

seabed carpeted with sponges, corals, brittle stars and other animals, some 1000 m down. On the glacier, the team was able to deploy its ice coring equipment for the first time in the SubICE programme headed by Liz Thomas, which aimed to collect ice cores 10–25 m long from each ice-covered stop.

Then it was onwards to the Balleny Islands, a steeply bordered volcanic chain west of the Ross Sea, and home to colonies of Adélie and chinstrap penguins. Located on the Antarctic Circle, and almost inaccessible, the islands get few visits. The helicopters were used to make accurate maps of the islands and to count the penguins. Nets and bottles captured plankton, microbes and even viruses for later study, and the drillers extracted the first ever ice core from the islands.

A short distance away lay tiny volcanic Scott Island, a mere 500 m long by 300 m wide. It lies in the recently declared Ross Sea Marine Protected Area, the largest of its kind in the world. Aerosols, small particles in the air, were a prime target for study, as were the songs of blue whales, and their food - krill. Crossing the mouth of the Ross Sea to the east, the next target was Siple Island, another volcano, this one connected to the coast of Marie Byrd Land by the 500 m thick Getz ice shelf. The scientists busied themselves with ice coring, plankton sampling, observing penguins, and deploying the ROPOS to examine the seabed.

Further along the coast lay Peter I Island, still surrounded by pack ice. Air sampling for aerosols accompanied snow sampling for microbes, and the inevitable ice coring. Sophisticated analytical equipment in a container laboratory on the deck provided Julia Schmale with the character of the aerosols, most of which comprised sea salt. The data will inform models that simulate the climate.

*En route* to Punta Arenas, the ship visited the grass-covered Diego Ramirez Islands close to Cape Horn. Fortunately the seas were moderate and landing proved possible. Dominic Hodgson's drillers extracted cores of peat, for a record of climate change, and the beaches were searched for signs of plastic pollution.

South Georgia, with its 123 receding glaciers, was the next port of call. Rats and reindeer were eradicated there recently in a 4-year programme during 2011–2015, and the bird population has increased as a result. The island is home to 28 species of seabirds and nearly 95% of the world's population of fur seals. Despite some awful weather, ice cores were collected, along with samples of aerosols. The team assessed biodiversity and searched the shore for plastics, but dredging proved a problem. Water samples were collected for their isotopes, to examine the exchange between ocean and atmosphere, knowledge of which is crucial for understanding the climate in this inhospitable region.

Next came the South Sandwich Islands, yet another volcanic chain, where dredging continued, along with

recordings of whale song and analyses of the saltiness of the seawater, which has been declining in recent decades - probably as a result of the ongoing melting of land ice and ice shelves. Last stop to Cape Town was Bouvet, another volcano, this one the most isolated island in the world and the property of Norway. Quick collections were made of moss, rocks, water and snow, and the drillers managed to extract a 14 m long ice core.

This 33 000 km journey in the southern summer of 2016–2017 was just the beginning. Now comes the scientific analysis. How is the Southern Ocean affected by what happens elsewhere, and how does it affect the rest of the globe? We may already know a lot about this, but soon we will know a great deal more thanks to this unique enterprise, its progress recorded in some beautiful photographs.

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### **Antarctica: the frozen continent's environment, changing logistics and relevance to India**

Jagadish P. Khadilkar  
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There have been few accounts of the Indian activities in Antarctica and those few reports and books that have been published have not been available outside India. For that reason alone, I was delighted to see the efforts made by Jagadish Khandilkar to not only explain about Antarctica to his fellow countrymen but also to document, in English, some of the Indian Antarctic efforts. That said, there is unfortunately a great deal that is not quite correct in this new volume. The author makes a valiant attempt to cover everything from logistics to science and relies heavily on several older general accounts as well as Wikipedia. In addition, the book has clearly not been copy edited as well as might be expected for a Bloomsbury publication, leading to frequent errors in names etc.; for example, it should be Kerguelen not Kergulan, Priestley not Priestly, Drygalski not Dragalski, and Vivian not Vivien.

His objectives are twofold: to explain about the importance of Antarctica through its history and some of the science, and to review the Indian contribution to Antarctic development chiefly through its logistics. As an ex-Indian Army commander, he spent some time as the Base Commander at Dashkin Gangotri and now wishes to share his experiences with a wider audience.

There are too many errors to list them all but let me point out some of the more important ones. On page 22, in describing sealing discoveries, he fails to mention

James Weddell. On page 24 he makes no comment about the dispute over the lack of evidence for transmission of canine distemper from sledge dogs, and on page 25 he fails to state that the first sovereignty claim was by the UK in 1908. He provides no evidence to support his statement that Operation Highjump and Windmill were intended to establish an American station and makes no reference to the previous US Antarctic Service Expedition that established a station on the Peninsula before World War II. His remark that permanent stations began in 1957 in the International Geophysical Year not only ignores the first ones established by the UK under Operation Tabarin in 1944 but also indicates he was not aware of the French station at Port Martin (1950), the Australian station at Mawson (1954) and the Argentine and Chilean stations established in the late 1940s. On page 32 he wrongly suggests that longline fishing is for whales and on page 35 suggests that an increase in icebergs will have an effect on sea level - it will not.

On page 42 the Scott Polar Research Institute is said to be in Birmingham rather than Cambridge, on page 51, in describing fossil evidence for Gondwana, he omits to mention dinosaur fossils, and on page 65 he reports that there are more than 145 subglacial lakes (there are over 380). On page 81 he suggests that sea ice grows to 3 m thick in the Arctic but only 1 m thick in the Antarctic, a clear misunderstanding of the formation of multiyear sea ice. On page 105 there is no ice cap anymore on Marion Island, and on page 132 he states that krill live for 5–10 years, which is only true if you include the krill kept in captivity in optimal conditions. Commercial fishing in Antarctica did not begin until the 1960s, not 1905 as he states on page 146 (that was the start of whaling).

On page 160 he talks about membership of SCAR and suggests that there are many countries that are members of the Treaty but not of SCAR, which provides entirely the wrong message. All the Consultative Parties are members of SCAR but there are 12 Acceding Countries that are not active and have thus seen no need to join SCAR so far. On page 172 he lists the Convention on Biological Diversity as relevant to the functioning of the ATS but it cannot be as it can apply only to sovereign states, so the Antarctic is outside its remit.

The reference list is very poorly constructed for a book of this type, with everything from personal letters to newspaper articles listed but without the strict format control needed to ensure that the reference can be traced. Books by Priestley, Amundsen and Ross are listed by title not author, the article on Scott Base has no author (it should be Claire Duncan and it appears in two separate issues of *New Zealand Memories*). Whilst I appreciate that some of the citations are complicated I would have expected the publisher to provide expert assistance here. Listing a magazine apparently published at Dakshin Gangotri under a Hindi name is not helpful to an

international audience as it will be impossible to access, nor is listing PowerPoint presentations from workshops or, for example, a talk given by Lou Sanson (whose name is wrongly spelt) at Otago University of any value in support of statements.

A reliance on just a few sources without independent checks has also led to incorrect statements, such as the Antarctic Treaty being up for review in 2041. This he has taken from Robert Swan's continuous reiteration about the Treaty ending in that year. In fact, the Treaty runs indefinitely and it is the Protocol that comes up for possible review, and here 2048 is the important date. This will be 50 years from the coming into force of the Protocol and therefore the point at which any Consultative Party can request the calling of a conference to review its extension. As any changes suggested by such a conference require agreement by three quarters of the Consultative Parties, the likelihood of major changes is severely limited, despite the efforts of Swan to mislead people.

Chapter 8 on the Indian programme is perhaps more useful, providing details of logistics and development for the three Indian stations that are hard to find elsewhere. He is highly critical of the management of the National Centre for Antarctic and Ocean Research and especially so of its failure to inform the Indian public about its efforts. He also emphasizes the need for India to become more self-reliant in its logistics, but he tells us nothing about the way in which India selects its science objectives, funds its research and trains its scientific experts. Equally, he says nothing about the long-term failure of the Indian political system to ratify the many Measures that the Treaty has passed, surely an indication of a lack of political interest.

His website listing is unusual, as many important websites are missing, including those of AWI, the Antarctic Treaty Secretariat, [www.antarctic-circle.org](http://www.antarctic-circle.org), [www.discoveringantarctica.org.uk](http://www.discoveringantarctica.org.uk), [www.asoc.org](http://www.asoc.org), [www.polarfoundation.org](http://www.polarfoundation.org) etc. His Appendix 1 provides a Timeline of Antarctic Exploration based largely on one compiled by Marilyn J. Landis and without any reference to Robert Headland's very detailed and annotated chronological listings of all Antarctic expeditions.

I recognize that the author, a retired Lt Colonel in the Indian Army, sought comments from his Army colleagues but it would appear that their Antarctic expertise was not sufficient to identify the errors. I regret to say that many of these errors would have been completely avoided if the author had taken the trouble to check the manuscript with experienced Antarctic staff from other countries, or had undertaken a more thorough reading of up to date Antarctic literature. The publisher is also at fault for poor copy editing. The quality of the colour photographs is generally poor, with many out of focus, again due to poor quality control by the publisher.

Given the effort that went into writing this book it is a great shame that so many errors are contained within the text, and, although published in 2017, information on many subjects seems to be absent after 2012 or even earlier. Perhaps because the author is not a scientist he seems to have largely missed the point of working on a continent for science - it is the quality of the

science that counts not the quality of the logistics, which is simply a means to an end. India has highly talented scientists and engineers. It ought to be making an important contribution to Antarctica but sadly you could not tell that from this book.

D.W.H. WALTON