‘Some Late Improvements in the Means for Preserving the Health of Mariners’

James Cook and the Struggle against Scurvy

The greatest of the library’s treasures is, of course, the *Endeavour* journal, but open it at the first page of writing and you are in for a surprise. What greets your eyes is an apparently unrelated letter by Dr. John Hutchinson of HMS *Dolphin*, who is assessing for Captain Samuel Wallis the efficacy of various supposed scurvy remedies supplied for trial on recent their voyage to Tahiti. The letter, written on board just before the *Dolphin*’s arrival back in England, is dated a week before Cook begins his journal. It is reasonable to suppose that it was Cook who placed it with the journal, the more so as he elsewhere records his thanks to Wallis for advice on crew health. Health was a major concern for any commander facing a long voyage; another captain thanked by Cook was John Campbell, who thirty years earlier had sailed with Anson on a circumnavigation that had lost a thousand men to scurvy. Dr. James Lind had subsequently demonstrated that fresh citrus would cure the disease, but oranges and lemons were expensive and would not keep on a lengthy voyage.

So what was the state of knowledge when Cook sailed in 1768? Scurvy was associated with sea voyages of longer than a couple of months but its cause was unknown. A monotonous diet of salt meat, dried peas and sea biscuit was the prime suspect, but sea air and cold and wet living conditions also figured. Sir John Pringle, soon to be president of the Royal Society, had a theory that the seaman’s diet caused internal putrefaction. It seemed credible enough: after scurvy appeared, typically announced by lassitude followed by swelling of the gums, aching joints, and livid sores, the body seemed to be rotting from within, a process that terminated in death unless fresh food became available, in which case a quick recovery was almost assured.

Dr. Hutchinson had reported to Wallis that saloup (dried orchid tubers), portable soup (offal boiled down to a gummy solid), mustard, vinegar and distilled water were all useful items of diet or restoratives but the only antiscorbutic effect he had observed was when wild celery gathered in the Straits of Magellan was boiled for breakfast with wheat and portable soup. As an afterthought, he expressed the opinion that the seaman’s habit of spreading slush (fat from the boiling of salt meat) on his biscuit was conducive to scurvy, and he would have outlawed it if he could. He did not mention citrus, but Wallis recorded that at Tinian the ship had taken on 500 limes for every man aboard. Cook was issued with all of the stores listed by Hutchinson and, in addition, rob of oranges and lemons as advocated by James Lind. This concentrate was an attempt to provide citrus that would keep; what Lind did not know but Pringle suspected was that heating to make the rob all but destroyed the fruit’s anti-scorbutic quality. Furthermore, the amount supplied was so limited that it could not be used as a preventative but only as a cure once scurvy had appeared. A more important addition, because it was provided as an item of diet, was sauerkraut, long valued in the Dutch service. Four tons were shipped, enough to last 70 men for a year at one pound (half a kilo) per man twice a week. The cabbage had been pickled, not heated. By careful husbanding Cook was able to make the supply last for two years.

The Voyage of the *Endeavour*

Once at sea, Cook soon demonstrated his determination to do all he could to protect his crew from scurvy. It was common to refresh whenever opportunity presented, but Cook took the practice to another level. At Madeira he took on fresh beef and vegetables and proceeded to issued 30 pounds
(14 kilos) of onions to each seaman as a personal ration. If the seaman restricted himself to one a
day the supply would have lasted him four months. Furthermore, Cook had a marine and a seaman
flogged for refusing the fresh beef. It was a dubious invocation of the Articles of War, relying on a
provision which forbade as mutinous conduct the stirring up of disturbances ‘on account of the
unwholesomeness of victual’, but in any case Cook had no intention of relying entirely on naval
discipline for man management.

Seamen in the eighteenth century were treated by their superiors as if they were oversized, unruly
children, which was not far off the mark. Profoundly suspicious of innovation, their trust was hard to
win and easy to lose. The lash had its place, but Cook understood that in matters of diet and hygiene
compulsion could take one only so far. After Madeira he broke out the sauerkraut, but not as
regular issue. It was served to the officers, but the men were left to take it or leave it as they pleased.
Within a week it had to be incorporated in the ration scale as an allowance because, to quote Cook,

Such are the tempers and dispositions of seamen in general that whatever you give them
out of the common way, although it be ever so much for their good yet it will not go down
with them and you will hear nothing but murmurings against the man that first invented it;
but the moment they see their superiors set a value on it, it becomes the finest stuff in the
world and the inventor a damned honest fellow.

Getting the seamen to eat pickled cabbage was one thing, but Cook had a sterner test for them.
Taking a cue from Wallis and Hutchinson, at Tierra del Fuego the crew were sent to gather scurvy
grass and wild celery. These were consumed as salad or boiled with pease or wheat and portable
soup. Several men complained that such messes were not fit to eat but, according to Cook, ‘they
were soon convinced that it was good for them and all turned excessive fond of it’. The forecastle
might not have been as unanimous as Cook liked to think. Some men found the taste offensive, but
as one later remarked, it had to be suffered if there was nothing else, although ‘it was no
uncommon thing when swallowing over these messes to curse [the captain] heartily and wish for
God’s sake that he might be obliged to eat such damned stuff with his broth as long as he lived’. Whenever the least hint of scurvy appeared, the suspect was dosed with Dr. McBride’s wort –
powdered malt boiled and fermented - which was supposed to prevent the putrefaction warned of
by Pringle. Banks treated himself successfully with generous measures of lemon juice preserved in
brandy. When Solander the botanist fell ill on passage to NZ he was given the rob. He recovered,
but the quantities supplied restricted the number and size of doses. In other cases there was no
discernable outcome and surgeon Monkhouse lost confidence. The truth was that so many
preventatives and cures were being trialled simultaneously that there was no way of being sure
about what was working.

In New Zealand, the captain enlarged his menu of edible plants. From the New Zealand rimu, which
to Cook resembled black spruce, he brewed beer according to a native American recipe that 200
years earlier had saved Jacques Cartier during a Canadian winter without fresh provisions. The
manuka was tea-like and could also be brewed. This sampling of plants on the strength of similarity
to known species might seen naive but appearance was simply a prompt; the true test was taste, the
more tart and acrid the better. Contrariwise, there was a species that did not look much like its
northern equivalent but was so much alike in taste that Cook called it New Zealand scurvy grass.
In Australia, the sampling and harvesting of local flora and fauna continued but scurvy reappeared. On
arrival at Endeavour River Tupia the Tahitian and Green the astronomer were clearly scorbutic. Significantly, these were civilians who, like Banks and Solander, could not be subjected to dietary discipline. Tupia, who had spurned Cook’s vegetable regime, went ashore and temporarily cured himself by reverting to his traditional diet of fresh fish. The crewmen remained more or less clear of the taint but before the ship reached Batavia Tupia was again suffering from scurvy. At Batavia he, like others, was carried off by dysentery, but in his case scurvy must at least have been a contributing factor, as it probably was for Green, who subsequently died on passage to Capetown. Cook was censorious of the astronomer:

He had long been in a bad state of health, which he took no care to repair but on the contrary lived in such a manner as greatly promoted the disorders he had had long upon him, this brought on the flux which put a period to his life.\textsuperscript{vii}

Cook was conscious that the ship’s health record would be scrutinised. When he met up with a homebound Indiaman at Capetown and learned that she had lost 30-40 men, a good many to scurvy, on a 12 month voyage, he reflected wryly that it would not rate a mention in England while his own comparable losses over nearly three years, mostly caused by dysentery from Batavia water, would be highlighted. Any success he had in overcoming disease would be attributed to Providence.

In the event, the Admiralty credited Cook rather than Providence. He had not lost a single crewman to scurvy and that was unprecedented for such a long voyage. Unfortunately, Monkhouse had died and it was not possible to be very precise about what had been effective. The wort had become an item of diet in the ship and thereafter very few men presented with symptoms: it seemed to be a good preventative. Those who did present were given the rob of citrus and that was successful; it appeared to be curative. This was hardly conclusive but the Admiralty was well pleased. One might have expected some attempt to refine results on the second voyage, perhaps by testing each preventative and cure in isolation as Lind had done, but the matter was again left in Cook’s hands. He sailed with the same suite of remedies, augmented by the latest nostrum, a marmalade of yellow carrots as recommended by Baron Storch of Berlin. On this voyage, however, there could be a comparative experiment of sorts because Cook had two ships, identically rationed. If one returned with a better record than the other the cause might be found in differing practices. It was not a clinical trial but at least there was something like a control for purposes of comparison.

\textbf{The Voyage of Resolution and Adventure}

Shortly after the first refreshment stop in New Zealand it became apparent which ship was the de facto experiment and which was the control. Two or three serious cases of scurvy were reported aboard the \textit{Adventure}, which was commanded by Tobias Furneaux, and the ship’s cook died of the disease. In the \textit{Resolution}, Cook had easily alleviated early symptoms with wort, marmalade and rob, and suspected that the \textit{Adventure}’s men had not been eating their greens at Queen Charlotte’s Sound, ‘partly for want of knowing the right sorts and partly because it was a new diet which alone was sufficient for seamen to reject it’.\textsuperscript{viii} He advised Furneaux to brew wort, spruce beer and manuka, increase the sauerkraut ration, boil cabbage with the pease, substitute wine for spirits and shorten the allowance of salt meat. It was unnecessary: Furneaux had already tried them. This led Cook to an unpalatable conclusion; if the wort had been administered in proper quantities, up to 5 or 6 pints a day, ‘we have a proof that it alone will neither cure nor prevent the sea scurvy’.\textsuperscript{ix} In Furneaux’s opinion the wort did neither, but it did stay the advance of the disease.
By Tahiti many of the Adventure’s scurvy sufferers could not get on deck without assistance, whereas Resolution had but one case. Fresh fruit revived them all. Three months later the ships lost contact and Furneaux returned to England without recording anything further about scurvy, at least in his public account. Cook pressed on for another year, at one stage being 14 weeks without fresh provisions, which so destroyed the crew’s appetite for salt junk and hard tack that their empty stomachs would not even accept the wort. When Cook finally called a halt to exploration, one of his stated reasons was that the antiscorbutics were all gone and if scurvy reappeared he would have no means of dealing with it. He returned to England and recorded with satisfaction that the Resolution had lost only one man to disease and it was not scurvy.

Cook had done it again. In learned circles there was nearly as much interest in his health regime as in his discoveries. He was elected a Fellow of the Royal Society on the strength of a five page letter he wrote to Pringle outlining his practices. In summary, these were:

- Personal hygiene: cold bathing, clean hands
- Personal exercise: walks ashore
- Personal comfort: clean, dry clothes, hammocks and bedding
- Personal rest: short passages, three watches instead of two
- Ship hygiene: cleanliness, ventilation, fumigation
- Galley discipline: ship’s coppers scoured after use
- Hydration: no water rationing, frequent replenishment
- Diet: reduced salt meat, prohibition of meat fat, fresh food whenever available, sugar in place of oil, wheat in place of oatmeal
- Antiscorbutics: sauerkraut as item of diet, portable soup as dietary supplement, various others as medicines

Pringle read Cook’s letter to the Society and followed it up later that year with an unprecedented announcement: Cook would receive the Copley Gold Medal, the Society’s annual award for the paper that contained ‘the most useful and most successful experimental inquiry’. This was irregular, as Cook’s work was hardly experimental in the scientific meaning of the term. He had written a letter, not a paper. He had not been a Fellow at the time and so was not even eligible to read it to the Society. Indeed, he could not be there to receive the medal in person because he had already sailed on his third and, as it turned out, fatal voyage. Pringle proceeded to read a paper of his own composition that elaborated at length on Cook’s letter. No-one moved dissent from this novel proceeding, because the scientifically-minded gentlemen of the Society understood that the defeat of scurvy would be, as we say today, a force multiplier for the Royal Navy.

Before leaving on his third voyage, Cook took steps to familiarise fellow mariners with the new antiscorbutic plants. He asked the publishers of his book to include etchings of the New Zealand spruce, tea-tree and scurvy grass. The rimu and manuka were illustrated but the scurvy grass, known to the Maori as nau, was omitted. So here today, 235 years on, I’d like to remedy the publishers’ failure and let Cook show you what to look for when stranded in New Zealand with swollen gums. It is striking that all of the plants illustrated in the book are included for their utility rather than their interest to science.
The Voyage of Resolution and Discovery

On the third voyage Cook again lost no man to scurvy. He continued his search for antiscorbutics and at an inhospitable archipelago in the Southern Ocean came across the Kerguelen cabbage, which became the salvation of many a whaler during the following century. It is watery and acrid, said Cook, and best eaten raw.\textsuperscript{xii} It was named for Pringle. From Alaska Cook reported to the Admiralty that after more than two years on voyage there had been little sickness in the ships ‘and scurvy not at all’.\textsuperscript{xii} By then all he had to do was set the example. While ashore he would always find some edible plant. Master’s mate Alexander Home observed that in time the men adopted the same humour and disposition as by infection 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 aboard from a pleasure jaunt with a handkerchief full of greens.\textsuperscript{xiv}

It is therefore rather sad to relate that only two months before his death Cook was again faced with a minor mutiny like that at Madeira. As an economy measure he had brewed sugar cane beer that was to be substituted for spirits every second day. The crew collectively wrote to him complaining that the decoction was injurious to their health. The real issue, of course, was reduction of the grog ration. Cook pointed out the speciousness of their argument given that they stole sugar cane to eat it raw. If they would not drink the beer he would send the spirits cask below and they could drink water. The cooper was subsequently flogged for spoiling the cane beer. Cook told the ship’s company that he regarded their letter as a mutinous proceeding and they could expect no indulgence from him in future. He remained convinced that it was by such ‘little innovations’ that he had kept the ship largely free from scurvy but the episode reveals that in this, as in other matters, Cook’s relationship with his men was deteriorating.

The Unknown Ingredient

We now know that scurvy is caused by a deficiency of vitamin C, which our bodies cannot synthesize. In Cook’s day it could only be obtained from plant and animal food. Our bodies also cannot pool more than about 1500 milligrams and a minimum daily intake of 5-10 milligrams is necessary to maintain health. Time and heat degrade vitamin C, so even good sources can become or be made impotent. Contact with metals, including copper and iron cooking vessels, is also destructive.\textsuperscript{xxv} Of Cook’s naval provisions, the sauerkraut was probably the most enduring antiscorbutic: even after a month’s storage it would still have been delivering about 50 mg of vitamin C every 2-3 days and after two years Cook could declare it to be still wholesome and palatable, although its potency would by then have declined considerably. Nevertheless, fresh provisions apart, for the early part of the voyages sauerkraut would have underpinned the whole antiscorbutic regime. To what extent the other antiscorbutic stores could have effectively supplemented the sauerkraut over time can be estimated from the following table.\textsuperscript{xvi}
Vitamin C Content of Antiscorbutic Stores (mg/per 100 g or /100 ml)

<table>
<thead>
<tr>
<th></th>
<th>Initially</th>
<th>After One Month</th>
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<tbody>
<tr>
<td>Cabbage</td>
<td>45-60 (raw)</td>
<td>10-15 (as sauerkraut)</td>
</tr>
<tr>
<td>Rob of oranges</td>
<td>240</td>
<td>60</td>
</tr>
<tr>
<td>Wort of malt</td>
<td>0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Marmalade of carrots</td>
<td>(unknown but ‘few opportunities’ to try)</td>
<td></td>
</tr>
<tr>
<td>Saloup</td>
<td>(unknown but only 90 doses available)</td>
<td></td>
</tr>
<tr>
<td>Portable soup, sugar, vinegar</td>
<td>negligible</td>
<td>negligible</td>
</tr>
</tbody>
</table>

Note the precipitous decline in the potency of the rob, which at that rate would make it ineffective within three months. In any case the 24 pints shipped were only sufficient for 120 doses of 100 ml each. The figures for the wort are misleading because Cook administered it in massive doses that contained as much as 3.6 mg/day of vitamin C. This may explain why Cook was able to conclude that the wort arrested scurvy even though it could not cure advanced cases. Ironically, early in the voyage his men would have got far more vitamin C from the malted barley had it been served dry rather than as wort. Cook dismissed the rob as ineffective, which it almost certainly was late in the voyages, but his statement to that effect is said to have had the unfortunate consequence of delaying the introduction of unconcentrated lemon juice, which the navy did not issue on daily allowance until 1795.

As to the value of Cook’s ‘found’ antiscorbutics, it was a case of the less processing the better. Fresh spruce leaves and shoots, for example, retain nearly half of their vitamin C content in solution but when the solution is allowed to ferment lose nearly all of it. Nonetheless, that half milligram per hundred millilitres of vitamin C retained by the fermented product would have protected any seaman who drank three pints a day.

**Cook’s Legacy**

Cook was not an innovator in the large sense. Most of the remedies he tried were foisted on him by the Admiralty or gleaned from the experience of his peers. This was empirical medicine at full stretch and Cook had no way of knowing exactly what was having the desired effect. The point that impressed contemporaries however, was that whatever he was doing it worked. When George Vancouver, who had sailed twice with Cook, was given his own exploratory voyage, he expected that if he followed the Cook regime it would control scurvy, whereas a quarter of a century earlier he would have accepted losses as inevitable. One can appreciate his ‘utter astonishment and surprise’ then, when en route to Juan Fernandez in 1795, there was a major outbreak. Vancouver was at a loss to explain it until the cook confessed: against strict orders he had been selling slush from the coppers. Thereafter the formerly reliable antiscorbutics seemed less effective. With reinforcement of the prohibition and refreshment at Valparaiso all hands were returned to health.

So was there something to the concern of Hutchinson, Cook and Vancouver about meat fat? Studies in the 1970s suggested that there was: heating oxidizes the fat which inhibits the consumer’s
absorption of vitamin C. While we might allow this to be a triumph of observation, overall it is for Cook’s insistence that fresh is best - that an onion or a fish or a few pints of spruce a day could keep scurvy at bay - that posterity should honour him. This was not original, but the determination with which he extended the antiscorbutic menu and persuaded his men to dine appears as impressive today as it did then. We might therefore allow Cook the last words, in fact those with which he concluded his book of the second voyage.

It is with real satisfaction, and without claiming any merit but that of attention to my duty, that I conclude with the observation that our having discovered the possibility of preserving health amongst a numerous ship’s company, for such a length of time, in such varieties of climate, and amidst such continued hardship and fatigues, will make this voyage remarkable in the opinion of every benevolent person when the disputes about a southern continent shall have ceased to engage and divide philosophers.

G A Mawer

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\(^{ii}\) Ibid., p. 74
\(^{iii}\) Ibid.
\(^{ix}\) Ibid., p. 188
\(^{xi}\) J. Pringle, *A Discourse upon Some Late Improvement of the Means for Preserving the Health of Mariners*, Royal Society, London, 1776, p. 2
\(^{xiv}\) Ibid., p. 1456
\(^{xvi}\) Adapted from the table of analytical values of traditional antiscorbutics in K. P. Carpenter’s *History of Scurvy and Vitamin C*, Cambridge University Press, 1986, p. 226
\(^{xvii}\) Ibid.
\(^{xix}\) J. Watt, op. cit., pp. 58-9