Hans Ø, celebrated island of Nares Strait between Greenland and Canada: from dog-sledge to satellite mapping

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Hans Ø – or Tartupaluk to the indigenous population of North-West Greenland – is a small steeply sided island in Nares Strait at *c.* 80°50´N. Charted in 1871 and named after Greenlander Hans Hendrik, it is one of five limestone islands forming an integral part of the Greenland Silurian succession. Rising less than 170 m above normally ice-infested waters, the 1.25 km^2 island is physiographically far overshadowed by nearby Franklin Ø (Fig. 1).

The island's notoriety results from its placing more or less equidistant between the coasts of Kennedy Channel on the political boundary between Greenland and Canada. For 40 years the rocky patch has been the subject of a dispute between the Danish/Greenland and Canadian governments regarding sovereignty rights, an issue that remains unresolved. However, there is mutual understanding between Canada and Denmark that "since the question of sovereignty over the island has not yet been solved no action should be taken by either side which might prejudge the settlement of the issue" (Brückner 1984). Formally, this remains the position today.

2007 developments and this article

In 2007, two geological map sheets entitled 'Hans Island, Nunavut' were released by the Canadian government. Forming part of a richly illustrated report, the maps with structural cross-sections portray the island's geology and that of Kennedy Channel at scales 1:5000 and 1:100 000, respectively (Harrison *et al.* 2007). Also released are offshore geophysical and bathymetric data, including seismic and refraction profiles, obtained with the Canadian Coast Guard ice-breaker *Louis S. St-Laurent*.

The new data are an important addition to scientific knowledge of Nares Strait. However, the section 'History of geological research' does not match the excellence of the rest of Harrison *et al.'s* report. Beginning with Canadian geodetic activities in 1953, the section continues: "It has been reported that Robert L. Christie of the Geological Survey of Canada visited Hans Island between 1957 and 1966 during geological mapping on northeastern Ellesmere Island (see Dawes, 2004)". Yet, Dawes (2004) makes no mention of any such visit. Indeed, this author – who worked very closely with the late Dr. Christie on the history of exploration of Nares Strait and participated in his field programme in 1965 and 1966 – doubts that he ever set foot on the island or even planned to. Harrison *et al.* (2007) list further Canadian activity on and around Hans Ø but limit comment on Danish geological research to: "It is evident that Danish geologists have also visited Hans Island. There is a bedding attitude recorded on the island on the map of Dawes and Garde (2004) who consider bedrock here to be an exposure of the Cape Morton Formation of Silurian age". However, in a postscript, acknowledgement is given to Lauge Koch's map from 1922 with reference to Dawes & Haller (1979).

By any standards this is meagre reporting, particularly so since the island was initially mapped by Danish geologists and has appeared as an integral part of the Silurian of Washington Land on Danish maps for more than 75 years (e.g. Koch 1931; Troelsen 1950; Jepsen *et al.* 1983). The lack of reference to these studies seems even more odd when early Canadian geological maps of north-eastern Ellesmere Island covering the latitude of Hans Ø – for example, Christie (1964, 1967) – do not portray the island, and neither does the 1:250 000 map of Kennedy Channel that is part of the Canadian national map sheet coverage (Kerr 1973).

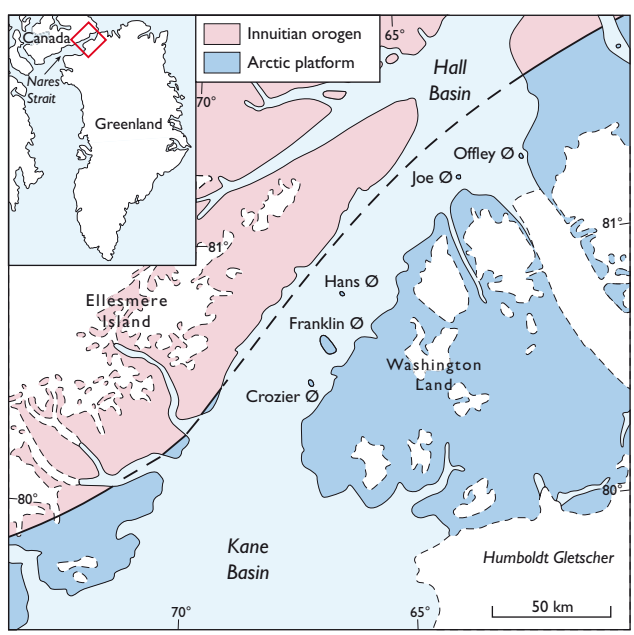

Fig. 1. Geological map showing two main structural provinces of Kennedy Channel and five carbonate islands, with Hans Ø in mid-channel.

This article is stimulated by the realisation that the early mapping of this part of the High Arctic is apparently little known internationally. The aim is two-fold. Firstly, to briefly summarise Danish geological work at Kennedy Channel, illustrated by the first map featuring Hans Ø (Fig. 2), and secondly, to illustrate how the Geological Survey in Copenhagen employs modern research techniques to maintain its interest in the far north.

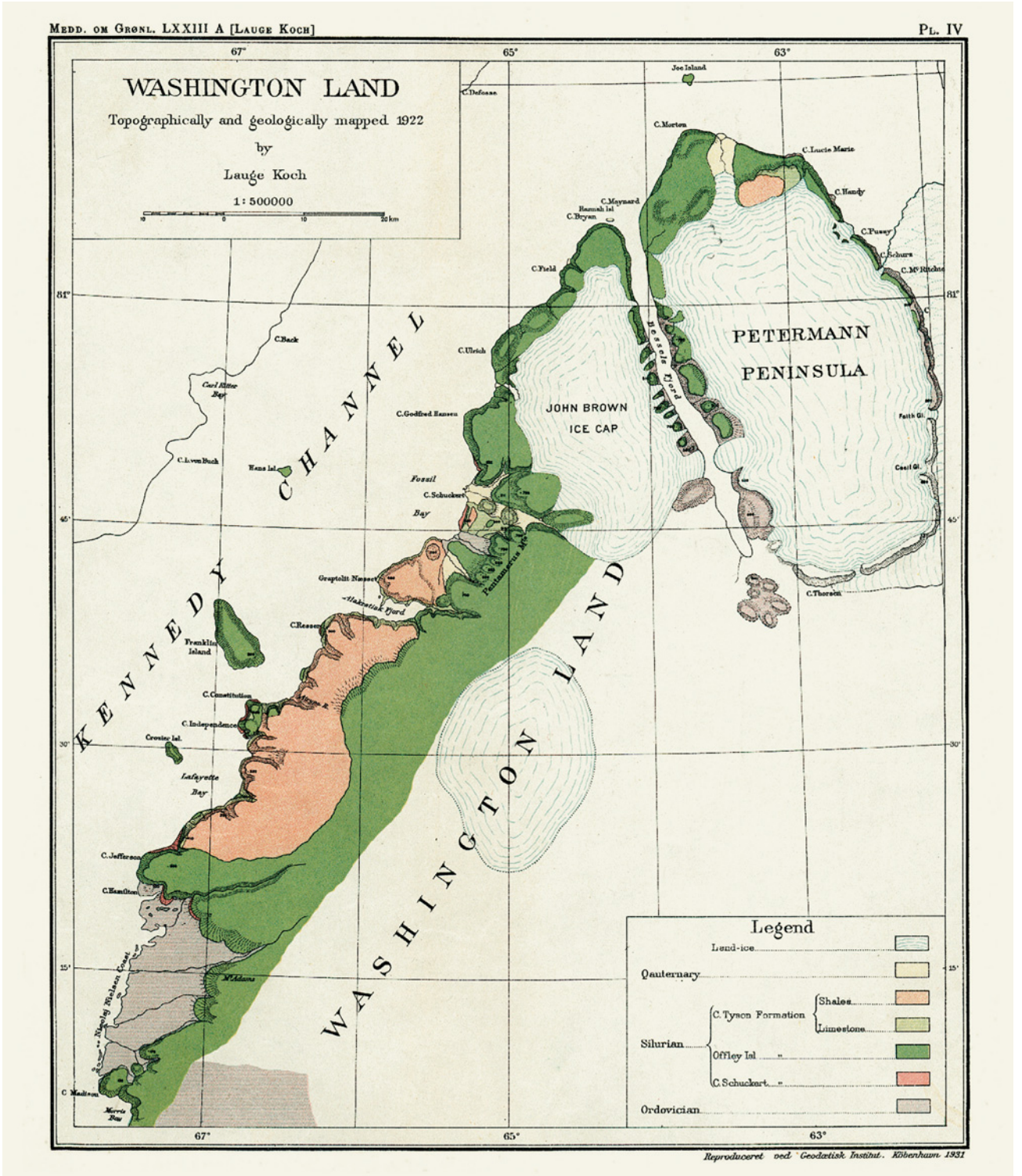

Fig. 2. The first geological map showing Hans Ø. Printed in 1931 and annotated for publication in volume 73, the map appeared in *Meddelelser om Grønland* volume 200 (Dawes & Haller 1979, plate 2; for explanation see text). From Dawes (1984; copies in Survey archives and The Royal Library, Copenhagen, are 28 × 23 cm).

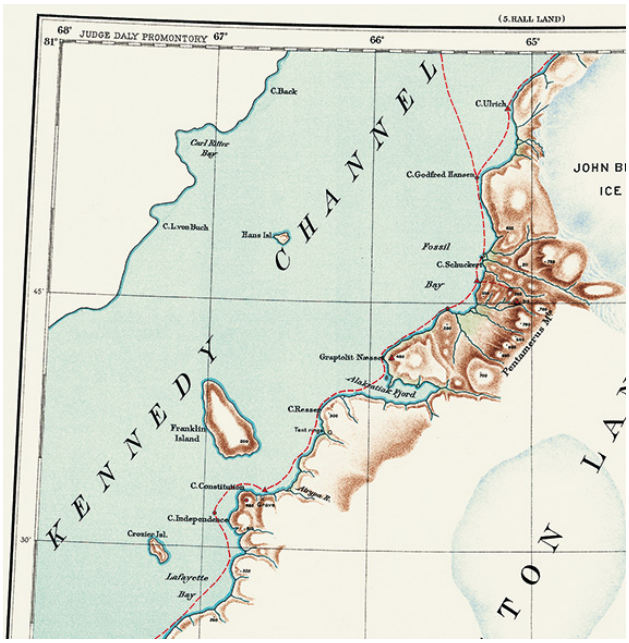

Fig. 3. Extract of 'Cape Constitution', sheet 11 of the topographical map of North Greenland, scale 1:300 000, showing Hans Ø. From Koch (1932). The original size of the extract is 21 × 23 cm.

First geological map of Hans Ø

The initial Danish mapping of northern Greenland took place via Nares Strait on two dog-sledge expeditions: the 2nd Thule Expedition 1916–1918 and the Bicentenary Jubilee Expedition 1920–1923. The expeditions carried strong political overtones and for the purpose of fund raising national pride was a timely motif. The overriding aim was regional mapping of the national territory of Denmark, with the ambitious plan becoming the lot of geologist and cartographer Lauge Koch. The scientific results were outstanding. For example, a topographical series of 19 sheets at 1:300 000 and a geological series of five sheets at varying scale were printed: geology in two batches, in 1929 and 1931, and topography in 1932 (Dawes & Haller 1979, fig. 3). Hans Ø, coloured as part of Greenland, appears on topographic sheet 11 'Cape Constitution' and on geological sheet 'Washington Land' where it is referred to the Offley Island Formation (Figs 2, 3). The five geological sheets with map descriptions were intended for publication in volume 73 of *Meddelelser om Grønland*, and the maps were annotated accordingly. Two were published as planned (Koch 1929, 1933). The fate of the remaining maps is intimately bound up with the destruction of stockpiles in Copenhagen during the German occupation in the 2nd World War destining the Washington Land map – compiled in 1922 and printed in 1931 – to be released years later in another volume of *Meddelelser om Grønland* (Dawes & Haller 1979).

Later Danish geological work

During the Thule and Ellesmere Land Expedition 1939–1941, Danish geologist Johannes C. Troelsen examined and refined Koch's (1929) Lower Palaeozoic lithostratigraphy in southern Washington Land. Hans Ø and the four other islands were included on his map in the same colour as the Silurian limestone and shale of the Greenland coast (Troelsen 1950). Air-supported regional mapping by the Geological Survey of Greenland in 1975–1977 and 1984–1985 included visits to Hans Ø and other islands, for example in 1975 and 1984, for the purpose of studying the bedrock with a view to correlation with the lithostratigraphic framework established on Washington Land and farther north (Peel 1984). Hans Ø was referred to the Cape Morton Formation of the Washington Land Group and so portrayed on the 1:250 000 map sheet of Jepsen *et al.* (1983).

ASTER satellite data and 3-D modelling

Combined with traditional information from aerial photographs, satellite data form an important tool in geological and commodity mapping in Greenland. Recently, ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer), the imaging instrument on NASA's Terra satellite launched in December 1999, has proved to be particularly attractive due to its availability and low cost. It provides high-resolution images in 14 different bands of the electromagnetic spectrum ranging from visible to reflected and thermal infrared light. The image resolution ranges between 15 and 90 m and can be used to create detailed maps of surface temperature of land, reflectance and elevation. The imaging power of ASTER data is illustrated by Fig. 4.

Concluding remarks

Initial surveying of the now celebrated island of Nares Strait can be attributed to the Inughuit with their specialised travel techniques since their historic name Tartupaluk, meaning 'kidney-shaped', precisely describes the island's coastal outline. Danish geological research along Nares Strait spans 90 years from the same dog-sledging era through helicopter operations to satellite mapping. Modern remote-sensing techniques provide an accurate perspective of an island traditionally visited by indigenous folk and a handful of explorers and geoscientists, but now – as a disputed border – by politicians and military personnel.

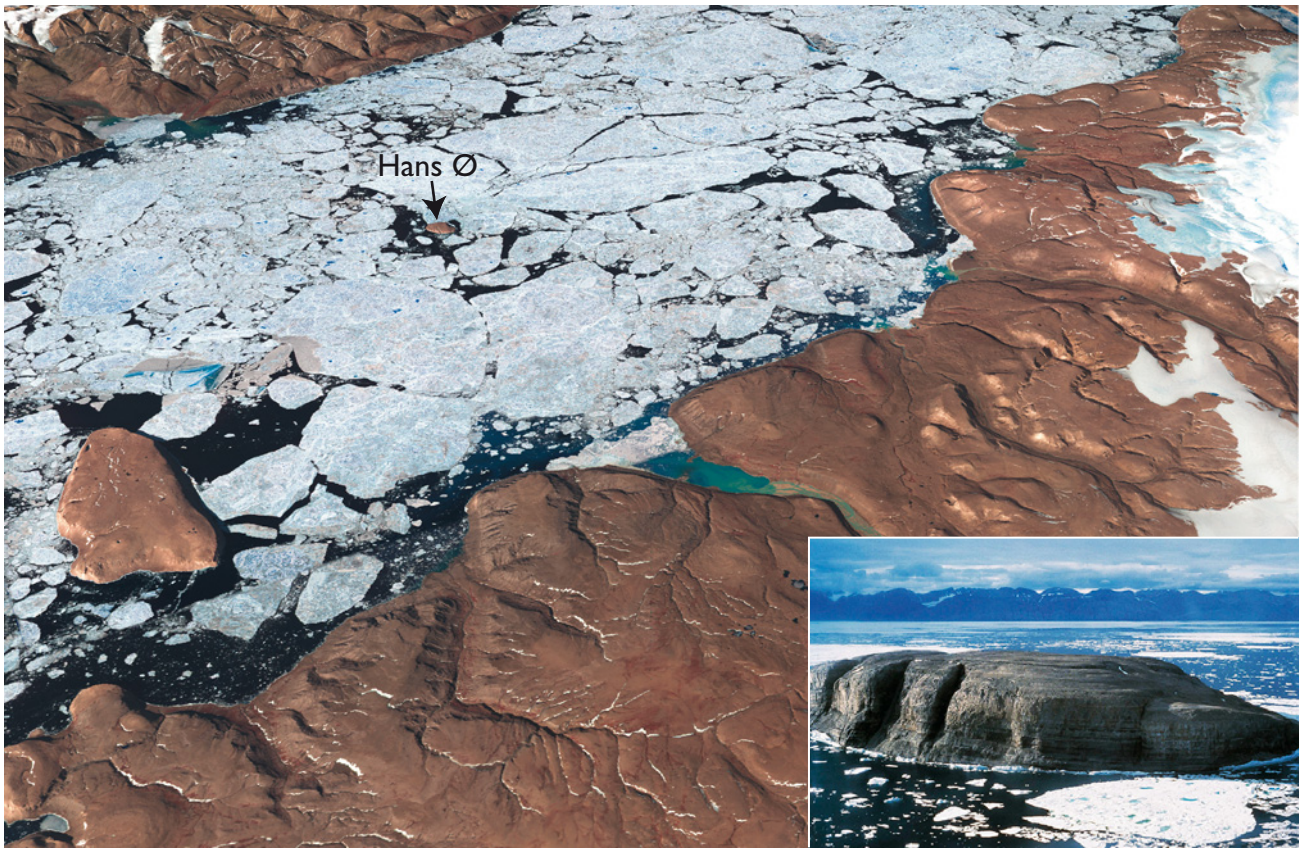

Fig. 4. Perspective view of Kennedy Channel showing Hans Ø and Franklin Ø viewed from the south towards Canada. The colour composite of the visible and near-infrared ASTER image data draped over the digital elevation model are extracted from four ASTER images taken between 26 June and 30 July 2003. Inset: Hans Ø viewed from the south-east.

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