3

Ecological Aspects of Antarctic Microbiology

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1. Introduction

If the science of microbiology is approaching maturity, then Antarctic microbiology is only just emerging from its infancy. The early expeditions of the 20th century used classical medical methodology to isolate and identify bacteria, yeasts, and fungi from sea water, soil, snow, air, and animals (Ekelöf, 1908; Tsiklinsky, 1908; Gazert, 1912; McLean, 1918, 1919). The initial emphasis was on survey and taxonomy, although Gazert (1912) noted the influence of marine bacteria on nutrient cycling during the German Antarctic Expedition of 1901–03. However, it is Ekelöf of the Swedish National Antarctic Expedition 1901–03 who may be regarded as the father of Antarctic microbial ecology. Between February 1902 and November 1903, he made a seasonal study of the soil and air microbiota at Snow Hill Island (64° 30′S) off the east coast of the Antarctic Peninsula (Fig. 1). Using rich medical media, he monitored viable bacteria, yeasts, and other microfungi but made no mention of the organisms resembling cyanobacteria and microalgae which are frequently the dominant primary producers in terrestrial Antarctic ecosystems (Ekelöf, 1908).

Studies of marine cyanobacteria and microalgae predate and parallel those of the heterotrophs (Hooker, 1847; West and West, 1911; Fritsch, 1912). Consideration of the Antarctic marine phytoplankton is outside the scope of this review, but the cyanobacteria and microalgae are a feature of the Antarctic microbiota, occurring in virtually all habitats where there is free water. A greater predominance of cyanobacteria in the Antarctic relative to Arctic benthic and soil ecosystems was first recorded by McLean (1918) of the 1911–14 Australasian expedition. He also noted that heterotrophic soil

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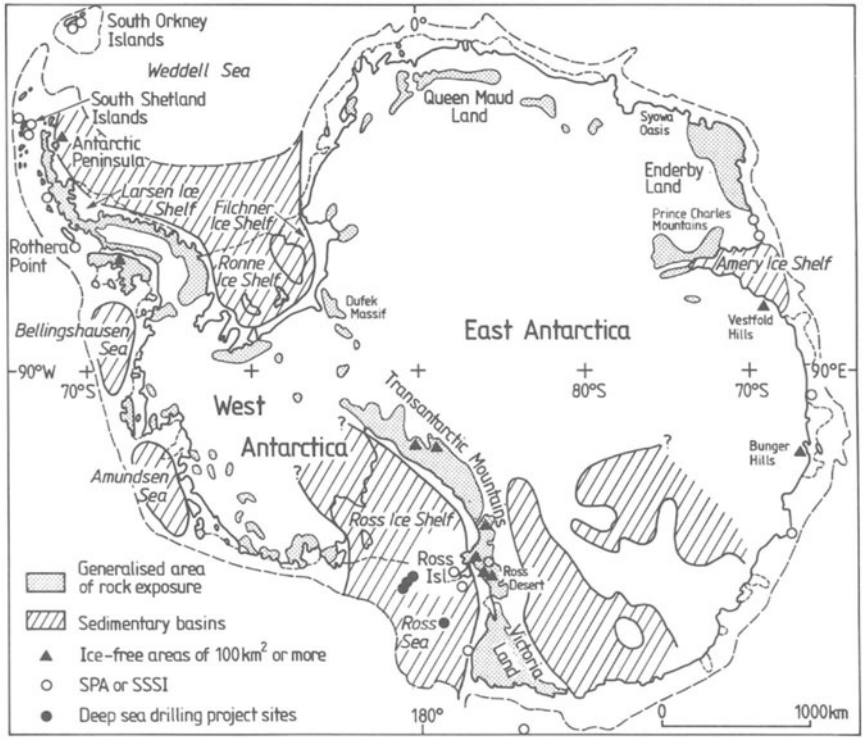

Figure 1. Ice-free land and sedimentary basins of Antarctica, showing SPA and SSSI locations and Deep Sea Drilling Project sites. [Redrawn from Elliot (1985), with permission.]

bacteria could not only survive but multiply at the low temperatures (1 to 2°C) prevailing at Commonwealth Bay (67°S). However, Ekelöf (1908) had earlier found an optimal temperature of 17.5°C for bacteria isolated from Antarctic soils that are warmed by insolation. These early expeditions laid the foundations for ecological studies of psychrotrophy, colonization, and nutrient cycling in Antarctic microbial ecosystems which are still of relevance.

After the "heroic age," there was a lull in Antarctic microbiological research until more coordinated expeditions were instigated (Roberts, 1958). However, it was not until the 1939–41 United States expedition to the Bay of Whales on the Ross Ice Shelf that the next microbial monitoring of air, snow, and soil was carried out (Darling and Siple, 1941). Antarctic air transport was by then more reliable, enabling collections from as far south as the Ford Range (78°S) and Scott Glacier (86°S) in the Transantarctic Mountains. Despite the instigation of a comprehensive biological research program in the South Orkney Islands, the Falkland Islands Dependencies Survey (later to become the British Antarctic Survey) did not include microbiological projects until 1963 (Heal *et al.*, 1967; Latter and Heal, 1971; Bailey and Wynn-Williams, 1982).