been the agents of other intestinal disease? Subacute diarrhoea of unknown origin is the commonest diarrhoeal problem in Ulster and elsewhere in the United Kingdom. Not infrequently it begins when the patient is on holiday, but it can begin at home. After some non-specific treatment the acute phase passes, and the patient continues for some weeks or months to have three or four or five loose stools a day. The stools are more loose and frequent in the morning. They are of small intestine type but they are not steatorrhoeal. There is no colonic disease. Sigmoidoscopy is normal. In the more severe cases there may be a little change in the barium x-rays of the small intestine, but it is usually equivocal. Bacteriological examination is negative. *Giardia lamblia* is practically never found. Cure is usually easily obtained by administering the tablet of sulphasalazine or sulphaguanidine and the tablet of folic acid, each for 8 weeks or so. Probably this jejunoileitis of unknown origin, so familiar to us, would produce sprue if the patient were chronically meat-deficient, like the sepoys described above. All the more, if in addition he had a small intestine impaired with infections and infestations, as so many Indian villagers have.

What is true and important for adult nutrition must be even more important for the growing, developing and maturing child, and young person. If normal meat nutrition is important, not only because it supplies amino-acids for anabolism, but also because it maintains a normal small intestine (as this paper proposes), then it
is an important public health duty to see that meat is provided at a price that all can afford.

Lastly, it is difficult for the physician with Indian experience, reading accounts of kwashiorkor in Africa, to see how that disease differs from the protein-deficiency sprue of India. Sprue has traditionally been described in adults who have finished growth and maturation, kwashiorkor in young children in a fast growing phase. The disease mechanisms, nevertheless, seem to be similar.

**Summary**

It is shown that sprue occurs predominantly in persons with a dietary deficiency of meat. Regular adequate eating of meat protects against sprue or modifies the attack, because it maintains the small intestine in a state in which it resists the communicable, presumably micro-organismal, agent, infection with which is the other factor concerned in producing clinical sprue. Administration of meat is essential in the treatment of sprue for those who will take it, even if other means such as folic acid, hydroxocobalamin, iron and intestinal antibacterial drugs are also employed. Large quantities of milk and milk proteins are helpful, but not so good as meat. What is necessary in adults is even more important in childhood in the time of growing and maturation. Sprue will probably disappear as income per capita rises, more meat is eaten and sanitation improves.

**Note on Animal Proteins**

Dahi is milk, boiled, and then inoculated with a little old dahi, whereupon it thickens and sets. It has been an article of food among cattle-keeping people, probably since pastoral life began. It was in use among the Irish and appears in the older Anglo-Irish literature as bonnyclabber (Irish: bainne – milk; clabair – something thick like mud). A similar artificial product is sold nowadays as yoghurt. The word is Turkish. Lasi is dahi, diluted with water to make a drink, with sugar or salt added. Dahi and lasi are much used in northern India and West Pakistan.

Buffalo milk contains 4.3 grams of protein per cent (and 8.8 grams of fat and 5.1 grams of carbohydrate). These values are greater than those of cow's milk, but buffalo milk is often diluted before it is drunk.

The only food other than milk which can be derived from animals without killing them is blood obtained by intermittent venesecton. This is practised by African tribes. Among the Masai who are a cattle-herding people there is said to be no kwashiorkor. Blood from cattle was a resource of the pastoral Irish. The blood could be mixed with meal and cooked. The modern representative is the black pudding.

Musalmans have no objection to eating beef if it has been ritually killed, but the killing of cattle is so particularly horrifying to Hindus, that for the sake of communal peace, Musalmans confined themselves to the meat of goats and sheep. Equally pork is forbidden to Musalmans, and it was never used in the Indian army by any group. Had whale meat been available, it would have raised a difficult question for Musalmans. If a whale is an animal, it would have to be killed ritually (which is impossible). If it is a fish, that would not be necessary.

Fish, although allowed for Hindu meat-eaters and for Musalmans, is so small in quantity and so local in availability as not to count as a source of protein. Fowl
are allowed to Hindu meat-eaters, and if killed ritually to Musalmans, but for the same reasons fowl made no contribution to supply. Nor did eggs.

The word mutton is commonly used in Indian English for both sheep and goat meat. Usually only male goats and sheep are killed for meat, so as to preserve the breeding stock. It is evident that great attention should be paid to the health and nutrition of sheep, goats and cattle, if the world supply of meat and milk is to be increased.

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