

CAPTAIN COOK AND SCURVY

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'We were all hearty seamen no cold did we fear And
we have from all sickness entirely kept clear Thanks
be to the Captain he has proved so good Amongst all
the Islands to give us fresh food.'

(Song by T. Perry, from H.M.S. *Resolution*) (23).

THE first encounter with scurvy at sea for the young James Cook, then 28 years old, might have been in July 1756, when he rejoined H.M.S. *Eagle* at Plymouth. The ship was being refitted and Captain Palliser had reported to the Admiralty the terrible effects of scurvy on maintaining his ships at sea (1):

Put ashore to the hospital 130 sick men, most of which extremely ill; buried in the last month 22. The surgeon and four men died yesterday, and the surgeon's two mates are extremely ill; . . . so that we are now in a very weak condition.

A year later Cook's ship, H.M.S. *Pembroke*, with others lying at Halifax in Canada, had so many sick on board that it took no part in the military action of Wolfe against the French. Cook remained with the *Pembroke* till 1762, for the most part in the basin of Quebec, and then for a further five years surveying Newfoundland. He probably had not heard of Jacques Carrier, the first European to sail up the St Lawrence River, who wintered in 1535-36 at the site of the present city of Quebec, at Stadacona with a crew ill and dying from a strange and fatal disease, 'la grosse maladie'. Nor would he have heard of their miraculous cure, on the advice of a friendly Indian, with a decoction of the leaves and bark of the tree Annedda, the 'arbor vitae' of the natives. Human memory is short and it is therefore not surprising that 72 years later, when another French explorer wintered in these regions and many of his men fell sick with symptoms described by Carrier, the Indians did not know of a tree called Annedda, nor of Carrier's remedy (2).

The disease was obviously scurvy and one of the first full descriptions of this hitherto unknown illness is given by Carder (2):

The disease, wholly unknown to us as it was, broke out among us with amazing severity. Some lost their very substance and their legs became swollen and puffed up while the sinews contracted and turned coal-black and, in some cases, all blotched with drops of purplish blood. Then the disease would creep up to the hips, thighs and shoulders, arms and neck. And all the sick had their mouths so tainted and their gums so decayed that the flesh peeled off down to the roots of their teeth while the latter almost all fell out in turn. [Translated by J. L. Launay] (2).

The eventual cure with an extract of leaves of the 'tree of life' is particularly interesting in view of Cook's use of spruce beer as an anti-scorbuticum. The tree Annedda (Ameda, Hanneda) appears to be, according to modern researches, the evergreen *Thuja occidentalis* brought to the Royal Garden of Fontainebleau in France around either 1536 or 1542 (2).

This disease became the scourge of seafarers, particularly after longer voyages without intermediary calls. This 'distemper' occurred during the voyage of Vasco da Gama to the East Indies in 1497, when 100 out of a crew of 160 died. A similar fate befell the crew of the ship of the sefarer, Fernandus Magellan, after a voyage of three months and twenty days in which he rounded the southernmost point of America. From then onwards the sorry tale of this killing distemper was recounted in numerous reports of long sea voyages. Hess (3) remarks:

. . . that crews of vessels which set sail in winter were more subject to scurvy than those which went out in the summer [and this] must be attributed to the existence of latent scurvy among sailors at the time of sailing, rather than the season of the year.—

as Lind thought (4, 5). The enlightened policy of the East India Company supported the plantation of fruit at the Cape of Good Hope: many ships, however, did not call there for fear of contracting infectious diseases, particularly dysentery ('the flux') (6, 7). Furthermore, later on, in the seventeenth century, the benefit derived from lemons and oranges was attributed to their acidity, and vinegar or sulphuric acid were often erroneously employed as antiscorbutics. The idea that an important substance was missing from the diet was not born, and for several centuries the use of alleged remedies was based upon a mixture of fact and superstition.

On land, prevention of scurvy was particularly important in northern countries. Thus we find that during the reign of King Charles XII, around the year 1700, the Swedish army in Europe apparently did not suffer from

scurvy, although this disease was commonly found among civilians in Sweden (8). This state of affairs was no doubt due to the influence of the first Swedish chemist, Urban Hjarne, Fellow of the Royal Society of London and Physician to the King of Sweden, who proposed that each soldier should drink every day a pint of ale in which fresh pine shoots had been steeped (cited by Friberg) (9). The original recipe of Hjarne included horse-radish, water-cress and whole lemon cut in cubes, but in the army only pine shoots were used. On the other hand, people in southern climates were not aware of these needs, and because of this ignorance scurvy and beri-beri took their toll in Spanish voyages in the Pacific between Acapulco and Manila (10).

In the eighteenth century, while Lind was making his famous experiments on the prevention of scurvy (4, 5), ships at sea were still exposed to the hazards of the disease. Thus Anson (n), during his voyage round the world in 1740-4, describes how the crew of his ship H.M.S. *Centurion* was so stricken with scurvy that only 200 out of the 400 men survived at Juan Fernandez, and these were largely incapable of doing duty. At this period (1745) the weekly rations in the Navy were 7 lb. biscuits, 7 gallons beer, 2 lb. salt beef, 2 lb. salt pork, 2 pints pease soup, 2½ lb. oatmeal, 8 oz. butter and 12 oz. cheese—a ration which could supply 5000 cal. a day. But unfortunately, because of poor storage and the wastage involved, very much less than this amount was available each day, particularly during longer voyages. At a rough estimate (12) the diet could have supplied sufficient thiamine, riboflavine and nicotinic acid, a rather low amount of retinol (vitamin A), but no ascorbic acid.

This was the situation when Lieutenant James Cook prepared for his first voyage to the Pacific in 1768 on H.M.S. *Endeavour*.

COOK'S FIRST PACIFIC VOYAGE WITH H.M.S. *Endeavour*
(1768-1771) (13, 14)

The *Endeavour* was a ship of 368 tons and its complement was 84; this included, apart from the officers and crew, 12 marines. Among the supernumeraries was the Royal Society's party—Mr Banks (naturalist), who later became P.R.S., Mr Solander, a Swedish naturalist, pupil of Linnaeus, Mr Green, astronomer, and Mr Parkinson and Mr Buchan, natural history artists. The total of persons on the ship was 95. Although the expedition was the best equipped that had ever left England, the accommodation must have been very crowded. The documents which passed between Cook and the Admiralty, the Victualling Board and others, reveal both the thoroughness of the Lieutenant of forty years of age who was in charge of the ship, and his

particular care to obtain provisions which he considered to be right for such a long journey. His Journal makes constant references to fresh food and water and, in particular, green vegetables, which were to be replenished whenever possible.

The Admiralty and Navy Board advised that an investigation should be made of the value of the antiscorbutics which were then in favour. 'Saloup' (Saloop), a hot drink of salep or sassafras, drunk as a substitute for coffee in London, was recommended, and 40 lb. of the salep powder was taken on board. 'Portable soup' was another item. Thus one finds a direction from the Sick and Hurt Board to Cook:

Portable soup to be issued on Banyan days (three meatless days of the week in the Navy) when fresh provisions are not to be had to the well men as well as to the sick and convalescents, it having been found extremely beneficial in long voyages; we have given instructions for 1000 lb. to be sent on board . . .

Instructions how to mix the soup follow. One oz. of the soup is thought to be sufficient for a man a day. This was dissolved either in pease soup or oatmeal 'soup'. The Portable Soup was prepared as described by Sir John Pringle (15):

. . . having by long boiling evaporated the most putrescent part of the meat (it) is reduced to the consistence of a glue, which in effect it is, and will, like other glues, in a dry place keep sound for years together. Indeed, 166 years after (12) a slab of such a flat cake, believed to be a sample of Cook's Portable Soup, was examined and did not appear to have undergone any marked change. Since fresh greens were added to the soup whenever possible, this might have been the reason for its beneficial effect in prevention of overt scurvy.

The rob of oranges and lemons, as inspissated juice of these fruits was called, was also taken on board, but evidently no proper use was made of this material (15), since only small amounts were available, and most of the ascorbic acid had been destroyed during the process of concentration. Ten years later Sir Gilbert Blane wrote:

There is reason to think, from experience, that the more natural the state in which any vegetable is, the greater is its anti-scorbutic quality. Vegetables, in the form of salads, are more powerful than when prepared by fire: and I know for certain that the rob of lemons and oranges is not to be compared to the fresh fruit. [Cited from Muir] (16).

This might be the reason why Captain Cook did not have a great opinion of the antiscorbutic value of rob of lemons and oranges.

Of real value was the supply, as long as it lasted, of Sauerkraut, 7860 lb.;

15 June 1768, *Victualling Board Minute*:

Order Admiralty loth that His Majesty's Bark the Endeavour at Deptford being fitted out for a distant voyage it will afford an opportunity for a fair tryal to be made of the efficacy of Sour Krout against the Scurvy (etc.). Write the Commanding Officer, a proportion for twelve months for seventy men will be sent aboard at the rate of two pounds per man per week; desire he will let us know how the same shall be found to answer for our reporting it to their Lordships accordingly.

As judged from the content of modern canned Sauerkraut, this ration could have provided as much as 150 mg ascorbic acid weekly. There is no doubt that Cook's 'Sour Krout' had a lower vitamin content than the modern product but nevertheless was certainly a source not to be underrated. Nevertheless there were difficulties in persuading the crew to eat it. Cook used a psychological approach, though previously, in Madeira, he had been prepared to use corporal punishment to persuade men who refused to take their allowance of fresh beef. He writes in his Journal, 13 April 1769, on arrival in Tahiti:

The Sour Krout the Men at first would not eate untill I put in pratice a method I never once knew to fail with seamen, and this was to have some of it dress'd every day for the Cabbin Table, and permitted all the Officers without exception to make use of it and left it to the option of the Men either to take as much as they pleased or none at all; but this pratice was not continued above a week before I found it necessary to put every one on board to an Allowance, for such are the Tempers and dispossissions of Seamen in general that whatever you give them out of the Common way, altho it be ever so much for their good yet it will not go down with them and you will hear nothing but murmurings gainest the man that first invented it; but the Moment they see their Superiors set a Value upon it, it becomes the finest stuff in the World and the in venter an honest fellow.

Cook was able to report to the Victualling Board, on 12 July 1771:

I am to acquaint you that Sour Kroutt together with the many other Antiscorbutics my Lords Comm^{rs} of the Admiralty were pleased to order to be put on board did so effectually preserve the People from a Scorbutic Taint that no one dangerous case hapned in that disorder during the whole voyage, and it is the Surgeons, Officers and my opinion that Sour Kroutt had a great Share in it and that it will always be found extreamly beneficial to seamen when they are obliged to live long upon a Salt diet; it has the good quality not to loose any part of its Efficacy by

Keeping, we used the last of it in September last after having been above two years on board & it was then as good as at the first.

In this account the operative word is 'dangerous', since as we shall see below cases of scurvy did appear on board but were effectively cured.

It is surprising that so much value was attributed by Cook to wort of malt, Dr McBride's Medicine. This 'antiscorbutick' was recommended by the Admiralty since 'it may be of great benefit to seamen in scorbutic and other putrid diseases'. The surgeon of the ship was advised to keep an exact account of the effect of the wort and his Journal was to be transmitted at the end of the voyage. Perry, Surgeon's mate, who succeeded Monkhouse in 1770, put in the report on 12 July 1771:

. . . Sour Krout, Mustard, Vinegar, Wheat, Inspissated Orange and Lemon Juices, Saloup, Portable Soup, Sugar, Melasses, Vegetables (at all times when they could possibly be got), were some in constant, others in occasional use: these were of such infinite service to the people in preserving them from a Scorbutic Taint, that the use of the Malt was, with respect to necessity, almost entirely precluded. Again, Cold Bathing was encouraged and enforced by Example; the allowance of Salt beef & pork was abridged from nearly the beginning of the voyage and the Sailors' usual custom of mixing salt beef fat with their flour &c strictly forbad.

This restriction was quite clearly related to the current belief that salt food was the primary cause of 'sea-scurvy' and also to the advice from John Hutchinson (13), Surgeon of Captain Wallis, whose sea voyage ended in 1768 with a high incidence of scurvy on board, that restriction of beef fat 'would be a means of delaying an attack of the Scurvy in long voyages'. Perry continues:

What opportunities have occur'd of using (Mr McBride's Medicine) have constantly been embraced; that more have not happen'd is, if a fault, the fault of the Humanity of the Lords of the Admiralty and of the Care of the Captain of the Ship . . . [Describes four cases of scurvy in March and April 1769, as discussed below]... From (12 April 1769) while at sea the Wort became a part of our diet, so that, excepting five cases, three happening in port at New Holland and two while on the coast of New Zealand, not a Man more suffer'd any inconvenience from this distemper. In the cases I have mentioned a trial was made of the Robs and attended with success. *It is impossible for me to say what was most conducive to our preservation from Scurvy so many being the preventives used:** but from what I have seen the wort perform, from it's mode of operation, from Mr McBride's reasoning I shall not hesitate a moment to declare

my opinion, viz. that the Malt is the best medicine I know, the inspissated Orange & Lemon juices not even excepted.

There is a contradiction in Perry's last two sentences. To this Cook added:

We found the Malt so indifferent (notwithstanding it was perfectly dry and sweet) that the Surgeon could make little or no use of it in the common way!... I order'd as strong a Wort to be made of it as possible and in it boild ground Wheat for the Peoples breakfasts.

Cook's remark appears to disprove the suggestion (17) that the sprouting of the grain might have produced enough of ascorbic acid to account for the praise of malt or wort. The efficiency of 'sweetwort' was further mentioned by Cook in his report to the Royal Society after his second voyage (26):

We had on board a large quantity of Malt, of which was made sweetwort, and given (not only to those men who had manifest symptoms of the scurvy, but to such also as were, from circumstances, judged to be most liable to that disorder) . . . This is without doubt one of the best antiscorbutic sea-medicines yet found out; and if given in time will, *with proper attention to other things** I am persuaded, prevent the scurvy from making any great progress for a considerable time: *but I am not altogether of opinion, that it will cure it in an advanced state at sea.**

Sir John Pringle, in his Presidential address (15), singled out this information without emphasizing Cook's proviso of the inability of wort to cure advanced scurvy. He was evidently very much in favour of McBride's 'fixed air' (carbon dioxide) theory which associated fermentation with the scorbutic putrefaction and which advocated the used of 'fixed air' to oppose putrefaction. This particular stress misled many regarding the antiscorbutic properties of wort.

Cook insisted on the collection of fresh vegetables at every port or landing place. Thus after 7 weeks at sea, onions were issued to the ship's company at Madeira, 20 lb per man, and fruit was obtained despite certain difficulties with the local authorities. Two days later an additional 10 lb onions per man were issued. The ascorbic acid content of raw onions can be as high as 30 mg/100 g edible portion; even when they are boiled they contain at least 2- 8 mg/100 g (18). If we assume a minimum requirement of 10 mg ascorbic acid/day (19, 20), the supply of onions should have gone a long way to prevent scurvy provided that these were regularly consumed and that no spoilage occurred. Cook writes to Admiralty on 20 September 1771:

* Our italics.

Also at Madeira I purchased a quantity of Onions which was distributed to the ships Company and which I understand has been Practised by ships on the like voyages. And likewise at Batavia the sickly state of the ships Company, made it necessary to have an extraordinary quantity of Vegetables every day, which Article I have charged in my accounts. And Pray their Lordships order that it may be allowed me.

Wild celery (*Apium graveolens, australe, antarcticum*, and, in Tolaga Bay, also *A. prostratum, A. filiforme*) which was greatly favoured as a constituent of soups was obtained at Tierra del Fuego (on the southern tip of the Americas) and in New Zealand. It contains about 8 mg ascorbic acid/100 g and even with bad cooking it would have been a valuable antiscorbutic adjuvant. Scurvy grass (*Cardamine gladialis*) was gathered wherever possible; the type of 'scurvy grass' collected at Tolaga Bay in New Zealand appears to be *Lepidium oleraceum* (13, p. 184). The use of scurvy grass as 'good to fasten loose teeth and to heal spongy, foul gums' and 'gainst scorbutic cholick' was well known as early as the first half of the sixteenth century (12). Banks in his Journal (21) writes that the scurvy grass in Tierra del Fuego grows in damp places near springs and resembles the English *Cardamine pratensis* (Lady's Smock, Milkmaids or Cuckoo-flower) only that the flowers are much smaller.

Other greens used in soup, often twice daily, were the 'cabbage' from the cabbage tree, being different species of *Cordyline*, which the Maoris called 'ti'; the leaves may have as much as 17-20 mg ascorbic acid/100 g edible portion. Sweet potatoes (*Ipomoea batatas, Kumara*)—containing 20 to 30 mg, were obtained in Tahiti, and 'Cranberries' (from the shrub-type plant *Pernettya mucronata*, named *Arbutus rigida* by Banks and Solander) which were gathered by specially arranged parties at Tierra del Fuego may have fruit with 5 mg ascorbic acid/100 g. The bread fruit (rich in ascorbic acid, 29 mg/100 g) was particularly noticed in Tahiti by Banks, and in 1793 he helped to introduce the tree into the West Indies, where it flourishes today (22).

Scurvy on board ship: The ship left Tierra del Fuego on 21 January 1769 and, after 2 months at sea, when she was approaching Tahiti (March-April 1769) four cases of scurvy were found. Among them was Banks (21), who observed that by the end of March his gums swelled and 'some small pimples rose on the inside of the mouth'. He rushed to use his private supply of lemon juice which was made up on the recommendation of Dr Hulme and consisted of five parts of lemon juice and one part brandy. Banks added this mixture to every kind of liquor that he drank, so that he consumed nearly six ounces a day of it. The effect was dramatic; in less than a week his gums became as

firm as ever. Surprisingly, no mention of this event is made in Cook's Journal. Banks ate 'sour-cROUT constantly', though he preferred salted cabbage, as well as wort, of which he drank a pint or more every evening; but 'all this did not check the distemper'. According to Perry, the ship's surgeon, three more cases developed in port at New Holland (Australia) in June 1770; Cook reports that 8 or 9 were 'afflicted with different disorders but none very dangerously ill'. Among them were Tupea (Tupia), a native of Polynesia, and the astronomer, Green. Banks (21) notes on 16 June:

Tupia had for the last few days bad gums, which were soon followed by livid spots on his legs and every symptom of inveterate scurvy. Notwithstanding acid, bark, and every medicine our surgeon could give him, he became now extremely ill. Mr Green, the astronomer, was also in poor way, which made everybody in the cabin desirous of getting ashore, and impatient at our tedious delays.

On 18 June:

Tupia . . . was surprisingly recovered; poor Mr Green still very ill.

There is no further note about the patients nor, unfortunately, is a list given of the remedies which helped their recovery.

The proportion of cases of scurvy was very much smaller than in other similar ships, and none of those afflicted had died. This was a great credit to the passionate determination of Cook to provide a varied diet, with as much greenstuff as was possible. Nothing can detract from this success despite the fact that he lost many men, thirty-one in fact, from dysentery and from malaria contracted in Batavia on his journey home.

And so the *Endeavour* reached Cape Town in better shape than the East Indiamen anchored there after much shorter voyages.

COOK'S SECOND PACIFIC VOYAGE WITH H.M.S. *Resolution* AND
Adventure (1772-1775) (23)

The success of the voyage of the *Endeavour* so impressed the Board of Admiralty, particularly Lord Sandwich and Sir Hugh Palliser, Lords of the Admiralty, that Cook, now promoted to Master and Commander, was asked to lead an expedition towards the South Pole and again to circumnavigate the world by way of the Pacific, so as to ascertain whether there existed a southern continent which reached into the Antarctic. Captain James Cook, R.N., was appointed to command the *Resolution*, 462 tons, with a complement of 112 (including 20 marines) and six supernumeraries, Mr Wales, the astronomer, Mr John Reinhold Forster and his son George, noted German naturalists, and an artist, William (Jam⁵) Hodges, with their

servants. The *Adventure*, 336 tons, was commanded by Captain Tobias Furneaux, R.N.; the number she had on board was 83 including Mr Baily, the astronomer.

Originally Mr Banks, the 29-year-old naturalist—within six years to become President of the Royal Society—was invited by Lord Sandwich to join the expedition and with him Solander, James Lind, as astronomer(!), and the chemist Priestley. However, in the end none of them sailed. It would have been an interesting company, though somewhat overwhelming for Captain Cook. It is futile to speculate whether the presence of Dr Lind, whose treatise on scurvy had by then reached a third edition, might have enhanced even more the achievement of Cook in combating scurvy and shortened the lag period of general acceptance of effective antiscorbutic treatment, such as with lemon juice, which came into operation only in 1795 in the Royal Navy on the recommendation of Sir Gilbert Blane and Dr Blair (12).

Provisions: On the basis of the experience of the first voyage, and with the strong support of Sandwich and Palliser, Cook started to provide the two ships with provisions which he considered most desirable for the long voyage:

But few of the antiscorbutick articles before mentioned have been interduced into the Navy and those few only for the use of the Sick, indeed I do not recolect any thing but Portable Broth to have been put on board any Ship, excepting those latly sent on discoveries, or to other remote parts who have had some of these articles put on board partly for general use and partly for experiment. Some account of them may not be unexceptable to the curious.* Of Malt is made sweet wort and given to such persons as have contracted the Scurvey, and to such as from their habit of body are liable to contract it, at the discretion of the Surgeon.

Sour Krout, is Cabbage cut small, and cured by going through a state of fermentation (I am not acquainted with the proper method) it is afterward close pack'd in Casks with its own liquor, in which state it will keep any length of time, it is a very wholesome food and a very great antiscorbutick, a pound of it is served to each man each Beef day, it is much use(d) in several parts of Germony from whence it has its name which signifies Sour Cabbage, it having that taste to a high degree and may be eat either raw or boild.

Salted Cabbage, is Cabbage cut to pieces well salted and close packed in Casks, it will keep good equally long with Sour Krout, but whether

* We had most of these articles on board the Endeavour Bark, but I have forgot if the use of them was explained in my Journal of that Voyage, and I have it not now with me.—Cook's note.

it be as great an Antiscorbutick or not the Faculty or experience must determine; it is served to the people in the same manner as Sour Krout, but must be freshened and boild before it can be eat.

Portable Broth is made from flesh meat, an Ounce of the former is said to contain the nourishing Juces of about three quarters of a Pound of the latter; the Commissioners of the Sick in their Instructions tells us that one ounce of Broth will be sufficient to make one Quart of liquid broth, so strong that it will Jelly when cold; but experience tells us that it will require double that quantity; it is dissolved in boiling Water and given to the Sick at the Discretion of the Surgeon; but to the well Men or Company in general, an Ounce to each Man is boiled in the Pease or Wheat on Banyan days, Days so call'd in the Navy, which are Mondays, Wednesday and Fridays because on these days they have no flesh meat.

Saloupe and Rob of Lemons and Oranges are intend(ed) for the Sick and Scorbutick only. Mustard is intended for all in general, it is allowed to be of an antiscorbutick quallity and its use is well known.

Marmalade of Garrets, is the Juice of Yallow Garrets Inspissated rill it is of the thickness of flued honey or Treacle which last, it looks like and in some degree tastes like; it is recommended by Baron Storsch of Berlin, as a very great Antiscorbutick. He says 'a Spoonful of this Marmadlade, mix'd with Water, taken now and then will prevent the scurvy, it will even cure it if constantly taken'. It is much used by the poor people in Germany.

The Inspissated juce of Malt, which might be reckoned among the Antiscorbuticks, I shall speak of in another place. It will be unnecessary and tedious to enumerate the several articles of Naval Stores that are on board, nothing is wanting that was thought necessary, and the quantity Sufficient for so long a Voyage.

These 'antiscorbutic' remedies were mostly identical with those taken on board for the first voyage. Salted cabbage, specially mentioned here, was favoured by some more than sauerkraut (for instance by Mr Banks) but might have had very little antiscorbutic value by the time it was consumed. Mustard is referred to, but unless the seeds were germinated little benefit could be derived and 'the mustard seed (if it was such) was so bad that not an Animal on board would eat it' [Cook to Admiralty, August 1775] (23). The new remedy on board ship was Baron von Storsch's marmalade of carrots, but it proved to be unsuccessful.

As to the wort made of malt, in August 1775 Cook informs the Admiralty, as he did Sir John Pringle, P.R.S. (26), that it

is without doubt one of ye best Antiscorbutic Sea Medicines yet found out and if given in time will, with proper attention to other things, prevent ye Scurvy from making any progress, but I am afraid it will seldom be found to cure it, we have been a long time without any, without feeling ye want of it, which might be owing to other Articles (23, p. 954).

Even more outspoken is Cook's note in July 1773 (23, p. 188) in which he says:

We have proof that it [wort] alone will neither cure nor prevent the Sea Scurvy.

This is in contrast to the unqualified approval of wort as an antiscorbutic referred to by Sir John Pringle (15), the value of which was seemingly favoured by the latter.

The portable soup was a good vehicle for offering the greenstuff obtained on land and taken on board whenever possible. On arriving in the Queen Charlotte Sound in New Zealand in May 1773, Cook himself went in search of celery and 'scurvy grass' and returned before breakfast with a boat load; he ordered

that it should be boild with Wheat or Oatmeal and Portable Soup for the Crew of both Sloops every morning for breakfast and also with Pease (and broth) every day for dinner and I took care that this order was punctually complied with *at least in my sloop*.*

We shall see below that Captain Furneaux on H.M.S. *Adventure* might have had a lesser discipline with disastrous consequences in terms of outbreaks of scurvy among his crew.

Again, in November 1773, Cook observed that he

. . . caused Scurvy grass and sellery to be dressed every dav for all hands and by this means they have been mostly on a fresh diet for these three months past and at this time we had neither a sick or scorbutic person on board.

A plant which Cook called 'Lambs quarters', which when boiled eats like 'spinach', and 'Scurvy grass' was served to the crew in such a manner. The 'Lamb's quarter' was probably *Antriplex jubata* or possibly *Tetragonia expansa*, the 'New Zealand spinach' and the 'Scurvy grass' was most likely the latter plant or *Sesuvium portulacastrum*; all three plants are common on sandy beaches and coral sand islets about new Caledonia like the one Cook visited [note by Beaglehole, p. 560] (23).

* Our italics.

Again, a thousand bunches of onions were purchased in Madeira, on the first stop of the voyage, and

distributed among the people for a Sea Store, a Custom I observed last voyage and had reason to think that they received great benefit therefrom.

Unfortunately it is not known how long the supply lasted, but nevertheless the onions probably provided a goodly supply of ascorbic acid.

The new addition to the preventive or curative antiscorbutic substances was 'spruce beer'. In a recipe for brewing such beer (23, p. 137) Cook describes the use of fresh leaves of the spruce tree which most likely was in New Zealand, the *Rimu*, *Dacrydium cupressinum* (23, p. 114). Since it was rather astringent it was mixed with an equal part of leaves of the Teaplant (Manuka tree, *Leptospermum scoparium*; *L. cricoides*), and fermented with inspissated juice of wort and molasses to make a drink which was offered instead of grog. On Cook's third voyage (24), when near Alaska, another * Spruce' was used which apparently was the Sitka spruce (*Picea Sitchensis*). The latter was not very popular, and indeed while in the Arctic Cook almost faced a mutiny, but in the end his will prevailed. The beer brewed from New Zealand 'Spruce' was more acceptable and according to Clarke, 2nd Lieutenant of the *Resolution*, 'the People . . . seem to drink plentifully of it'. In the course of time Cook's recipe found due praise. Edward Bell of the *Chatham* wrote in 1791:

Our Spruce Beer, which was made after the directions given by Capt. Cook, prov'd excellent, and was served out to the Ship's Company in lieu of Spirits. *Hist. Rec. N.Z.*, II, p. 498 [Beaglehole, p. 138] (23).

The 'spruce' from which the beer was made reminded Cook of the

Americo black Spruce which from the knowledge I had of. . . , with the addition of the other articles, would make a very wholsom Beer and make up for the want of Vegetables which this place [Dusky Bay, New Zealand] did not afford and the event proved I was not mistaken.

Cook with an uncanny instinct had chosen a good antiscorbutic remedy which might have contained a fair amount of ascorbic acid (see below). Andreas Sparrman, a Swedish naturalist, who on the recommendation of the Forsters joined the *Resolution* at Table Bay in South Africa notes in his book (25):

After a small amount of rum or arrack has been added, with some brown sugar, and stirred into this really pleasant, refreshing and healthy drink, it bubbled and tasted rather like champagne [*sic!*]; it was called *Kalkbogas*, after a similar mixture in North America.

The reference to the North American drink that is also described by Banks in his journal from Newfoundland which he visited in 1766, recalls the use of a decoction of the bark and leaves of conifers by Cartier more than 200 years previously (2). The fermented spruce drink might have been a refinement of the latter. Mockle (2) found the following concentrations of reduced ascorbic acid per 100 g of leaves or needles of the following trees: *Abies balsamea*, 270 mg; *Picea rubens*, 168.7 mg; *Picea mariana*, 56.3 mg; *Pinus strobus*, 31.5 mg (in this species the bark contained 200 mg/100 g); *Thuja occidentalis*, suspected to be Carder's Anedda tree, 45 mg. These results confirm the potential antiscorbutic properties of these materials and there is a good chance that Cook's 'Spruce beer' made from fresh leaves or shoots, as mentioned in his Journals, contained a fair amount of ascorbic acid. In contrast, the ascorbic acid content of dried material would have been nil. A recipe based on dried spruce leaves was sponsored by McBride (n):

Dry spruce, if boiled in water about one hour and a half, will make good Chowder-beer . . .

H.M. ships carried stores of 'essence of spruce', presumably a concentrate of the dried material. Lind (4, 5) had already drawn attention to the use of decoctions of young pine shoots in Sweden and Russia as antiscorbutica; and as late as in the last war, in the North of the Soviet Union extracts of pine needles were used to protect children against scurvy.

Scurvy on board ship: Captain Cook could report (26) to Sir John Pringle, Bart., P.R.S., on 7 March 1776 in a communication, for which the Royal Society rewarded him with the Copley Medal, that

The *Resolution* performed a voyage of three years and eighteen days, through all the climates from 52° North to 71° South, with the loss of one man only by disease, and who died of a complicated and lingering illness, without any mixture of scurvy. Two others were unfortunately drowned, and one killed by a fall; so that of the whole number with which I set out from England I lost only four.

This was a remarkable and unique achievement in those days when during voyages of only 12 months' duration, half or more of the crew might die from scurvy. Nevertheless there *were* cases of scurvy on H.M.S. *Resolution*, but particularly on Captain Furneaux's H.M.S. *Adventure*, although all but one, Mortimer (Murdock) Mahony, cook on the *Adventure*, recovered when proper measures were taken.

The ships left Plymouth in mid-July, taking fresh provisions in Madeira (onions!) and again in Cape de Verde Islands in mid-August. On 30 October they arrived in Cape Town with the 'people all in perfect Health and spirits',

at least those in the *Resolution*. In the *Adventure*, as Cook remarks later on 20 December, 'two men came, even, from the Cape highly scorbutick'. It was evident that their food was low in vitamin C and any relaxation of the carefully devised dietary regime might have precipitated a severe outbreak of scurvy. In contrast to this two Dutch East India ships anchored in the harbour after 4 to 5 months' voyage, had between them 191 dead and 60 in hospital. Cook's ships departed for the Antarctic on 23 November and after 4 weeks he reported that measures had to be taken to combat symptoms of scurvy in the *Resolution* and particularly in the *Adventure*. The two men who had been suffering from scurvy since the Cape benefited from taking the rob of oranges. Mr Wales, the astronomer, was one of those stricken by the disease on the *Resolution* and was given both wort and rob of oranges, the latter alone not being very effective.

Cook was cruising till the end of March 1773, when the *Resolution* reached Dusky Sound in New Zealand, contact with Furneaux's H.M.S. *Adventure* having been lost. But *Adventure* rejoined him in May further north in Queen Charlotte Sound. Cook writes:

After such a long continuance [4 months] at Sea in a high Southern Latitude it is but reasonable to think that many of my people would be ill of the Scurvy, the contrary however happened; . . . we had only one man on board that could be call'd very ill of this disease, occasion'd chiefly by a bad habit of body, and a complication of other disorders: we are not to attribute the general good state of health of the crew, wholly to the sweet wort & Marmalade, this last was only given to one Man, we must allow Portable Broth and *Sour Krout* to have had some share in it, *this last article can never be enough recommended.**

It was in the *Adventure* that scurvy broke out with some severity. After being at sea for about 45 days the cook Mahony died of scurvy off New Zealand on 23 July,

being so ver(y) indolent & dirtily inclined there was no possibility of making him keep clean, or even to come on Deck to breath the fresh air. This man was a natural prey for scurvy.

But worse was to come. Within a week it was reported to Cook that the *Adventure* has 20 men sick with scurvy and flux. On the *Resolution* three men were ill, but only one man with overt scurvy, though several showed slight symptoms. The measures taken on the advice of Cook appeared to check deterioration until the end of August when the sick, who could scarcely

* Our italics.

walk, were put ashore in Matawai Bay (Tahiti) where they recovered on fresh fruit and vegetables.

The reasons for the outbreak of the 'distemper' are clearly stated by Cook in his report to the Admiralty on 1 August 1775:

We came to few places w(h)ere either ye act of Man or Nature had not provided some sort of refreshments or other, either in ye Animal or Vegetable way, & it was first care to procure them by every Means in my power & Oblig'd ye people to make use of them, *both by example & authority*. * It is from these kinds of refreshments I can only Account for the Resolution having few or no scorbutic people on board on our passage from New Zealand to Otahiete [Tahiti] the first time, when at the same time ye Adventure had many of the best men far gone in that disease; for except Fish they had hardly any refreshments from ye time we left ye Cape till I join'd them in Queen Charlotte's Sound [New Zealand], which was about Six Months; they were unacquainted with the method of making Spruce Beer & Strangers to many ye Vegetables with which that place abounds, consequently not benefited by them, whereas ye Crew of ye Resolution had been living on Fish, Spruce beer & Vegetables for upwards of two Months, which eradicated every seed of ye Scurvy, & this was not ye only time we received this Benefit during the Voyage (23, p. 955).

There was another period when scurvy threatened to break out on the *Resolution*. It was at the turn of the year 1773 when in the South polar regions for about 5 weeks, the older Forster and twelve other men complained of rheumatic pains which, as we shall see below, might have been the first signs of scurvy. There were also a few slight symptoms of scurvy (23, p. 311). By the end of February 1774, the younger Forster and many others were scorbutic so that 'they crawled about the decks with the greatest difficulty'. They had been for 14 weeks without vegetables, living on salt beef and pork [cf. Wales] (23). During this period, Cook himself became ill, not from scurvy, but with acute cholecystitis and complicating intestinal obstruction (22). It was only when they reached Easter Island, 18 days later, that potatoes, yams, taro (tropical plant of arum family) and plantains became available. Cook at first did not think much of these refreshments but noted that

It was afterwards found that the few Roots &c^a . . . proved of infinite service to us.

No other scorbutic outbreak marred the voyage and when steering for the Cape of Good Hope in February 1775, Cook remarks (23, p. 647):

* Our italics.

We had been a long time without refreshments, our Provisions were in a state of decay and little more nourishment remained in them than just to keep life and soul together. My people were yet healthy and would cheerfully have gone wherever I had thought proper to lead them, but I dreaded the scurvy laying hold of them at a time when we had nothing left to remove it.

Sauerkraut had been almost finished. After three years in various climates all other provisions were in a bad condition; the Cape was reached and a fresh supply of provisions and water taken on board, and England sighted on 29 July 1775.

COOK'S THIRD VOYAGE WITH H.M.S. *Resolution* AND *Discovery*
(1776-1780) (24)

Captain Cook never completed this voyage, being tragically killed by natives in 1779. The purpose of the voyage was to find an approach to the supposed North-West Passage from the west. Two ships were equipped, Cook's old ship the *Resolution*, and the *Discovery*, of 300 tons, captained by Commander Clerke, R.N., a former associate of Cook, with a complement of 112 and 70 men, respectively.

Provisions and state of health of the crews: Cook ordered his supplies of antiscorbutic foodstuffs with the experience of the last two voyages. There was no more of Baron Storsch's marmalade to be taken on board since it had proved such a failure previously. As before, greens, vegetables of all kinds, and fruit were to be gathered whenever and wherever possible. For a new antiscorbutic, nettle tops and wild leeks were boiled with wheat and portable soup and served at breakfast, so that for some time even sauerkraut could be left out of the diet. Special spruce beer was brewed from pine shoots as mentioned before. Wherever possible, edible berries were picked by special parties consisting of one-third or as many of the crew as could be spared. Cook describes the fruit as Hurtle-berries (*Vaccinium vitis idaea* and *V. ovalifolium*), Partridge berries (possibly Alpine Partridge-berry, *Arctostaphylos alpina*), and Heath berries (*Empetrum nigrum*) (24 [notes by Beaglehole, p. 440]).

The dietary regime was such that no case of scurvy occurred,

So that if there was any seeds of the Scurvey in either Ship, these berries and Spruce beer which they had to drink every other day, effectually removed it (24, Cook, p. 448).

So ingrained had the dietary habits become, for both officers and crew, that

even after Cook's death in February 1779, the health of ship's crews remained excellent. Samwell, surgeon's mate on the *Resolution* till 1778, writes:

In the Discovery of which I was Surgeon above 2 years we did not loose one Man by sickness—a Circumstance unparallel'd in ye History of Navigation. We had not the least appearance of Scurvy in either Ship (24, p. 1562).

Alexander Home, quartermaster on the *Discovery*, writes from personal experience of Cook as a dietician (24 [cited by Beaglehole, p. 1455]):

we Met with Nothing Else that did any hurt and When one Considers it it is astonishing How we have Come to so little Damage in this way during so Long a time for it was the Custom of Our Crews to Eat almost Every Herb plant Root and kinds of Fruit they Could Possibly Light (upon) with (out) the Least Inquirey or Hesitation or any Degree of skill & knowledge of their Qualitys, and as they have been so far Lucky as to Light upon Nothing Hurtfull I thing it is highly probable this disposition has been the principle Means of preserving Our Healths for such a Number of Years Almost Constantly on the water. *Captain Cook raised this spirit Amoungst us by his Example for scarc(e)ly any thing Came wrong to him that was Green and he was as Carefull in providing Vegetables for the Messess of the Crews as for his own Table and I do Belive that in this Means Consisted his graund Art of preserving his people in Health During so Many of the Longest and Hardest Voyages that was Ever Made.**

It was his practise to Cause great Quantitys of Green Stuff to be Boiled Amoungst the pease Soup and wheat and Care'd Not Much whether they were Bitter or Sweet so as he was but Certain they had no Pernicious Quality and Frequently to one who Considered only the pleasing of their Taste without having Respect to health the Messess were somewhat spoiled But as there was Nothing Else to be got they were Oblledged to Eat them and it was No Uncommon thing when Swallowing Over these Mess(es) to Curse him heartyly and wish for gods Sake that he Might be Oblledged to Eat such Damned Stuff Mixed with his Broth as Long as he Lived. Yet for all that there were None so Ignorant as Not to know how Right a thing it was. But the Generality of them for all that will please their Palate and run the Risque of their Health if it is Not to be procured or preserved but by Eating things that are Bitter & Disagreable.

He would Frequently Order them on shore in partys to walk about the Country and smell the Fresh Earth and Herbage and from His

* Our italics.

Example and Disposition they were in a Manner Let to know that it was Expected they Woud [missing] their Stomach with any green stuff that Could (be go)t if it was even at the Risque of geting the grip(es) [missing] (w)alking About himself he was shure to be [missing] and as he was Not Nice he Commonly Succeeded and in time the Men adopted the same Humour and Disposition as by Infectsin and perhaps in Many it Might be with a View of making their Court to him, for they knew it was A great Recommendation to be seen Coming on board from A pleasure Jaunt with A Handkerchif full of greens.

A tribute to Cook as a wise and effective commander from one with long experience of him.

When one reads of the experiences recorded in Cook's Journals and in those of his associates, one is struck by the precision of the description of the scorbutic condition and with the timing of the onset of symptoms after the ships left a port with fresh supplies of vegetables and fruit. The lag period before the outbreaks agrees well with modern experiments on human volunteers (20) where about 8 to 10 weeks elapsed before lesions of the gums, haemorrhages on mucosal membranes and around hair follicles in the skin appeared. 'Rheumatic' pains and effusions into joints were also common about this time. In an early Medical Research Council investigation with human volunteers the earliest signs of ascorbic acid deficiency occurred around the 17th week of deprivation. These subjects were, however, given 50 to 70 mg/day of ascorbic acid for some weeks before deprivation began. In the old days a ship's crew may well have been living on a diet relatively poor in ascorbic acid before the voyage began.

The significance and uniqueness of Cook's contribution to knowledge was not so much that he used greens and fruit as antiscorbutics, since these had been advocated before, but by his passionate determination to enforce by example and by authority on his, sometimes non-cooperative crew and officers, a dietary regime which he believed was right. If he knew them he may have derived moral support from the views of James Lind or Johannes Bachstrom, the Dutch doctor who wrote:

Causam veram et primarium Scorbuti nullam aliam esse, quam abstinentiam diuturniorem a quocunque genere recentium vegetabilium. [Observationes circa Scorbutum, 1734] (12).

He could scarcely have heard of the Austrian doctor, G. H. Kramer, who reported in 1720:

If one could have available a supply of green vegetables, or ... oranges, limes or lemons. . . then one could be in a position to cure this dreadful disease without other help (27).

In view of the upbringing which he describes in the Preface to his Journal of the Second Voyage (23) one may hesitate to assume that Cook was aware of the scientific arguments of this period. Perhaps the fact that he rose from a low rank gave him an insight and a special understanding of the means to command.

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BIBLIOGRAPHY

- (1) Carrington, Hugh, *The life of Captain Cook*. London: Sidgwick & Jackson, 1967. (Watergate Editions, Ed. C. V. Wedgwood.)
- (2) Cartier, Jacques, 'La Grosse Maladie'. Reproduction photographique de son 'Brief Recit et Succincte Narration, 1545' suivie d'une traduction en langue anglaise du chapitre traitant des aventures de Cartier aux prises avec le scorbut et d'une nouvelle analyse du Mystere de l'Annedá; B. L. Frank and others, Montreal, *XIX Congres International de Physiologic*, 1953. The Ronald Printing Co. Ltd, Montreal.
- (3) Hess, Alfred F., *Scurvy past and present*. Philadelphia and London: J. B. Lippincott, 1920.
- (4) *Lind's treatise on scurvy*. A Bicentenary Volume containing a reprint of the First Edition of 'A Treatise of the Scurvy' by James Lind, M.D., with Additional Notes. Ed. C. P. Stewart and Douglas Guthrie. Edinburgh University Press, 1953.
- (5) Lind, James, *A treatise on the scurvy. In three parts*. 3rd Edition. London, 1772.
- (6) Allison, R. S., *Sea diseases*. London: John Bale Medical Publications, 1943.
- (7) Larsen, Oivind, *Schiffund Seuche, 1795-1799*. Ein medizinischer Beitrag zur historischen Kenntniss der Gesundheitsverhältnisse an Bord dänisch-norwegischen Kriegsschiffe auf den Fahrten nach Dänisch-Westindien. Oslo: Universitetsforlaget, 1968.
- (8) Aberg, B. (1950), *J. Chem. Educ.* 27, 334. 'Urban Hiaerne, the First Swedish Chemist.'
- (9) Friberg, U. (1958). Thesis, Stockholm.
- (10) Merrill, Elmer Drew, 'The botany of Cook's voyages (and its unexpected significance to anthropology, biogeography and history)', 1954. In *Chronica Botanica*, 14 (5/6), 1950/51; Ed. F. Verdoorn.
- (11) Anson, George (Lord), *A voyage round the world in the years 1740, i, 2, 3, 4*. Compiled by Richard Walter, M.A., Chaplain of H.M. Ship the Centurion, in that Expedition; 3rd Ed., 1748.
- (12) Drummond, J. C. & Wilbraham, A., *The Englishman's food. A history of five centuries of English diet*. London: Jonathan Cape, 1958.
- (13) Cook, James, *The Journals of Captain James Cook on his voyages of discovery. I. The voyage of the Endeavour, 1768-1771*. Ed. J. C. Beaglehole, Cambridge University Press, 1955.

- (14) Cook, James, *Captain Cook's journal during his first voyage round the world made in H.M. Bark 'Endeavour' 1768-1771* (a literal transcription of the original MSS.). Ed. by Captain W. J. L. Wharton, R.N., F.R.S. London: Elliot Stock, 1893.
- (15) Pringle, Sir John, Bart., P.R.S., 1776: A Discourse upon Some Late Improvements of the Means for Preserving the Health of Marines in *Six Discourses. On occasion of six annual assignments of Sir Godfrey Copley's Medal, 1783.*
- (16) Surgeon Rear-Admiral John Reid Muir, M.B., F.R.C.S.E., *The life and achievements of Captain James Cook, R.N., F.R.S., explorer, navigator, surveyor and physician.* London: Blackie & Son, 1939.
- (17) Anonymous (1928), *Lancet*, i, p. 481. Captain Cook's dietetic sagacity.
- (18) Disselduff, M. M. & Murphy, E. La C. (1968), in *Vitamins in the elderly*, Ed. A. N. Exton-Smith and D. L. Scott. Bristol: J. Wright & Sons, p. 60.
- (19) Bartley, W., Krebs, H. A. & O'Brien, J. R. P. (1953), *Vitamin C requirement of human adults.* Medical Research Council, Spec. Rep. Ser. No. 280. H.M. Stationery Office.
- (20) Baker, E. M., Hodges, R. E., Hood, J., Sauberlich, H. E. & March, S. C. (1969), 'Metabolism of Ascorbic- $i-^{14}C$ acid in experimental human scurvy.' (In the press.)
- (21) Banks, Sir Joseph, *Journal of the Right Hon. Sir Joseph Banks, Bart., K.B., P.R.S., during Captain Cook's First Voyage in H.M.S. Endeavour in 1768-71 to Terra del Fuego, Otahite, New Zealand, Australia, The Dutch East Indies, etc.* Ed. Sir Joseph D. Hooker. London: Macmillan, 1896.
- (22) Thrower, W. R. (1951), *Lancet*, ii, 218. Contributions to Medicine of Captain J. Cook, F.R.S., R.N.
- (23) Cook, James, *The journals of Captain James Cook on his voyages of discovery. II. The voyage of the Resolution and Adventure, 1772-1775.* Ed. J. C. Beaglehole. Cambridge University Press, 1961.
- (24) Cook, James, *The journals of Captain James Cook on his voyages of discovery. III. The voyage of the Resolution and Discovery, 1776-1780.* Ed. J. C. Beaglehole. Cambridge University Press, 1967.
- (25) Sparrman, A., *A voyage round the world with Captain James Cook in H.M.S. Resolution.* English translation. Ed. Owen Rutter. London: Robert Hale, 1953.
- (26) Cook, James (1776), *Phil. Trans. R. Soc.* **66**, 402-406. Letter to Sir John Pringle, Bart., P.R.S., on the Method taken for preserving the Health of the Crew of His Majesty's Ship the Resolution during her late voyage round the World.
- (27) Harris, Leslie J., *Vitamins in theory and practice.* Cambridge University Press, 1938.