

## **Supplementary Material 9**

**Beckler H. (1867). Ueber das Auftreten und den Verlauf von Scorbut im Innern Australiens. Im Auszuge und mit einleitenden Bemerkungen in der Sitzung vom 18. April. vorgetragen von Prof Dr Hirsch *Verhandlungen der Berliner medicinischen Gesellschaft*. 1865-66 pp. 211-240.**

Translated by Thomas A. Darragh.

### **On the outbreak and progress of scurvy in the interior of Australia by Dr Hermann Beckler, late medical officer to Burke's exploring expedition Dr Hermann Beckler**

Presented in summary and with introductory remarks by Professor Dr Hirsch in the Session of 18 April.

Gentlemen! Today I beg leave to draw your attention to a disease, the consideration of which no doubt offers an insignificant practical but still predominantly scientific interest for us; I speak of scurvy, about which an interesting report lies before us, which Dr Beckler, physician with the Burke expedition through the interior of Australia in 1861 and discussed so much on account of its unfortunate conclusion, sent to me and has made available for our Society's purpose.

If I stress the scientific interest that this disease offers compared to the insignificant practical interest that scurvy affords, given the confirmed almost complete decline of this form of disease from the theatre of diseases that especially occupy us, I particularly have the question of the aetiology of it in mind, which in spite of numerous studies directed at it still waits a final solution. I may assume as known the conditions under which scurvy usually occurs on water and on land particularly. There are grounds for the supposition that with this peculiar malnutrition etiologically it essentially concerns the influence of certain alimentary deleterious agents; that it owes its origin particularly to the lack of fresh vegetables or fresh meat or even just to the eating of a poorly apportioned nutriment subject to no variation, or other similar factors; and that it is still a question to be decided whether this peculiar

disease according to its whole appearance bearing the character of a specific form of disease owes its origin to such a clearly specific alimentary deleterious agent, or whether manifold and various deficiencies given in the manner of nourishment and errors, individual or combined with one another, are capable of causing that malnutrition from which scurvy results.

The report submitted by Dr Beckler offers an important contribution to the answering of this question, in so far as he saw the outbreak of the disease on the expedition into the interior of Australia which he accompanied under circumstances that were essentially different from the circumstances mostly observed previously. His experiences must be ascribed all the more importance as the results to be drawn from them for the pathogenesis are controlled by a series of repeated observations communicated by him. However, it seems to me no less deserving of attention as the one that Dr Beckler communicates about the course and the state of the disease, so that I may be assured of your approval, when I recommend this report, which I can communicate to you today only in abstract, for the full inclusion in the memoirs of our Society.

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During the preparations for Burke's expedition, to which I was attached as physician and botanical collector, I ascertained from the various reports of Australian exploration that several of the expeditions sent into the interior of the country had suffered much from scurvy.

Captain Sturt, who had stayed with his companions so long in regions of Central Australia and was himself brought to the edge of the grave by this disease, gave no details about it. He just mentions it very frequently as a highly insidious and fearful disease; likewise Leichhardt and Carron in their accounts of Kennedy's expedition. I also had observed some, but slighter, cases of scurvy in Australia myself. Therefore I had to make myself properly prepared for the appearance of this feared visitor of the dry inland, but nevertheless the disease slipped into our party almost undetected and at a time when it was scarcely thinkable that we would have already such an uninvited companion.

We left the depot on Pamamero Creek near the Darling River on 25 January 1861 and I find in my diary already on 22 February, after travelling only a distance of 200 English miles, an observation that I had suspicion of scurvy outbreaking soon, on account of lack of water in this whole time (whereas under the usual difficulties of such a journey double the distance could be travelled in the stated time).<sup>1</sup>

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<sup>1</sup> For example I made this journey from Pamamero to Dooroodoo (200 miles) previously in company of two Blacks and with eight camels and a horse there and back in 14 days.

We reached Dooroadoo on 13 February and after various attempts to advance further into the interior, we had to remain in the vicinity of Dooroadoo until the middle of March, because this was the only place at which water was still to be found remaining from the October rain. Here the disease began to appear.

The idea that scurvy is generally the consequence of a lack of fresh vegetables, of continual consumption of salt meat, unsalted bacon, with lack of fresh meat, of old dried bread or biscuit and other similar deficiency in the manner of nourishment has such a general acceptance and is confirmed by so many observations that one can have hardly a reasonable doubt on the admissibility of it. However I must admit that what I observed myself on the sea and land and have experienced warrant a substantial modification of the generality of that idea, all the more so as I think that the observations made by me at sea constitute not the exception but the rule in ship's hygiene.

On a small ship that went from Hamburg to Australia with 250 passengers and on which, with exception of the serving of fresh potatoes during the first three weeks, none of the 250 steerage passengers received a scrap of fresh meat, fresh vegetables or even just fresh bread, no case of scurvy was observed. The salt meat was in general good, but of the ship's biscuit, the sailors maintained that it had already been on a long voyage, at any rate had crossed the equator already once, which was very likely according to its appearance. On the Continent, it is a rather widespread opinion that in this respect sailors are now much better provided for than previously. Certainly there is better provision especially in fresh water, but by far not so as one thinks. During a three month voyage on an English passenger ship, a model ship of one of the best known firms, I have seen the sailors getting no fresh food, with the exception of potatoes at the beginning of the voyage, whereas the steerage passengers on this ship received preserved meat in tins twice a week and lime juice is also given to the crew, although by no means always.

One of the most important experiences for the answering of the question about the manner of origin of scurvy, I find in the fact that expeditions in Australia with much poorer fit out than ours spent months in the interior of the country without being struck by scurvy, although they had only insufficient rations for several weeks before their return and had to suffer real distress. Furthermore experience teaches that thousands of shepherds and stockmen (people who are employed on cattle stations) get neither fresh meat, nor milk, nor potatoes, nor other fresh vegetables for months and yet even with their very monotonous diet do not fall ill with scurvy. Therefore it is all the more imperative to enter here into a detailed description of the transport offered for our expedition, because according to the general assumption the manner of nutrition is in such close connection to the genesis of scurvy.

Our whole equipment, all our necessities were advised by a committee, which consisted of distinguished men and experts, who for the most part had instigated the undertaking of the expedition by establishing a fund and by collection of contributions.

This Exploration Committee also made it its task to choose our provisions. After the sad end of the expedition no small part of the failures were laid on this committee's account, therefore by this opportunity I also feel obliged to acknowledge gratefully the active enthusiasm of it as well as the extreme care and the most scrupulous consideration and testing of all suggestions before they were adopted.

There was a store of rich and various experiences in the travel works of previous Australian explorers at hand. In the Committee itself sat men, who had made significant inland journeys. In addition the written advice of famous travellers was readily placed at the disposal of the committee. A leading question was of course the article "meat".

To begin with what kind of preserved meat might come closest to a freshly slaughtered animal and in what state such meat would keep the best during a long journey through hot and dry regions was discussed most thoroughly. Salted beef found no recommendation at all in these deliberations, but salted fatty pork (bacon), which Gregory took with him on his great journey and which had kept very well. All his companions ate it with great eagerness (how strange this may sound considering the summer heat in a tropical country – Victoria River in northwest Australia), which must be ascribed more to an instinctively felt necessity than to a personal preference and perhaps was connected to the consumed quantities of nitrogenous, fat-free food and the increased metabolism with the way of life and activity of the people that were determined by the conditions. You see the metabolism in the tropics with continuous sojourn in the open air and with a bodily activity that one regards as usually impossible for Europeans in hot countries seems to be increased no less than under similar conditions in temperate zones.

The process by which the so-called 'pemican' is prepared was regarded as the best way of preserving meat, an article, which played a great role in polar and land journeys in North America. However, none of the samples produced in Melbourne matched the expectations of the committee. This pemmican contains muscle meat and fat in proportion from 9 to 5. The former is dried and then pulverised muscle meat is intimately mixed with melted fat and then packed in skin sacks. However for an Australian overland journey it already appeared unsuitable for that purpose because the fat would probably be only rarely in any another condition than semi-liquid, therefore the transport and the use of a packet would be possible only with great loss, whereas in polar countries though the daily

rations were cut out with a hatchet. Pemmican therefore was given up and they decided on air-dried beef, salted pork and bacon.

This was, however, not the supply of meat that we had. Burke took the largest part of this supply with him into the interior; I did not accompany him myself for certain reasons, but waited on the Darling until a second party departed, which I then joined. We had a significantly better supply of meat.

The supplier in Melbourne had correctly deferred the delivery of the dried meat until the last day. One had to have it and accepted it therefore, although it left much to be desired. On the contrary we prepared our supply of dried meat ourselves. We cut the meat of freshly slaughtered animals into long thin strips, which we hung up strewn with pepper to dry. In 4-5 days the meat strips were dried. Those parts, which on account of their shape and their fat content did not dry in the manner mentioned, were salted and buried, wrapped in the fresh skin of the slaughtered animal. After 4-5 days the meat was taken out, and likewise hung up to dry, and so retained the largest part of the fat. In this way we had 450 pounds weight of meat of four very fat beef cattle, whose individual weight in life was calculated at 800 pounds.

I still have to make mention of an article that is certainly only very little known in Europe, but which during this expedition proved very worthwhile and earned the warmest recommendation for similar journeys. Gregory, the famous Australian explorer, to whom the interior of Australia became home through his many expeditions, gave the first idea about it. His wide experience and his versatile talent also did not desert him in any difficulty. A part of his provisions for his great journey from the Victoria River in northwest Australia to Queensland consisted of boiled preserved beef. This article was imported from England and also from the Continent and replaced to some extent the fresh meat on passenger ships, but because his people found it quite unpalatable, he suggested the meat with the surrounding liquid be mixed with flour to a dough and be backed in small flat cakes. The biscuit tasted very well and now became the most popular article of food for everyone.

Dr Mueller, director of the botanical garden in Melbourne, who had accompanied Gregory on this expedition and who with few others contributed the most to the success of our expedition, recommended to the Exploration Committee, to which he also belonged, having a larger supply of these meat biscuits prepared in addition in Melbourne. This was prepared in a quantity of 1200 pounds under my special supervision in a steam biscuit bakery. The weight proportion of meat, fluid and fat on the one hand to flour was 26 to 40 and became our best article of food. It packed well in barrels, later also in bags and kept for months during the whole journey exposed to heat without shadow quite well, whereas our supply of meat suffered very much both from the heat as well as from insects and their larvae.

This biscuit can be eaten without any further preparation. Pounded with boiling water it gives an appetising soup in the shortest time and with careful preparation of them individual particles of meat are hardly to be distinguished or not at all.

As for our remaining provisions and their quantities, a list of articles received by me in the Government Store conveys the conviction that on our journey into an inhospitable country we had not carelessly exposed ourselves to starvation.

The provisions given were calculated for 20 men for a period of 12 months and were as follows:

- 6000 pounds wheaten flour,
- 2200 pounds rice,
- 800 pounds oat meal,
- 2776 pounds sugar,
- 372 pounds tea,
- 22 pounds coffee!
- 100 pounds dried apples,
- 172 pounds cooking salt,
- 10 gallons vinegar,
- 20 gallons lime-juice,
- 50 pounds large raisins,
- 50 pounds currants,
- 144 pounds dates,
- 20 pounds chocolate,
- 60 pounds powdered mustard,
- 30 pounds pepper,
- 1000 pounds Schmalz (ghee),<sup>2</sup>
- 1800 pounds bacon (salted, not smoked),
- 1320 pounds meat.

The quality of all these commodities was carefully checked and delivered only after they were found good.

How advantageously our meat provisions differed from Burke's, I have already mentioned. Moreover on our stay in Dooroadoo, three of us (Stove [Stone], Hodgkinson and I) had according to

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<sup>2</sup> The item Schmalz is unknown to the British. This 1000 pounds of ghee was cunningly intended for the camels, but they got even less of it than we ourselves. [In the printed list of provisions given as 'ghee or clarified butter'. See *Transactions of the Royal Society of Victoria* 5: lxxv.]

circumstances an abundant supply of meat in the form of wild ducks, whereas the other five (Becker, Purcill, Wright, Smith and Beludsch) certainly did not enjoy this advantage.

During our stay at Puria Creek (from 20 to 28 March), we found an abundant and varying supply of meat in wild ducks, doves, small kangaroos, black swans, ibis, water hens, fish, crabs and shrimps and likewise at Bulla and on the return journey at Koorliatto Creek fresh meat, admittedly only in the form of rats, which, although prepared in the best way and in the most pleasing form, were still only little palatable to most of my companions and they finally became revolting even to Wright and me, who ate these little creatures without any prejudice.

In our meat biscuits we had in addition the most suitable combination of albuminous and fatty food, at the same time in the most compendious and lasting form and of a pleasant taste, so that even with daily use we did not become indifferent to this biscuit and we never got sick of eating of it. Very appropriately we combined fat with flour in large well-baked cakes, in the mixing of which we often added sugar, whereby it was only to be regretted that of pure fat we had taken with us only a very tiny supply of 'Schmalz.' The consumption, which we could make of rice and sugar (in small brown crystals), was almost unlimited. Likewise during our whole journey we had fresh bread and where it was possible, we baked small loaves for breakfast daily. Rice with apple or with sugar, prepared in the Indian,<sup>3</sup> that is in the most superior way, was a part of our daily food.

A barrel of dried apples (from California) retained its original freshness during the whole journey and was an excellent article.

On the other hand there is little good to say about our preserved vegetables. We had only a couple of packets of dried mixed vegetables (the firm provided for the French navy), whose nature of preparation could be justified according to the supposition that they would substitute to some extent for the lack of fresh vegetables. These vegetables were dried but not compressed. By far the largest part of our stores consisted of unmixed, dried and compressed vegetables of very different kinds, which I must regard as useless according to impartial judgement. We boiled them for hours without getting anything other than leathery, tasteless and odourless indigestible scraps. They were not worth taking along however negligible their weight.

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<sup>3</sup> Despite much practice and attentive observation we could not reach the virtuosity of our Indians in the preparation of rice. The rice was simply boiled with water in a large tin receptacle. When Beludsch or Batan undertook this function the rice was completely ready with the evaporation of the last drop of water and the beautiful swollen grains lay all isolated beside one another, a dish that neither English nor German cooks accomplish.

Finally we did not lack spices and other stimulants for the stimulation of the secretory activity of the digestive organs. We had mustard, pepper, mixed pickles, chutney, curry powder (Indian mixture of spices), mustard pickles (fruits and vegetables preserved with mustard and vinegar), Worcestershire sauce, ginger, cinnamon and in addition we carried an astonishing store of tea, less coffee and chocolate with us.<sup>4</sup>

This overview of the provisions taken with us and the food otherwise prepared gives in fact the proof that in this respect we had no deficiency on any side. We carried nitrogenous food with us in great abundance, we had sufficient quantities of heat producing food stuff, we combined our food very diversely, and our provisions allowed us so much variation, **nevertheless scurvy made its appearance among us already three weeks after our departure from the Darling.**

How meagre a list of the provisions of other Australian expeditions both as concerns quality as quantity would look compared with ours, I will only allude to and yet so many of them remained immune from scurvy; like the party, sent off after our return which reached Coopers Creek and were chosen to bring the remains of Burke and Wills to Melbourne and whose provisions consisted for the most part of those which we had not taken and left behind, did not suffer from scurvy. With them went an esteemed fellow countryman Herr Brahn [Brahe], a Westphalian, who had been with Burke at Coopers Creek, and remained there five months at the Depot. He fell in with us on the return journey near Bulla, likewise became slightly scorbutic here. After our return to the Darling without recovery, he immediately returned again with the above mentioned party to Coopers Creek and finally came to Melbourne healthy. But they had – water – fresh water; because it had rained very much on the Darling and in the interior since the time of our return.

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<sup>4</sup> Among our provisions was even a sack of cocoa leaves (from *Erthroxylon coa*) that a Mr Ledger had given us, who at the same time knew not enough how to praise the superior and wonderful effects of these leaves to us. You see they represent nothing less than food and drink to the South American natives, herdsmen and travellers. They are said to chew a half to one ounce daily. Neither the feeling of hunger nor the torments of thirst can come to their full perception and in addition make the Indian wandering through waterless tracts still capable of completing his journey; naturally, if the absence does not last too long. According to Mr Ledger, Indians and herdsmen are said to have endured even a six to eight day scarcity with the help of this tranquillising stimulant, if one may say so. I myself went for several weeks with cocoa leaves with me in order to test their action, for which at times we too much opportunity, but it must be left to others, to chew dry coca leaves the whole day without a mouth full of water in order to slake their thirst.

With reference to coca as a means of warding off thirst, I remark that I have made such trials with the most varied means. Acids, sugar, extract of glycyrrhizine [licorice] all do not help. However, I always found the greatest relief, that is in great heat and motion, riding or walking, feeling as passable as possible and preserving my strength in wrapping my mouth and nose with a long piece of cotton cloth and breathing through it, while at the same time keeping 2-3 small pebbles in my mouth and from time to time rinsing them around with the tongue. They acted so evenly on the mucous membrane by their mild irritation and presumably on the salivary glands that the oral cavity always remained moist without having to cast up spittle.



The water we used, with the exception of Bulla and the Koorliatto Creek connected with it, had stood already for months without movement. A world of living creatures, plants as well as animals, had developed within it; a mass of whitish-grey clay was suspended in it; and had made it viscous and opaque and given it a dirty creamy colour. Often the gloomy thought stole upon us that we should have been pleased to have water here, in which we would not have even taken a foot bath at home. Nevertheless it did not taste bad at all and we easily became used to it. According to the water temperature measurements taken in Coopers Creek on the shady side by Mr Wills, it had an average temperature of 97.4° Fahrenheit and yet it seemed to us, cooled in a cooling bucket, extremely fresh and refreshing, nearly cold. On boiling it was covered by a dirty-brownish-yellow foam of small bubbles and left a filmy coating in the vessels that was hard to remove. However, tea precipitated this suspended material so that a large flocculent precipitate formed that reached up to half the height of the utensil.

**After all that we experienced and could observe, it was this condition of the water or rather the lack of fresh water that was the cause of the scurvy outbreak among us.** Especially speaking in favour of this was the early occurrence of the disease, in fact at a time when its genesis in no way was explained by the condition of the food. Above all the general and also rightly considered lack of fresh vegetables as the main cause of the scurvy was out of the question as an explanation for the outbreak of scurvy among us.

The circumstance that the disease befell single individuals of our expedition under the same or indeed little different external conditions in very different degrees in an extent of shorter or longer indisposition with continuing, although diminished, ability to work, up to complete exhaustion with lethal result, finds, as the following evidence will show, its sufficient explanation in the varying capacity of resistance and in the constitutional as well as conditions of age which influenced each one.

For the purpose of a description of the course of the disease, I intend firstly to specially describe the four fatally ending cases, then give a summary report on the form of the disease in the remaining cases and finally compile in a summary the most important pathological and therapeutic facts.

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## Case histories

**No. 1. Charles Stone**, a tall man of strong build, but poorly developed musculature. When he came to us, he asserted to be healthy; his appearance agreed with that very slightly, just his fat-free skin of

dark, drab-yellow colouration, particularly the angle between eyes and nose was conspicuously dark. In addition he was inclined to coughing and his voice mostly hoarse. Moreover he had suffered from syphilis by his own admission and treated himself haphazardly and unmethodically with quicksilver. Stone was now the first of our scorbutics. The notes about him began on 3 March. On this day, he showed me a small localised, hard swelling over the middle of the left tibia. Objectively I could regard the swelling only as a periosteal inflammation. A fresh outbreak of syphilitic disease might be favoured by the previous hardships and privations of the journey. The gums of his lower jaw showed a slight degree of loosening only at one small spot between two incisors. Already before this time we all had used lime juice as a preventative. I now prescribed Stone alum internally and as a mouth wash. Up until 15 March, he was with us in Dooroadoo and alternatively felt better, and then worse. It was just noticeable that while Hodgkinson and I could scarcely satisfy ourselves, Stone conspicuously ate less. He explained that he really had the very best appetite and could just not eat our provisions. Admittedly we had here the most primitive cuisine that one can think of (our camp, stores &c were already far in advance and we lived here only so to say from one day to another), but frankly Stone ought to have put up with it most easily from many years of habit. Notwithstanding the simplicity of our cuisine, however, we had here delicacies in form of very fat wild ducks and water hens, which were not to be scorned. In addition Stone complained very much about searing pains in the back, in the limbs, in the feet and —admittedly after very hard marches in looking for horses — about great fatigue. He was always with the horses, had the duty continuously until we came to Koorliatto Creek, where he, like we others, was severely drenched by a nocturnal shower of rain and next morning (3 April) complained about very intense joint pains and pains in the limbs. As Stone, like all bush people, had already suffered previously from rheumatic afflictions, I regarded these joint and back pains that so suddenly appeared after the drenching as rheumatic and treated him with Tinct. Colchic. [tincture of colchicine] and Tinct. Opii. [tincture of opium] despite the certainty that the invalid suffered from scurvy. The pain rapidly ameliorated, but the invalid now suddenly very weakened was no longer able to recover. On 5 April, despite my advice to remain here, nothing would stop him from travelling with Wright to Bulla.<sup>5</sup> It was pitiful to see the poor man (Stone), who could hardly walk, labouring with the horses and when he took leave of me, he was so exhausted that he himself thought about his speedy end.

On 14 April Wright, who visited us at Koorliatto Creek (25 English miles from Bulla), brought me the news that Stone was very ill, especially complaining about great shortness of breath and for some days had frequent thin stools, after which every time losing a considerable amount of liquid blood. I sent him quinine, tannin powder, Pulv. Kino comp. (Ph. Lond.) [compounded powder of kino, London Pharmacopeia] with the necessary prescriptions. On the evening of 21 April when we came to Bulla, I

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<sup>5</sup>You see Mr Wright left Koorliatto Creek on this day, while I had to remain here alone with two invalids (Mr Becker and Purcill) not capable of being moved.

found him with emaciated features, his eyes deeply sunken, the conjunctiva bulbi intensely yellow, the nose bluish-violet, the lips pallid, in addition extreme exhaustion, high level of dyspnoea, pulse irregular, intermittent, contracted, scarcely to be counted. The examination showed a complete dullness of the right rear half of the thorax, at the front the sound was tympanitic; respiration behind to the 3<sup>rd</sup> rib not perceptible, the ailing half of the thorax only moving very little on breathing. The cardiac dullness seemed intensified, the cardiac sound extremely weak, scarcely perceptible; no sound to be noticed. The patient had therefore a considerable serous exudate in the right pleural cavity and highly likely also one such in the pericardium. Repeated doses of morphine alleviated him substantially and procured him such a good night (the first for a long time) that next morning full of fresh hope he thought about his recovery. However, he died on this day at 2 pm under certain interesting circumstances.

It was this, the first day on which we were all in Bulla. Since 3 am the Aborigines troubled us several times and from 10 am until 1 pm we three confronted the Aborigines who were armed for action. Two people were absent to see to the animals, three, Stone, Becker and Purcill lay near to death in their tents. Yet in the last hours of his life and with a strength of voice, which the patient had not had for a long time, the dying man, lying between us under a small shelter, tried to make the natives understand in fragmentary sentences in the language of the Darling Blacks what we wanted and why we were here. They did not understand the language and shortly after we had driven off the natives by force, he died. The last great excitement, in which, undaunted by death, he still wanted to render us good service, had exhausted the whole remainder of his strength.

**No. 2. William Purcill**, cook, about 36 years old, a man of short, thickset build, however also prematurely aged. It was surely not an adventurous temperament or even enthusiasm for participation, even if still so slight, in a great difficult undertaking, but solely the prospect of good pay that had brought our cook to us. During our stay on the Darling he was mostly very quiet and serious, but the privations and the hardships of the journey that struck every one in equal degree, immediately caused him to appear in his true light. He became rough and common, and as soon as he found that even the greatest pay was too small for him to make sacrifices, he became discontented and full of despair. Without doubt this frame of mind did not remain without influence on the development and the course of the disease. Purcill was already ailing during the stay at Mud-plain camp (end of February until middle March). He had been exposed there to the same disease causing influences as Mr Becker, with whom he was stationed there, to uninterrupted great heat in a completely waterless desert, to bad drinking water,<sup>6</sup> and moreover to the depressing effects of such a solitary stay in one of the most inhospitable regions of the earth, and to lack of occupation, whereby he had completely free leisure to

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<sup>6</sup> The drinking water was brought alternatively by Hodgkinson and I every fifth day by camel to this camp from Dooroodoo 40 miles away.

indulge his ill-humour and to brood over the poor and uncertain plans of our advancement. During the journey from there to Puria Creek, our worst passage, Purcill was incapable of travelling. We lifted him and loaded him on a camel, lifted him down again, fed him and prepared his bed.

22 March, Puria Creek. Whereas Purcill could still remain upright six days ago, now he walked or crawled with bent upper body, the knees bent, in addition swelling around the ankle and in the hollow of the knees. Warm baths (which were made by means of excavations in the ground and waterproof tarpaulins).

30 March. Great weakness, swelling in the thigh, warm baths. Internally Citras. ferr. [citrate of iron], besides Chinin. sulphuric. [quinine sulphate].

His condition now altered really very little. He ate and drank extremely little and was almost always feverless. He became weaker and more ailing without particular symptoms. A few steps, which he performed half creeping, made him breathless and deadly pale.

In the evening of 15 April severe fever with attack of shivers. In the night of the 19<sup>th</sup> to the 20<sup>th</sup> April sudden feeling of nausea. Shortly after (for the first time during the illness) copious bloody stools of fetid odour. Severe fever. – Ordin. Pilul. Hydrarg. gr. X., Opii pur. gr. j [Mercury pill, 10 grains; powdered opium, 1 grain]. The diarrhoea did not return again.

21 April. Journey to Bulla. The patient bore the day long journey rather well. The prospect of meeting the others at Bulla and the change of locality seem to give him new hope. Even I still had by no means given up the patient.

23 April. The patient became faint as often as he tried to raise his head. He cannot take a drink of water, without sinking back weakly.

On 24 April at 4 am he asked Mr Wright who was keeping the watch, to have me come. He could still just complain of difficulty of breathing and asked for water. After 10 minutes he was a corpse.

**No. 3. Ludwig Becker**, attached to the expedition as artist and zoological observer. Because he always had lived in large cities and during the last seven years in Melbourne, bush living was completely foreign to him and this circumstance and the really significant hardships with his of age of 54 years might have had a markedly unfavourable influence on him. With him the main cause of the such rapid development of a high degree of scurvy was also the stay at Mudplain camp, which he himself called camp of desolation in his pictures. In fact here it was mainly the bad drinking water,

which came from Dooroadoo to that place in a condition of putrefaction through the transport at the time. However, Mr Becker was always in good humour, at least good morale. He also used to fill out the undisturbed leisure he had here with very diligent work. Here he completed some wonderful and true to nature sketches of small pretty lizards and salamanders that he found there. The first note about his illness I find from 10 March on which day he complained for the first time that his gums hurt him and were swollen. Four days later I found his appearance noticeably changed. Up to 20 March I saw him only twice, because during this time I had to go back and forth between Mudplain camp and Dooroadoo almost constantly. I finally saw him again on 20 March, after our arrival at Puria Creek. He had travelled with the horses and the great hardships of those three days, during which the travellers had to urge their horses on, which were completely exhausted from lack of water, in order to reach the creek, as well as the unbelievable agitation coupled with it and the consequent fatigue were already sufficient to exhaust the measure of strength of a healthy person. Quite close to the creek he fell from his horse and remained lying insensible for some time. On account of the invalids as well as the horses that were dead tired, Mr Wright decided to remain here some days and I hoped for a rapid improvement in the state of health of the invalids from the sojourn on the creek, where we had better water, a shady camp and also prospect of fresh animal food. Whereas Becker even five days ago could walk as usual, he now presented the distinctive sight of a scorbutic. Now only very restricted mobility was possible for him. His knees were set almost at a right angle, his back was bent forwards. Especially in the morning, his face showed oedematous swelling. On his hands and forearms one saw scattered larger and smaller bluish-red spots. His hands were swollen, the hand and metacarpal joints very stiff and painful. On the inner side of the lower leg equal hard swellings and streaky extravasationss of blood of considerable extent occupying over two thirds of the length. The left knee was bloated and painful, the synovial sheaths of the muscles inserted here, particularly the semimebranosus, semitendinosus and biceps stretched. In the middle of the tibia at the frontal edge of it, the hard, localised periostal swelling already characteristic for us, that Stone had already acquired in Dooroadoo, became noticeable here on Becker, Purcill and even myself. His gums were loose, at many places of dull blue colour. It also became difficult for him to chew bread and meat, although he had a good appetite. Evacuations of the bowels were somewhat restrained, and for that reason he often took mild opening medicine, after the working of which he always felt better. Here at Puria Creek, he now also received alum internally and as a mouth wash both Citras ferri c. Chinino [citrate of iron with quinine].

24 March. B is very weak this morning after having diarrhoea several times during the night. Somewhat irritable mood.

25 March. Somewhat better colour of the gums. Warm water baths.

29 March. Today we finally left the creek to travel further towards Bulla. B. was very weak; he could hardly mount a camel with our help, but we had no choice, we had to go on. We reached Koorliatto Creek in the evening of the following day after getting wet through at our last night quarters as a consequence of a shower of rain. At this place we had to take a rest of several days on account of our invalids. Here Wright came to the decision to leave both our invalids, Becker and Purcill here in order to send them back to the Darling as soon as possible with the camels, which were then to return into the interior with stores. I was to remain here myself with the invalids. During the next day B became very agitated in conversation and usually soon after falling asleep began to be delirious.

1 April. Last night delirious. Right leg very painful, hard and tight swelling around the knee joint in consequence of significant exudate in it.

6 April. Sleepless night, delirium, hot head. In the morning diarrhoea several times; thin stools mixed with some blood, without pain or straining. Small doses of rheum [medicinal rhubarb] and opium. Slight decrease in swelling on the knee; skin over the swelling somewhat wrinkled. In the afternoon diarrhoea again, after which extreme weakness.

7 April. During the night diarrhoea twice of very unpleasant smell. Great exhaustion. Patient can no longer walk. Pulse 80, oscillating. Tongue heavily covered with a wide brown stripe in the middle. Great thirst. In my desperation I then decided to give the patient some doses of calomel (2 grains every two hours) and in the evening an opiate in addition rice water and arrowroot. Several watery brown-coloured stools of putrid stench, which spurted out in sudden gushes. In one of them a 4 inch long by  $\frac{1}{2}$  - 1 inch wide membranous shred of flesh, which after careful investigation I could only regard as a piece of colon lining. It was greatly swollen and over 1" [one line  $\frac{1}{12}$  of an inch] thick. Only a few of the stools following after contained even smaller membranous scraps.

From 8 April increasing weakness, very frequent thin stools (six to 12 in 24 hours), quite similar to typhus excretions. Later from 15 April on a stool of mushy consistence without blood very constant in the morning, immediately following it two to three thin excretions mixed with blood, which visibly weakened the patient.

On the journey to Bulla (21 April) B deteriorated more and more. He was very delirious, constantly tugged at his blanket, frequently uncovered himself and groaned heavily.

25 April. The patient is only worried about his personal needs. He is completely indifferent to everything else. His weakness is so great that he can no longer raise his head from the pillow. Diarrhoea always continues.

29 April. Defective function of the constrictors of the pharynx, unconsciousness, light very slow breathing. Death at 5 pm. Becker was the third dead person within seven days, whom we had to bury from a company of 9 people.

**No. 4. William Patton** came on 29 April with the depot party from Coopers Creek<sup>7</sup> to Bulla. He was a young robust Irishman (25 years old) of tall slim build and on the departure from the Darling in blooming health. Two months before his departure from Coopers Creek he was thrown by his horse and injured his left leg. I found the left lower leg very swollen, almost double the circumference of the right, feeling equally hardish, the whole inner side from knee to ankle and behind up to the middle of the calf livid red. His gums showed the highest degree of scorbutic disease. On the upper jaw they hung like a fleshy apron over the teeth, so that there was only little to see of the latter; similarly on the lower jaw. Ulcers were not present. The patient also did not complain about substantial sensitivity or uncomfortableness. The skin of his body was clean and notwithstanding the already considerable emaciation still rather rich in fat and soft. For two days P could no longer walk alone. In the chance meeting with us he derived fresh hope of recovery.

1 May. Journey from Bulla to Koorliatto Creek. The patient withstood it rather well, however, I was induced to give him a small dose of morphine in the evening.

2 May. Fomentations of warm acetate of lead solution over the swollen leg. P has no thirst, but some appetite.

4 May. Contact and pressure of the lower left leg were easily endured. The intensive red began to fade somewhat from the calf.

5 May. Patient fainted when we placed him in a chair before the tent and complained, after coming to, of indisposition and cold. No thirst. Pulse 90. Chin. sulphur. gr. ij [Quinine sulphate 2 grains] every four hours.

7 May. Today we opened the tent wall again to have fresh air drawn around the sitting patient, but he immediately became so cold that we had to bring him to bed again. In the following days, the feeling of weakness rapidly increased without otherwise any significant change in the appearances and

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<sup>7</sup> Mr Wills, Brahe, King, McDonagh, Patton and Butan (a Parsee from west India) left the Darling River with Mr Burke. The party reached Coopers Creek on 11 November. The people left there, Brahe, Patton, McDonagh and Butan, after staying at Coopers Creek longer than Burke ordered them, fell in with us by chance at Bulla on their way back to the Darling.

quickly approached a condition of extreme exhaustion. The lightest breeze chilled him. The surfaces of the palms of his hands are waxy; the nails of almond shape; his face pale. The patient received laudanum or morphine in the evening on account of frequent lack of sleep. In the evening his pulse was usually between 100 and 108, less frequent in the morning.

On 22 May we departed from Koorliatto. A very comfortable cachao for Patton was prepared on a camel, but he endured the transport very badly. It was obvious that the shortest journey would completely exhaust him and that he could not endure the slightest movement, but unfortunately we had no other option than to travel.

In the evening of 24 May, the patient had for the first time a suspicious excretion, a mushy stool of bad odour, which was directly followed by a small excretion of blood, gelatinous mucus and membranous scraps. After this no more stools until the 29<sup>th</sup>, on which day he had two thin stools with severe griping pains. Highest degree of weakness and helplessness. The diarrhoea moderate, infrequent and mostly without blood.

In the afternoon of 1 June on the journey from Puria Creek via the desert, Patton became delirious. In the night sleep under continual delirium and groaning. Pulse in the evening 110; very laborious breathing. In the next two days his condition now remained the same. At 3 am on 4 June, the patient died in a camp in the middle of the desert, not far from the dismal Mudplain camp, where our first victims had laid the foundation of their deadly disease.

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**I now come to my journal notes about those patients who recovered.** However, because the notes are somewhat incomplete owing to occasional better health of the patients and to absence from the camp at times and so on, I thought these remarks about all the recovered invalids should be put together according to time. It will also most clearly render prominent the period of our greatest misery, in which we had the worst symptoms and the largest number of invalids and it will become understandable how at a time of our journey the fear suggested itself to us that we would no longer be able to manage the work involved with the march, the packing and care of so many animals even with the greatest effort. But as soon as this work could no longer be done from lack of strength, the journey also stopped. So the progress of this distressing disease could be measured according to the increasing exhaustion and with the watch in hand.

For example on the journey to Coopers Creek, we were four people, H., P., B. and I to pack and care for the camels. At the time we really had little practice in these accomplishments and yet we four



loaded and packed 3000 and some hundreds of pounds on 10 camels every morning and in spite of all the varied difficulties and delays could usually break camp between 7 and 8 o'clock. On the way back (at Koorliatto Creek) we were six to look after the camels. Indeed there were more animals, but the loads much smaller, nevertheless the work including the transport of Patton, seemed to us already so overwhelmingly great compared to our decreasing ability to work, that we strained our utmost for three days one after another to no purpose in order just to come from the place. Until we had all in order, it was afternoon you see and too late to depart and it was not hard to calculate up to what time the working strength would be insufficient to get on with such a caravan with the same progress of the disease.

During our stay at Dooroadoo, Hodgkinson and I suffered from an unhealthy increase in appetite for several days, really a proper gluttony that surprised us both and which I find noted in my diary on 7 March. On 10 March, Mr Wright, Smith and Beludsch returned from a reconnaissance. They had provisions insufficient for 8 days with them and were absent for 16 days. The disease of Smith and Beludsch dated from then, in fact mainly in consequence of the consumption of bad, brackish water that they took in plentiful measure and after which they got firstly vomiting and diarrhoea. Also now they still suffered from diarrhoea; they had a thick white coating on the tongue, alteration of taste and had no appetite.

On 24 April Beludsch showed me a rather extensive diffuse painful swelling of the left thigh, which, as he said, he felt for 14 days and which had increased very gradually. His gums were slightly scorbutic in spots. On the same day Smith also complained about pains in the right testicle, thigh and knee. Light swelling visible. Reduced appetite. I prescribed the invalid frequent bathing of the painful parts with warm water and internally somewhat larger doses of citric acid (Acid. citric. cryst.) as before.

On 29 April we received from the depot party<sup>8</sup> from Coopers Creek that met with us here besides Patton another invalid, McDonagh, an Irishman. Significant swelling of the region of the right knee, likewise (as with Patton) caused by a fall from his horse two months ago. Movement painful, swelling hard, reaching up behind the vastus externus. In the skin over the swelling numerous small effusions of blood. Gums already significantly affected, loose, in places of livid or greenish colour.

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<sup>8</sup>The depot party had likewise used citric acid for some time, but eaten little meat, because they had only small quantities of bacon and salt pork. In addition they had wild ducks, of which there were certainly a large number on Coopers Creek, but which soon became distasteful to them. In the end they completely ran out of meat and the water level had likewise already become very low.

On 30 April I found my gums swollen and chewing became difficult and painful. Beludsch's thigh is very stiff and hard; the hardness is considerable especially at the gluteal fold and very painful. Smith also has a swelling of the inguinal glands, which cause him much pain. I had now already sufficiently experienced the failure of the drugs used so far and by way of a trial gave both patients each  $\mathfrak{z} \text{ j}$  [1 scruple] of potassium iodide in solution per day.

3 May. Smith and Beludsch still complain very much about pains in the thighs and in addition Smith about pains in the side, particularly on breathing deeply, also about stomach ache. Nothing abnormal in the ailing left half of the breast was proved by tapping and by the stethoscope. The crural glands in Beludsch are also now swollen.

6 May. Beludsch complained about more pains in the right thigh than in the hitherto ailing left. The glands are still swollen, but at the same time he has an excellent appetite. Today Smith feels worse than during the last two days. McDonagh's leg grows worse with each day. Cold poultices instead of warm and application of Linim. camphorat. [camphor liniment]. Butan also reported in sick (a young Parsee, who came to us with the depot party). Livid loose gums, strong irritation of the integument.

7 May. The condition of the three patients is the same. All three, Beludsch, Smith and McDonagh are taking  $\mathfrak{z} \text{ j}$  [1 scruple] of potassium iodide per day; washing with warm water because McDonagh has stated he could not stand cold washing. Butan shows a light temporary non-diagnostic rash over his whole body, that is combined with severe itching. He had diarrhoea several times during the night.

11 May. Butan complained again about indisposition, stomach ache. In the morning two excretions that in part contain faeces and in part made up of little digested remains of food, a gelatinous mucous and congealed blood. Pulse of normal frequency. His tongue shows a thin yellowish coating (he chews tobacco). Beludsch and McDonagh complain about great pain; in both the swelling on the back side of the thigh protrudes most severely in the lower third and down into the hollow of the knee. Like Smith they also are able to move only with great trouble and severe limping and still more painful than the movement is standing.

14 May. Today Smith had four darkly-coloured, diarrhoeal stools; on the mushy fecal mass lay a layer of blood and gelatinose mucous. The patient complained that he felt weaker and in fact he looked much weakened. No increased pulse frequency. Loss of appetite.

15 May. During the night Smith had no excretions, but in the morning again diarrhoea three times of the same character as yesterday. Patient feels very exhausted. Pulv. Kino comp.  $\mathfrak{z} \text{ ij}$  Tinct. Opii  $\mathfrak{z} \text{ j}$ . [Composed kino powder two drams, tincture of opium 1 dram] during the day. The potassium iodide

was discontinued in all patients because up until now it has had no perceptible effect and instead 5 grains alum powder given four times a day. Beludsch has declined very much; he walks only a short stretch to the camels and has to lay down several times to rest. I am now also giving him quinine 12 grains per day, although I expect little from it.

17 May. All patients are worse. McDonagh's thighs show larger streaky effusions of blood under the skin. Despite closer investigation, a change of colour is not perceptible in the Blacks (Smith and Beludsch).

20 May. The patients lie powerless and hopeless around the camp, sometimes here, sometimes there; they are quite listless and the prospect of setting out on a long return journey through waterless country with them and without them being able to work turns out to be increasingly dismal. However, because it would be pointless to wish waiting for their recovery here and above all it matters that we the remaining ones, as long as we are still capable of working, reach the Darling with the patients, we set out on the return journey on 22 May. Butan became noticeably more distressed; he complained about severe pains in the joints and in the ankles and is hardly capable of walking. Also the same periostial swelling in the middle of the tibia like in Stone appeared in Beludsch and myself.<sup>9</sup>

27 May. Today we came to Pooria Creek coincidentally at a place where a great amount of *Mesembryanthemum* was growing. As is well-known (at least according to Australian experience), the succulent leaves of this plant have just as certain an antiscorbutic action as any plant of the Cruciferae. Consequently I am not wanting in the warmest recommendation of the liberal use of this plant and immediately undertook the preparation of a decoction of it.

30 May. The state of health of the patients is decidedly better. We found a mass of *Polygonum*, the sappy point of which is eaten by the Aborigines and which I now likewise incorporated into our diet. A few days later we again met with *Mesembryanthemum* and finally on 4 June fresh rain water.

For the sake of completeness and for a better understanding of the preceding, I remark that our retreat considering the lack of water was even more risky than our outward journey. The literally absolute waterless country that we had to travel through, had on our route an extent of 110 English miles and from Puria Creek, the last northerly place with water, we had sent water in advance only at two stations (40 miles). If ever there was providential rain for an expedition that needed water in a desert, we had to take delight in this help of heaven, because without this rain, even if light and localised, which gifts surprised us every time at the places where we should have least expected it, we would

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<sup>9</sup> Although we could hardly do without him, we did have to excuse him from the work, so that now we four had to deal with 16 camels, 22 horses, a dangerously ill man (Patton) and four ambulant invalids incapable of work.

have without fail all perished. In fact not only between Pooria Creek and Dooroadoo, but likewise between Dooroadoo and Mutanié Ranges, a wider stretch of 80-85 miles. Incidentally we had already become so light headed through the lucky discovery of water twice, that we made straight for Dooroadoo in full reliance of similar lucky chances with empty water bags. When we arrived there, all was dry and the question, should we start next morning, was really a question of life and death, because if there was no water here, we could also not count on water between here and Mutanié. Fortunately it rained again during the night and in the morning an inch high layer of water stood in the claypans,<sup>10</sup> enough to save the lives of us and the animals. So up to Mutanié we twice found small quantities of water, that fresh rain had left there. We had therefore during the greater part of the return journey not only water, but fresh water.

While the remaining patients now quickly recovered, the condition of Butan, the last to fall ill, deteriorated in a significant manner. On 9 June he could no longer walk, so that we had to lift him on the camel and take him down. He had constant great pains, feverish pulse, was sleepless and devoid of appetite, and of depressed mood, which must have contributed not a little to his condition. Only when we reached our old camp at the junction of Pamamero Creek with the Darling on 19 June, did he acquire fresh courage again and in fact his condition also now improved pretty quickly, although he and Beludsch complained even longer about vague pains and even after complete recovery had lost much of their original vigour.

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**A comparison of its progress according to the cases briefly sketched above shows a great diversity of symptoms, both in regard to its state, the period of its occurrence and its sequence.**

The first symptom, by which I became alert to the illness in Stone, was a localised swelling at the front edge of the tibia, whose seat I had to presume was in the periost. I found no purpura scorbutica in any of our invalids except McDonagh. One could not detect anything in Smith and Beludsch on account of their dark skin colour. Butan was also dark enough to no longer show a purpura, but even Patton, who was bedridden so long, never showed a trace of small effusions of blood in the skin, nor more extensive spots or strips (vibices). The latter on the other hand occurred in great expanse in Becker, Purcill and McDonagh, in all three shortly before they became very ill. In Becker they probably arose in the first place from the hard ride from Mudplain Camp to Pooria Creek, whereas

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<sup>10</sup> These are peculiar flat hollows of pan-shaped form, which occur in the hundreds here and there in the sandy terrain of the inland, but again can also be completely lacking over large stretches and whose hard whitish-gray clay bottom retains water for shorter or longer periods.

Purcill sat so comfortably on a camel that it is difficult to deduce the occurrence of the streaky skin colouration in him from riding. Swelling around the ankle occurred in all the invalids, in Becker and Purcill as the first sign of illness. I had to suffer from it myself and even our slightest case of scorbutic disease (Brahe) had at least to exhibit this symptom. Becker, Purcill and McDonagh had oedema of the back of the hand as well as the face and forearm. Becker, Purcill, McDonagh and Beludsch had large effusions of blood in their muscles, less in Smith and Butan. They appeared rather quickly in all cases, so that whereas in Becker and Purcill on 14 March there was still no swelling of the thigh to be seen, on 21 March both already had such extensive extravasation that they could only walk crippled, the upper body very bent over, their knees bent at right angles and stiff. I observed disease of the gums in Stone, Becker, Purcill, Patton, Beludsch, Butan, Brahe and myself, in all only in a moderate degree. In Patton alone this symptom reached such a high degree as I had never seen it, in fact already at the time when he came with Brahe from Coopers Creek. Whereas Becker without doubt succumbed in consequence of exhausting diarrhoea, Stone likewise decidedly succumbed to an effusion in the thoracic cavity. With Purcill no such precise cause of death was to be found. Just a few days before his end, he had a thin suspicious excretion at one single time that did not recur after a 10 gr. Pil. Hydrarg. [mercury pill, 10 grains], with 1 grain of opium. Obviously he succumbed to exhaustion and the same manner of death fell to Patton's lot, because the diarrhoea, which he had acquired a few days before his death, could hardly be the cause of his end. Without doubt the transport contributed substantially to this bad outcome. I certainly do not believe that by means of the most complicated bed or seating frame, the invalids could have been transported better than in the extremely simple apparatus that we made according to Beludsch's instruction, who had already participated in the same such invalid transport on camels in India. At the same time Hodgkinson and I accompanied the invalid constantly on horses in order to be ready at every moment for him, but his leg and his weakened body could not even endure the gentle and very regular motion of the camels in the long run. With Patton one had the sad opportunity, another moment, which favoured the disease and prevented recuperation as well as rest, to study the absolute inaction of the body. Also Smith and Beludsch, once ill, were accustomed to too much rest, whereas I certainly must admit that with McDonagh and Butan movement and work could not prevent the development of the disease. There are opinions whose correctness one cannot prove point for point, but I maintain the conviction that nothing encourages scurvy more than continual repose of the body, to which Patton was just condemned by his illness. In the confirmation of this opinion I will cite what I observed in this connection on myself. Already in Bulla, but even more during our first halt on the retreat (Koorliatto Creek), after the same localised swelling on the edge of the tibia had developed as in Stone and my gums were swollen, in the night, but especially on getting up, I felt twinging and acute pains in the knee region and around the ankles, likewise in the elbows. Much more perceptible than the pains was the stiffness of these parts, that increased every day. It was evident that the same process that had already laid three of us in the grave, also began to plague me more severely and because I had not given up the love of life, despite our

distress, I thought about the means to hold off the further development of the dreadful disease as long as possible. The first thing that I tried was taking a cold bath of 15 minutes daily (at the time it was May, therefore close to the winter solstice, the water was already very cold) followed by strong rubbing down of the skin. Already in a few days I felt a slight improvement, however, every morning on awakening I was still so stiff that it would have been impossible for me to get up immediately. Our nightly rest during the first days of our stay here was rather prolonged. Already nobody thought anymore of the Aborigines when in the morning we found fresh traces of them quite close to the camp. What likewise disturbed me very much at this time was a very increased secretion of saliva during the night. On awakening I often found my bed damp from it and on my cheeks streaky crusts of dried mouth secretions. At the same time I had very bad breath and bad taste. The thought now came to me to shorten my nightly rest and so as we again arranged our night watch, I always stayed up until 11 pm in addition to my own watch of two to three hours. Already a few nights later the discharge from my mouth began to decrease and today I still think that I have to thank the cold baths and the reduction of rest that I remained able to work during the rest of the journey.

No less alarming for the physician observing himself is the increasing feeling of weakness that came to my realisation as well as the others less in walking than in working and carrying. Every still so familiar object daily seemed heavier to the invalid. In lifting a load one had the feeling as if the muscles stretched and the arm became longer. While I was usually able to carry up two buckets of water (about 33 Maas [c33 liters] to the bucket) without difficulty four times one after the other from the deeply lying creek to the camp, I was now exhausted in going one way and sweated with significantly increased frequency in breathing and heavy beating of the heart, a fact that reminded me vividly of Carron's distressing report of Kennedy's expedition where two people leaning on sticks always had to go with one another to fetch a vessel with water to the camp, for which they required a quarter of an hour, whereas the distance of the camp from the water amounted only to a few yards.

Great differences in the individual patients emerged in the symptoms originating from affliction of the digestive organs. Some (particularly Purcill and Stone) suffered from complete loss of appetite while in others, particularly in the ambulant invalids at Bulla and even more at Koorliatto Creek, an unhealthy appetite developed so that they, Hodgkinson and I included, almost ate twice as much as under usual circumstances. It was an almost eerie sight to see these individuals resembling ghosts polishing off such masses of bread. In addition the digestion of these ambulant invalids suffered no disturbance with the increased supply, however rundown they might be, particularly the bowel evacuation remained regulated with rare exceptions. While the countenance of Stone had changed only little up to his death, with Becker an emaciation had set in, like one sees only very rarely. The emaciation of Patton was moderate and was not in proportion to his enormous weakness to which he finally succumbed. That peculiar club-like aspect of the finger tips, which is known from the

chronically tuberculous &c, given the very fitting name of almond-shaped nails by the British, developed in Purcill, whilst his hands just like his nose and a part of his cheeks showed a livid colour. Even in McDonagh and myself a dull bluish colour of the back of the hand with slight swelling and cracking of the skin could be observed. None of us remained completely spared from emaciation, but really frightening was the appearance of our Blacks, Smith, Beludsch and even Butan. A peculiar paleness shone through their otherwise so dark, fatty shining faces. Numerous furrows, unusual in them, ran lengthwise through their faces. The deep-set eyes were especially conspicuous by their dark tint, in addition the dry lustreless skin of the face and a lack of movement and in the play of the facial muscles, usually a sign of deep suffering instead of friendly smiling seemingly a terrible grin – as often as one looked at them, one had to think of mummies or New Zealand wooden masks.

Finally what should I say of the therapy? All the proven anti-scorbutics, fresh vegetables, fresh plant acids, fruit juices and the beautiful recipes of anti-scorbutic beers exist as the bitterest irony for us only on paper. However, all these we could have gladly done without, had we had just fresh water. Nevertheless I could not remain idle and of the medicines offered to me I have tried what seemed to me at all efficacious. Of the use of quinine as well as the elegant preparations of citrate of iron with quinine I have seen not the slightest utility, moreover to me the essential features of them also promise nothing. I thought to just fulfil a duty, when I prescribed it in the above mentioned cases. I may reckon on some success from the employment of alum, of gallic acid or of kino. I dare not decide whether they have been somewhat useful, if I except their very prompt and striking action with fresh diarrhoea. As mentioned above, however, I employed, usually a dose of *Pilul. Hydrag. Ph. L.* 10 gr. [mercury pill (London Pharmacopaea) 10 grains] with 1 grain of opium against this attack. I tried potassium iodide as a resorption promoting remedy against extravasation of the blood, but as it seems to me quite without success. The commercial lime juice is such a diversely adulterated article that one cannot trust it properly. We had 20 gallons of this liquid with us from Melbourne on, but they were, like so many other things, left behind long before we reached the Darling. We journeyed in this respect as with an air balloon, where one is always cast up in order to just advance. Instead we had 20 pounds of crystallised citric acid, of which we availed ourselves (in the form of acidulated water), before we yet came to Dooroadoo, with what effect our tale of woe teaches. The whole world of herbs around us was withered and no one liked to chew the dried leaves of the *Salsolaceae*. I chewed them as well as many others, gum leaves, *Acacia* leaves, but as it seems to me quite without use. I have already mentioned the employment of the sappy ends of a tall species of *Polygonum* that grows in water as well as the succulent leaves of a species of *Mesembryanthemum*; these and perhaps even more other plants seem to be just as useful with scurvy as our cultivated vegetables according to the above experiences. (To be sure I found *Cruciferae* in great abundance in the interior, but they were likewise completely withered). Dr Schwartz of the *Novara* Expedition is of the opinion that the eating of fresh vegetables alone is not able to prevent the outbreak of scurvy or to heal the disease, a

certainly surprising assertion, but in our experiences, as I believe has found confirmation in as much as according to my opinion the eating of fresh vegetables could not have hindered scurvy with the quality of our water. As a fact worthy of note, I state that Smith, but even more Beludsch and Butan also during their stay on the Darling spent a long time in the daily eating of fresh meat and fresh vegetables (*Portulacea oleracea* and various species of *Atriplex* and *Blitum* growing wild), before the last traces of the illness that they survived were eradicated.