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"Lebensspuren" made by penguins

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ABSTRACT

Grooves up to 7 mm deep are made by the nails and partly by the beaks of penguins in hard quartzitic sandstone of the Falkland Islands. Some of the grooves are already covered by a thin film of silica, hence can be considered fossil.

ZUSAMMENFASSUNG

In den Falkland-Inseln finden sich auf harten quarzitischen Sandsteinen devonischen Alters bis 7 mm tiefe Rillen, die von Fussnägeln und zum Teil von den Schnäbeln der Pinguine gemacht werden. Da sie zum Teil bereits wieder von Quarz bedeckt sind, können sie als fossil betrachtet werden.

Introduction

Some months ago Prof. W. Stingelin of the Zoological Institute of the University of Basel showed me a block of hard quartzitic sandstone covered with grooves (Fig. 2, left) which at first sight one might have compared with solutional furrows (Karren) formed on the surface of limestone, but certainly not on sandstone. After a few wrong guesses I was told that the grooves were made by penguins and that several blocks had been collected by N. Hufschmid and M. Stauffacher of the Zoological Institute, Basel, during their study in January-February 1977 of the fauna of New Island in the Falkland Archipelago (STAUFFACHER 1977, p. 9).

These grooves can be classed as Lebensspuren (ABEL 1935) or trace fossils (CRIMES & HARPER 1970). The following definition is applied to Lebensspur = "life-mark": "a sedimentary structure left by a living organism, a *trace fossil.* The term is also applied to a Holocene track or burrow" (GARY, MCAFEE & WOLF 1972). ABEL's descriptions of trace fossils caused by birds does not mention grooves made by penguins, nor does one find any reference in HÄNTZSCHEL's "Trace Fossils and Problematica" (1976).

New Island, Falkland Archipelago

New Island is the most westerly of the Falkland Archipelago which lies on the South American continental shelf in the South Atlantic Ocean about 450 km NE of Tierra del Fuego and about 600 km due E of Patagonia. the rocky coastline of New

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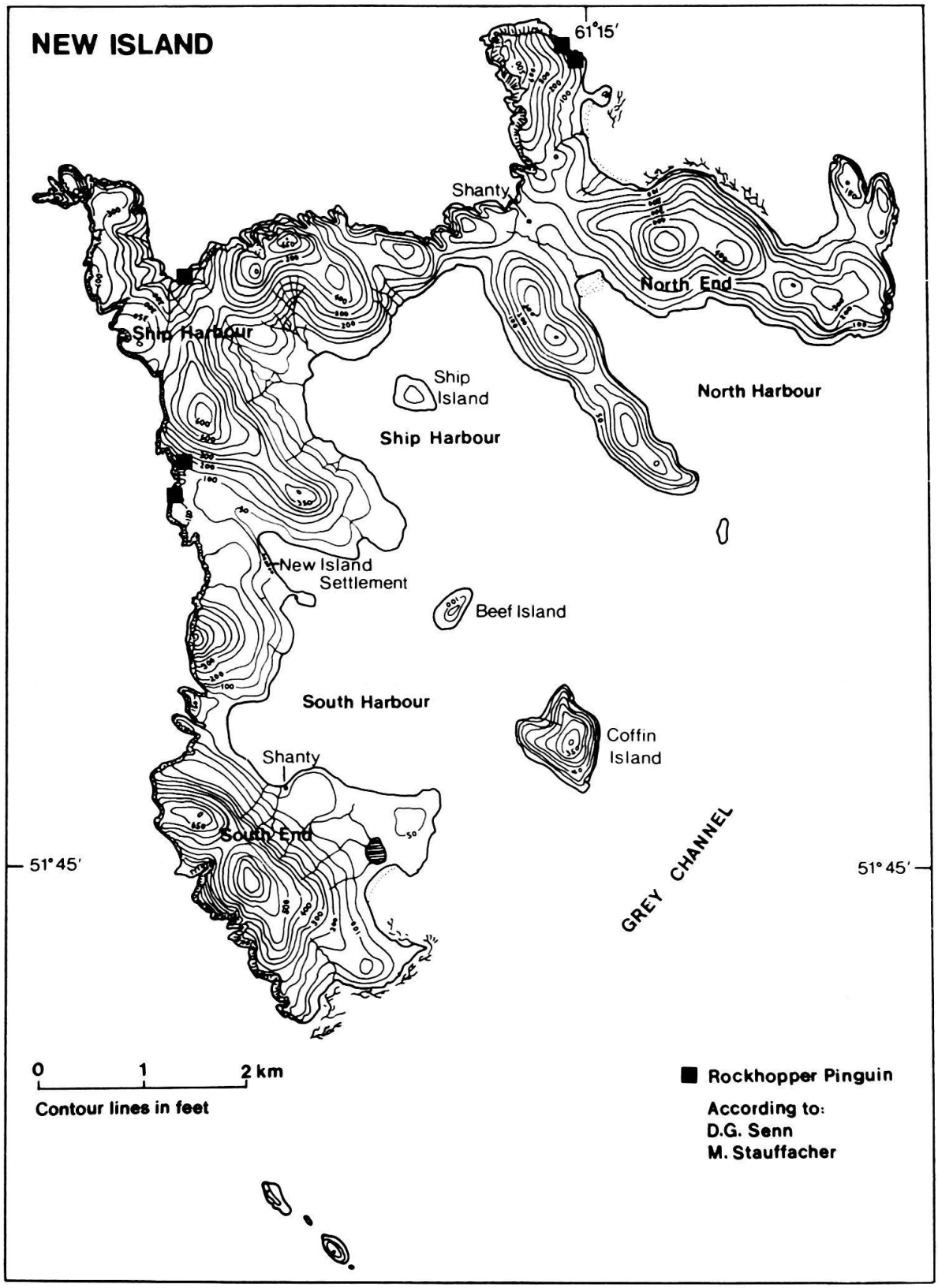

Fig. 1. New Island of the Falkland Archipelago.

Island is about 46 km long, and the whole island has a surface of almost 7 km². The highest hill at the south end has an elevation of 226 m (see Fig. 1).

Geology

New Island is built up of Lower Devonian Port Stephens Beds which rest almost horizontally on supposed Precambrian crystalline schists and gneisses. The Port Stephens Beds consist of alternating layers of coarse-grained unfossiliferous sandstones, quartzites and quartz-conglomerates with an estimated thickness of 1,600 m as measured on West Falkland (GREENWAY 1972, p. 12). Though the Port Stephens Beds are horizontal in the central part of the island, erosion along the coast has caused them to break into large inclined slipmasses and single slabs. Minor faults and frequent jointing are not only promoting disintegration of the beds but are also responsible for the strongly indented shape of the coastline.

Climate and vegetation

The animal life and the vegetation are controlled by the climate which is dominated by strong westerly winds and by the cold sea (4–9 °C) rich in nutritious material; currents are predominantly from the west and south. There are no trees in New Island though some dwarf shrubs occur. Tussock-grass *(Poa flabella)* as high as a man still covers large parts of the island, though the original cover has been considerably destroyed by sheep of which there are more than 3,000 (private information from D.G. Senn and M. Stauffacher).

Penguins

The three species of penguins nesting on New Island are the Gentoo *(Pygoscelis papua)*, Jackass or Magellanic Penguin *(Spheniscus magellanicus)* and Rockhopper *(Eudyptes crestatus)*, of which the latter are of special interest to us. "The Rockhoppers, whose colonies are on the face and brows of cliffs, or on steep talus slopes - all rising directly from the sea - come ashore in the adjacent rocks or ledges that provide access to their nests" (PETTINGILL 1964, p. 47). On pages 53 to 59 PETTINGILL gives a detailed account, supported by 7 figures of the Rockhoppers of New Island. "About 20,000 pairs nested in a colony on the upper slopes of several rock-strewn bluffs, 200 to 300 feet above sea." Adult Rockhoppers stand about 38 cm (Fig. 3). They are livelier and more agile than the other two penguins of New Island. "As their common name implies, they have, beside a forword walking gait, a method of progression by jumps, with the feet together, which are like those of a man in a sack race." Only in this way it is possible for the short legged Rockhoppers to cross the large loose blocks and ledges above the surf. Climbing these ledges and often steeply inclined blocks they use their beaks, as well as their nails, for holding on to the surface. In his Figure 12, PETTINGILL shows how a Rockhopper moves over the scarred ledge with nails hooked in and with flippers pushing and supporting.

Figure 3 represents a Rockhopper form the Zoological Garden, Basel, which was mounted in a similar position, though the nails could not be bent sufficiently by the taxidermist. Figure 4 is a reproduction of PETTINGILL's Figure 14, showing part of

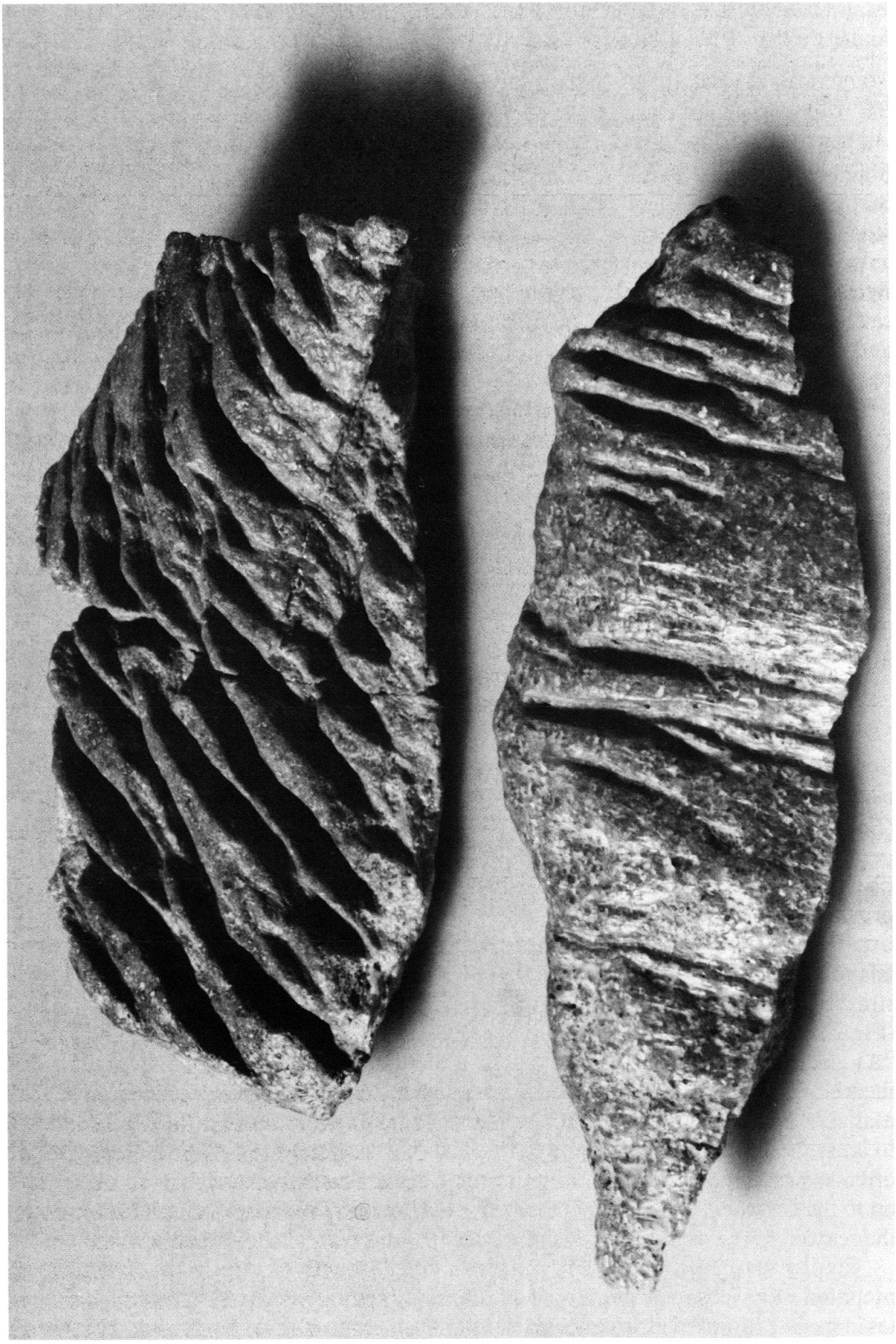

Fig. 3. Rockhopper, *Eudyptes crestatus* (MILLER). Specimen mounted on model (Natural History Museum, Basel).

Fig. 2. Samples of grooves made by Rockhopper penguins. Left side: recent grooves. Right side: fossil grooves. Natural size.

the colony of Rockhoppers at Kidney Island in the Falkland Archipelago. The grooves made by nails and beaks can be seen in the left foreground, though not as well as on Figures 12 and 13 of PETTINGILL's paper or on a Figure in the note of STAUFFACHER. All these figures depict the irregular course of the grooves and deep

Fig. 4. Part of the colony of Rockhopper penguins at Kidney Island (Photo by Olin Sewall Pettingill, Jr.; courtesy of Walt Disney Productions).

vertical scars. V-shaped grooves are fairly common, possibly pointing to a contraction of the three webbed toes during upward stepping. This is also shown in Figure 5.

The grooves

The left side figure of Figure 2 shows a piece from a rock with grooves made by Rockhopper penguins. It is a grey to light-brown, medium grained hard quartzitic sandstone. Width and depth of the grooves vary considerably due to the frequency and length of their formation by Rockhoppers. Depths up to 8 mm are noticed in the grooves of this specimen of rock. The average width is about 5 mm. To what extent excrements, loose quartz grains sticking on the feet, and muddy water are able to contribute towards the forming of the grooves is difficult to visualize. It has

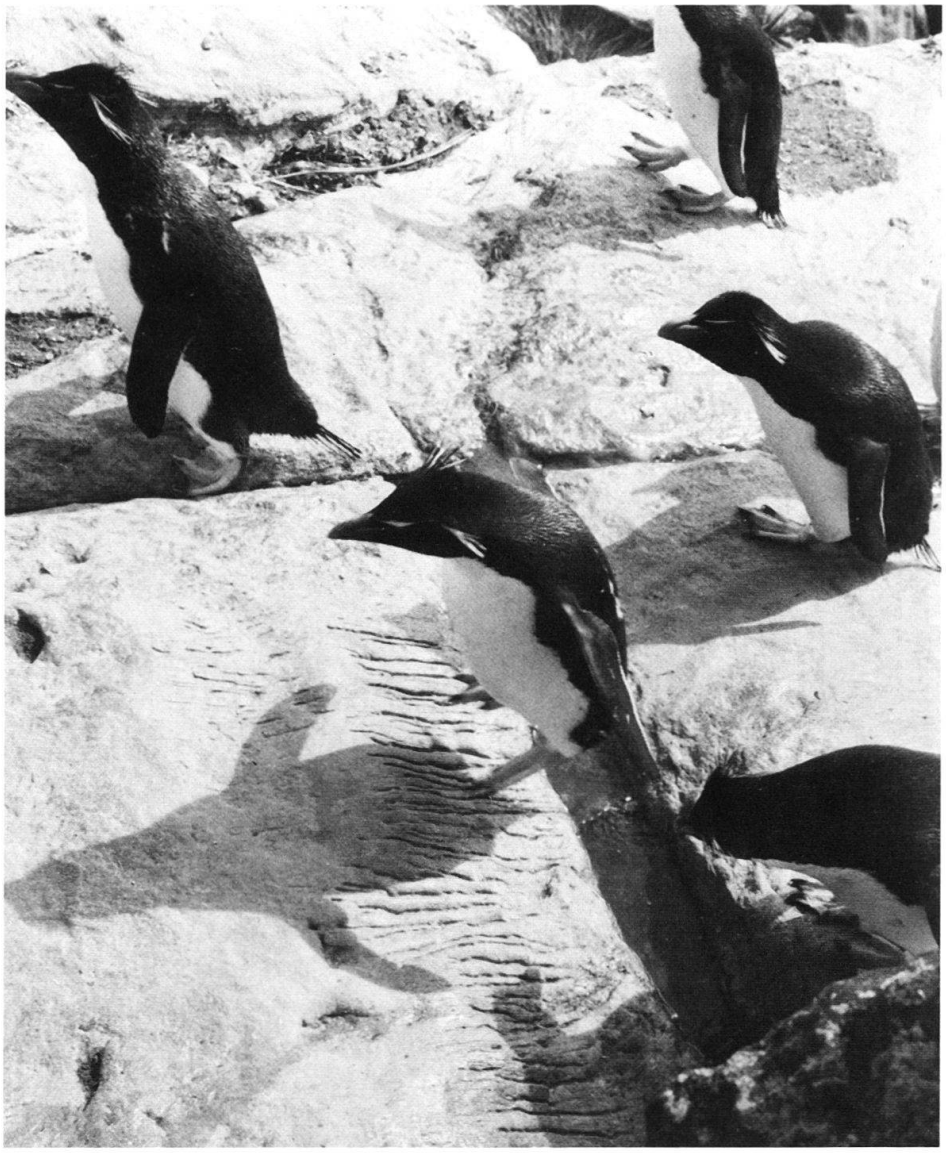

Fig. 5. Rockhopper of New Island. Centre specimen showing toes in grooves of the rock (Photo by M. Stauffacher).

certainly required hundreds, if not thousands of years to produce them. The right side figure of Figure 2 represents a piece of quartzitic sandstone with grains of kaolinitic material. The tips of the nails of an unmounted Rockhopper scratched these grains, hence one would expect that layers of graywacke, as also exist in the Port Stephens Beds, would lend themselves to easier grooving. This specimen of rock has the appearance of a highly polished surface from which coarser quartz grains protrude slightly. On closer examination one observes that the shiny surface is formed by a chalcedonic film of silica. Colloidal silica would, however, hardly be deposited on grooves that are daily scratched by large numbers of passing penguins, hence grooved rocks with a film of silica can be considered to be fossil.

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