Research of AWI in Greenland following the legacy of Alfred Wegener

Hans Oerter, AWI

Greenland/ Kalaallit Nunaat

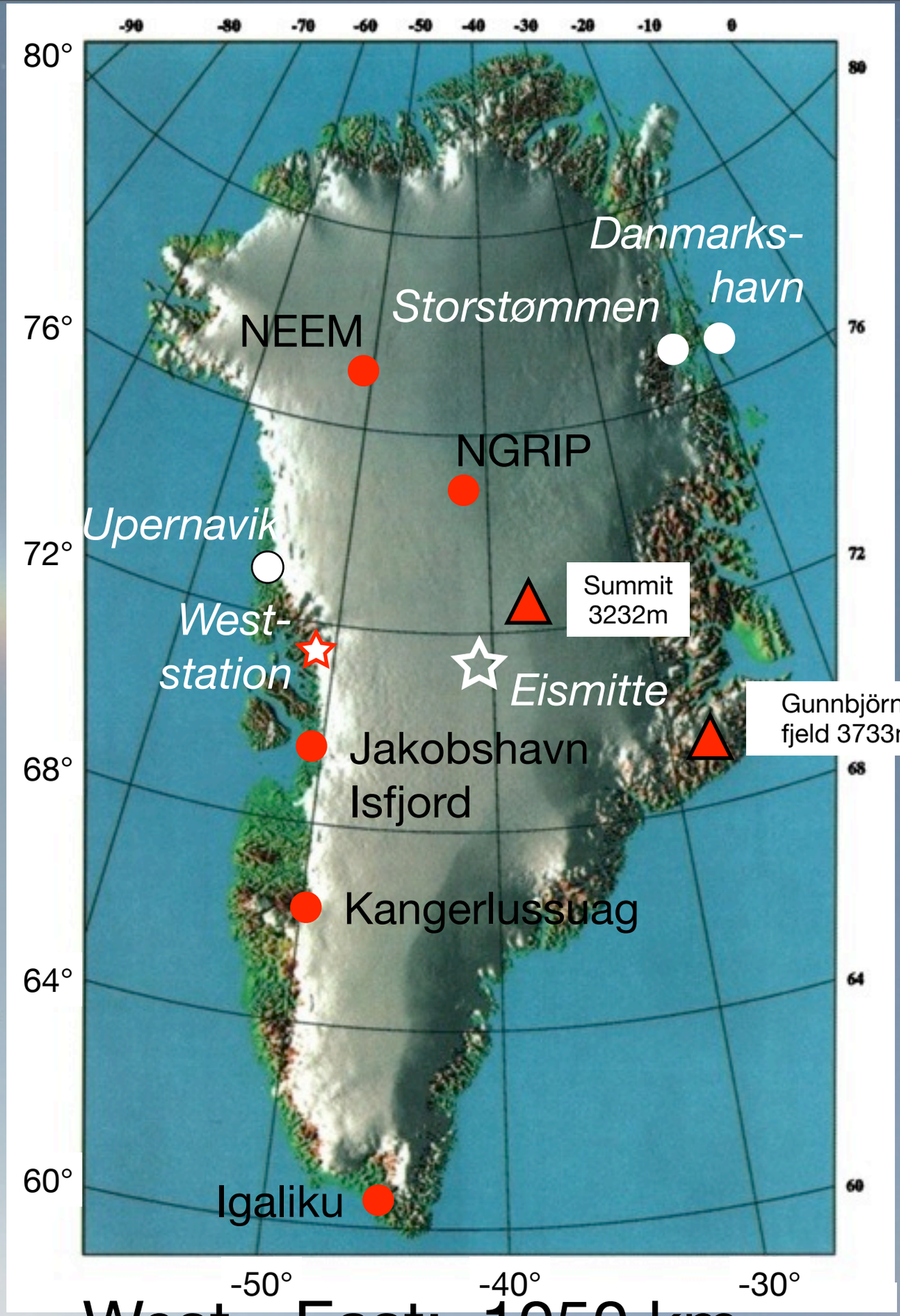
Area: 2.166 Mill. km²
Ice free: 0.410 Mill. km²
(Germany: 0.357 Mill. km²)
Ice covered: 1.756 Mill. km²
Glaciation: 81.1 %

Source: Der Fischer Weltalmanach 2009

Mean ice thickness 1670 m

The Greenlandic ice sheet equals 7.2 m of sea-level change

South - North: 2670 km



after: S. Ekholm, J. Geophys. Res. 101, B10 (1996)

West - East: 1050 km

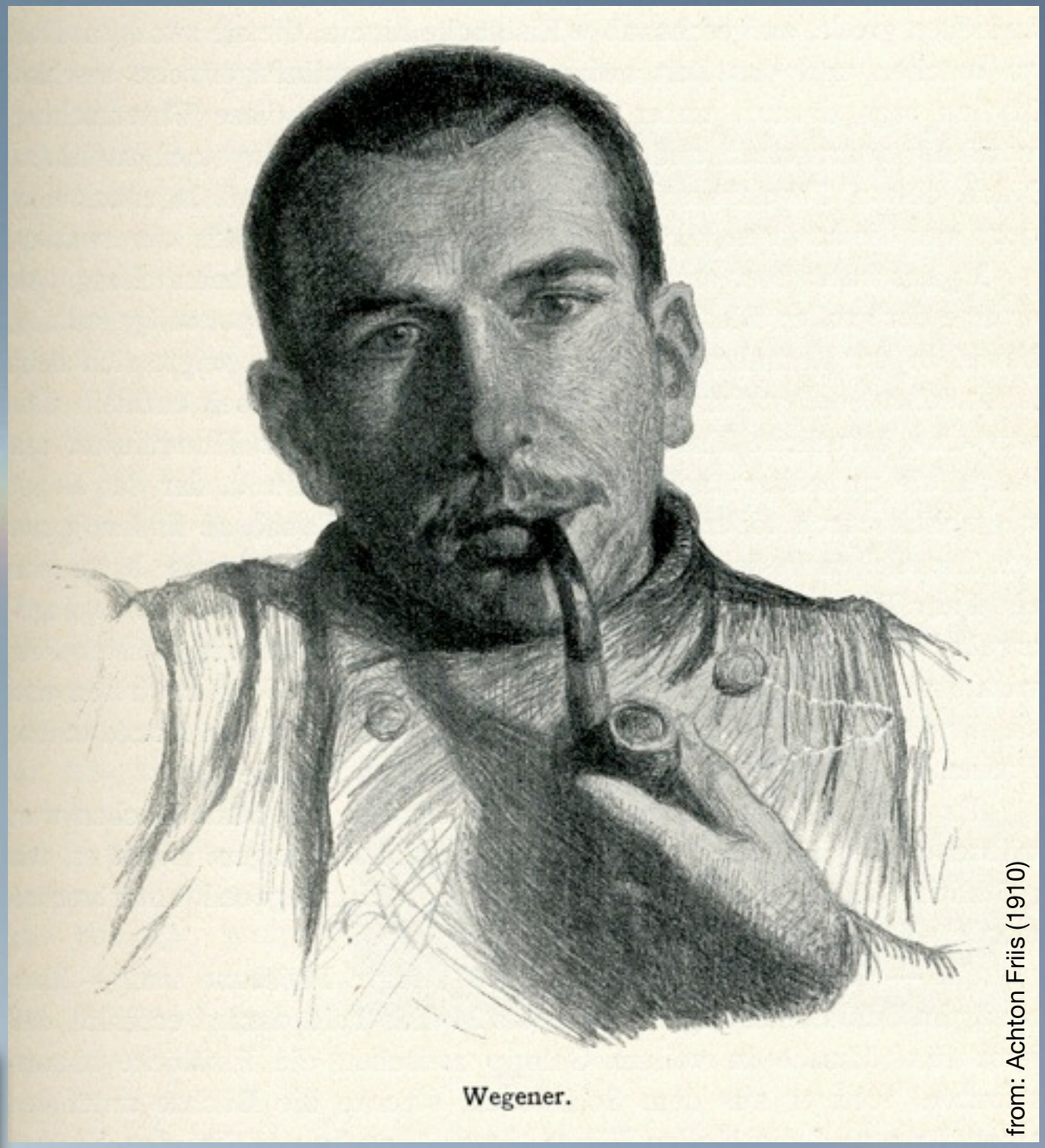
Main topics of research:

- Meteorology over the Greenland ice cap
- Geodetic surveying / ice movement
- Surface mass balance of the ice sheet
- Thickness of the ice sheet

Who was Alfred Wegener ?

1.11.1880 born at Berlin
1899 Abitur at Cöllnisches Gymnasium (High School) Berlin
1899-1904 Study of Mathematics and Science with focus on Astronomy at Berlin, Heidelberg and Innsbruck (Austria)
1904 Ph. D.: „Die Alfonsinischen Tafeln für den Gebrauch des modernen Rechners“ in Berlin
1902-1903 Astronomer at Volks-Sternwarte (Observatory) Urania at Berlin
1905-1906 Technical Assistent at Aeronautic Observatory at Lindenberg adjacent to Berlin, balloon flights for research

1906-1908 First Greenland expedition (Danmark-Expedition), under leadership of Ludvig Mylius Erichsen


Wegener.

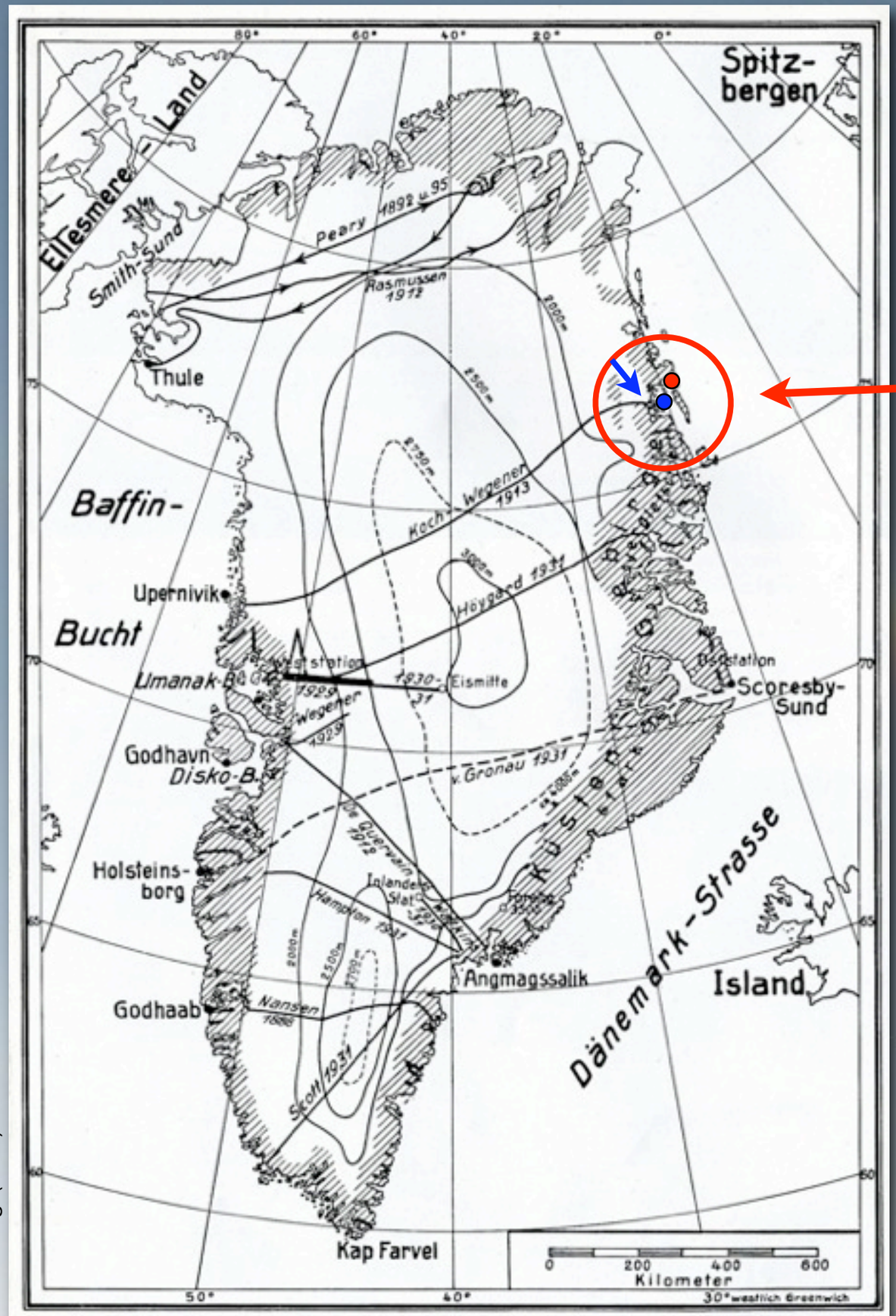
from: Achton Friis (1910)

Alfred Wegener 1880 - 1930
Meteorologist and Geophysicist

1906-1908
Danmarks expedition

Germanialand

- Danmarkshavn
- Dove Bay
- ↘ Storstrømmen ice stream



Übersichtskarte von Grönland entworfen von Dr. F. Loewe 1933

from: J. Georgi (1933)

foto: hans oerter, 1992

foto: hans oerter, 1992

Anno 1906/1908

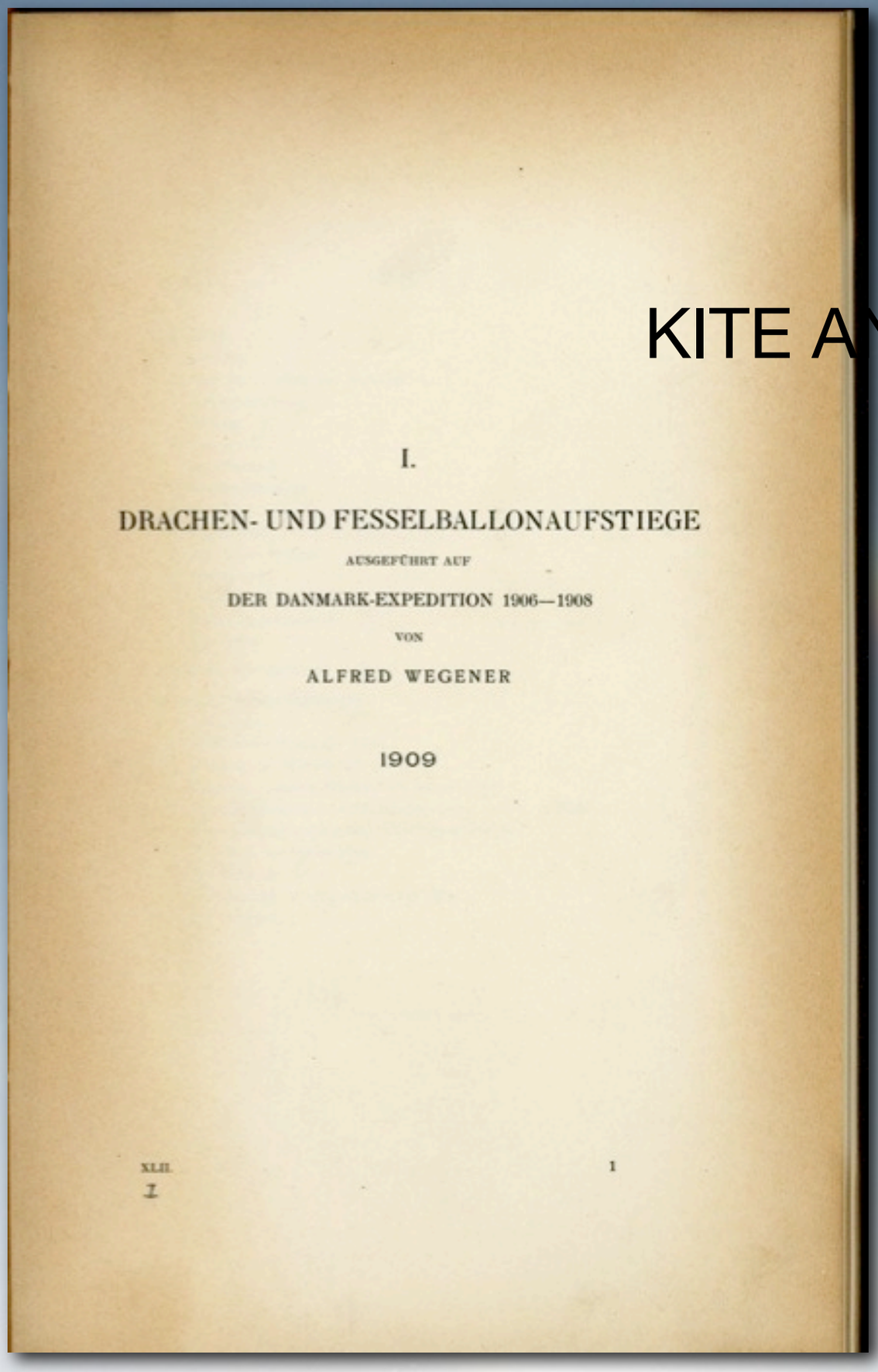
Ballonaufstieg.

from: A. Wegener (1909)

Anno 1992

Balloon launch with radiosonde

foto: hans oerter, 1992



I.

DRACHEN- UND FESSELBALLONAUFSTIEGE

AUSGEFÜHRT AUF

DER DANMARK-EXPEDITION 1906—1908

VON

ALFRED WEGENER

1909

XLII. 1

1

KITE AND CAPTIVE BALLON ASCENTS

CARRIED OUT DURING THE

DANMARK-EXPEDITION 1906-1908

by

ALFRED WEGENER

1909

MEDDELELSER OM GRØNLAND VOL. XLII, No. I

foto: hans oerter, 1992

DANMARK-EKSPEDITIONEN TIL GRØNLANDS NORDØSTKYST 1906—1908 · Bind VI · Nr. 1

SÆRTRYK AF »MEDDELELSER OM GRØNLAND« XLVI

DIE GLACIOLOGISCHEN BEOBACHTUNGEN

DER DANMARK-EXPEDITION

VON

I. P. KOCH UND A. WEGENER

KØBENHAVN
BIANCO LUNOS BOGTRYKKERI
1911

DANMARK-EXPEDITION TO THE NORTHEAST COAST OF GREENLAND 1906-1908, VOLUME VI, NO.1

REPRINT OF MEDDELELSER OM GRØNLAND VOL. XLVI

THE GLACIOLOGICAL OBSERVATIONS OF THE DANMARK-EXPEDITION

by

J.P. KOCH AND A. WEGENER

KØBENHAVN
BIANCO LUNOS BOGTRYKKERI
1911

AWI camp 1990ies

GEUS base camp

from: Koch & Wegener (1911)

Who was Alfred Wegener ?

1909-1919 *Habilitation in Meteorology and Astronomy and Privatdozent (lecturer) at University Marburg (Germany)*

1912-1913 *Second Greenland expedition together with Johan Peter Koch, Lars Larsen und Vigfus Sigurdsson*

foto: Archive AWI

Alfred Wegener 1880 - 1930
Meteorologist and Geophysicist

View from top of „observation hill“ across Danmarkshavn and Dove Bay

foto: hans oerter, 1992

Dove Bay

foto: hans oerter, 1990

from: Koch & Wegener (1911)

Storstrømmen

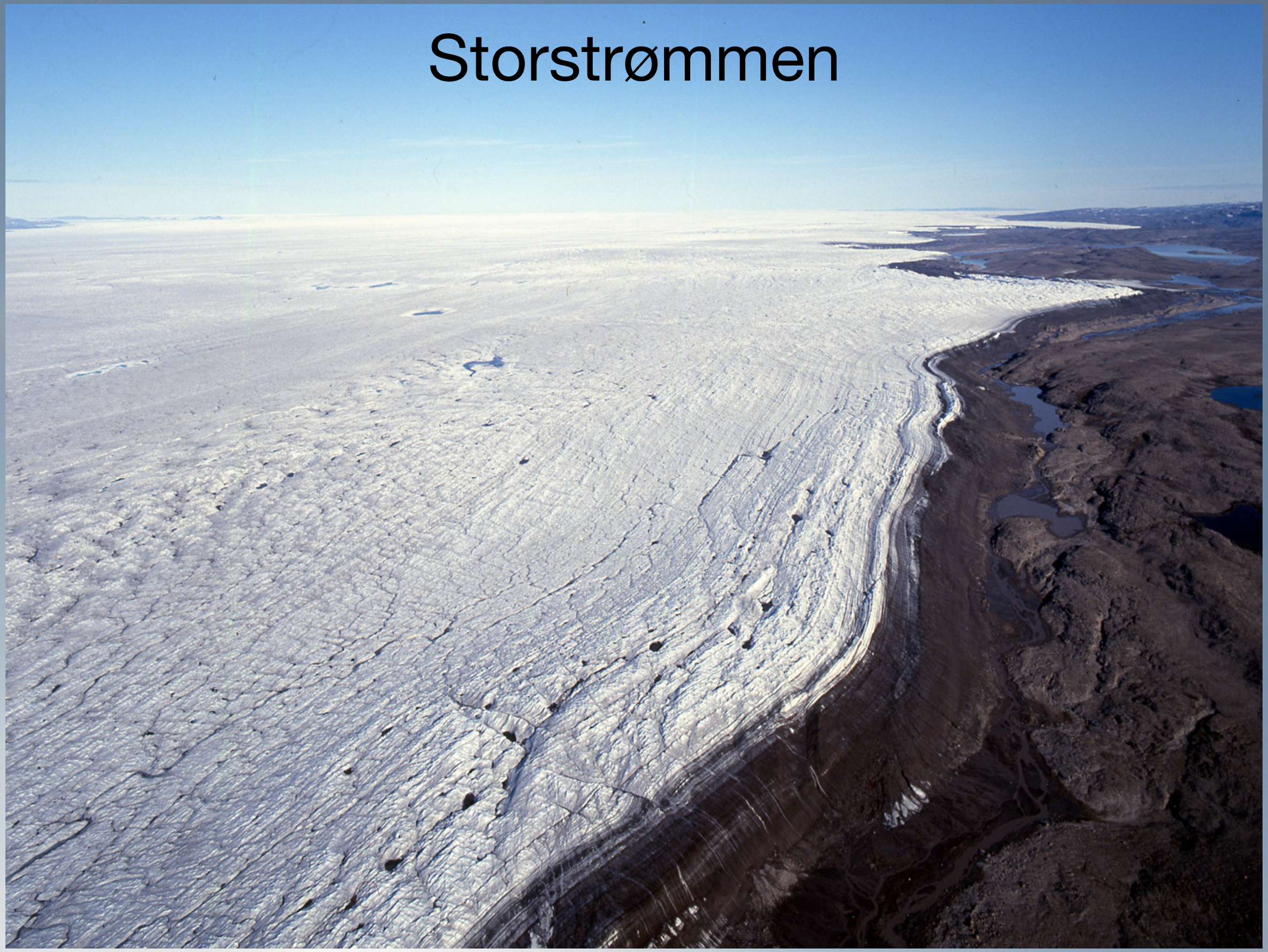


foto: hans oerter, 1994

foto: hans oerter, 1990

foto: hans oerter, 1990

calving front of Storstrømmen

foto: hans oerter, 1993

Surging Glaciers

77° 00‘N

76°45‘ N

76°30‘ N

23° W

22° W

Borg

Brædderne

Bistrup Bræ

Carl Ha

77° 00‘N

76° 40‘N

23° W

22° W

Ice front Aug. 1978

Borg

1984

1912/13

Brædderne

Kap Agga Berthelsen

Kap Jarner

Kap Stop

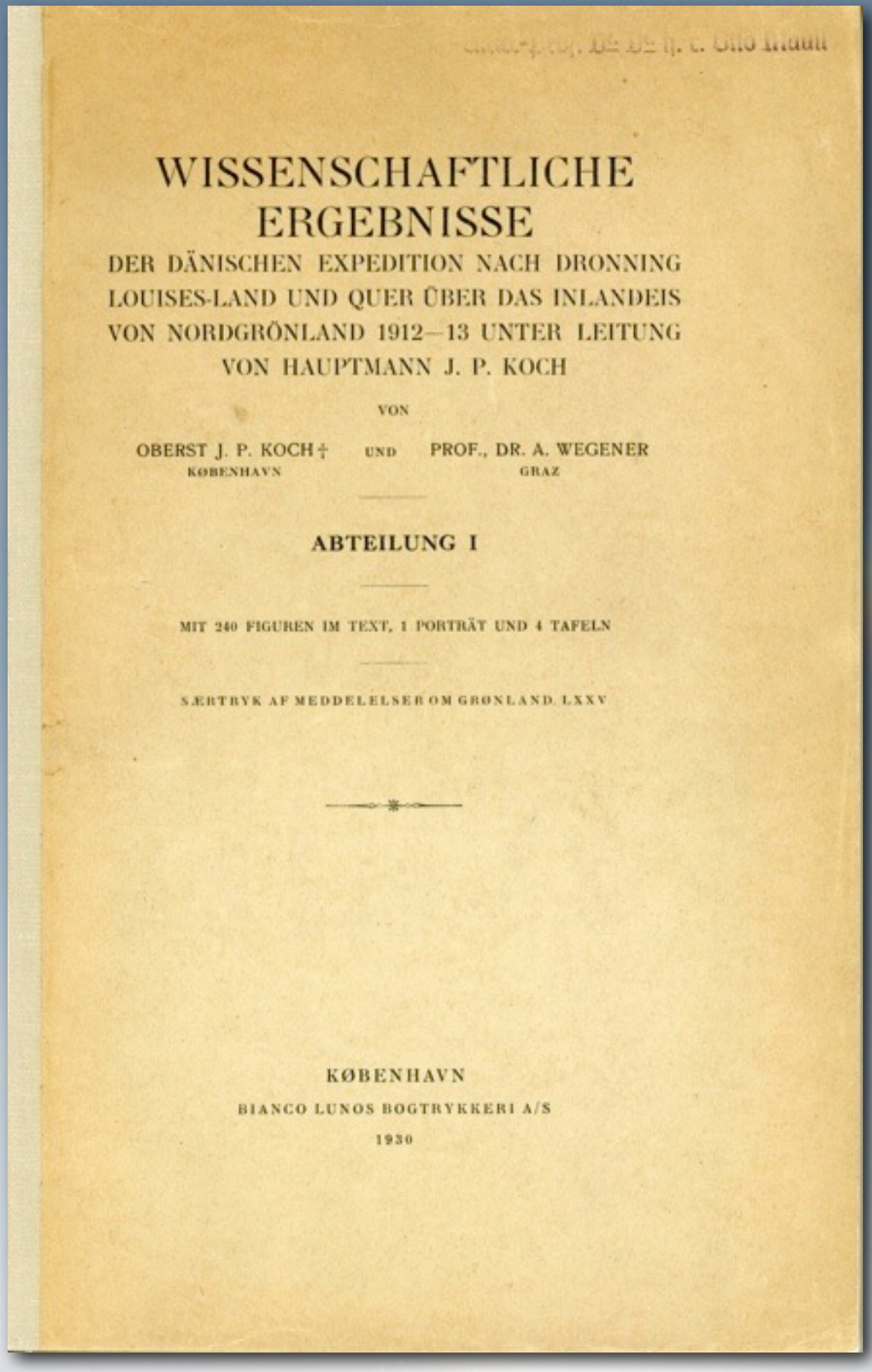
Bistrup Bræ

Map (detail) from 1906-08, publ. 1911

Map (detail) by AWI (1995)

at „Borg“ 1993

foto: hans oerter, 1993



WISSENSCHAFTLICHE ERGEBNISSE

DER DÄNISCHEN EXPEDITION NACH DRONNING LOUISES-LAND UND QUER ÜBER DAS INLANDEIS VON NORDGRÖNLAND 1912—13 UNTER LEITUNG VON HAUPTMANN J. P. KOCH

VON

OBERST J. P. KOCH † KØBENHAVN UND PROF., DR. A. WEGENER GRAZ

ABTEILUNG I

MIT 240 FIGUREN IM TEXT, 1 PORTRÄT UND 4 TAFELN

SÆRTRYK AF MEDDELELSER OM GRØNLAND. LXXV

KØBENHAVN

BIANCO LUNOS BOGTRYKKERI A/S

1930

Scientific Results

OF THE DANISH EXPEDITION TO DRONNING LOUISES-LAND AND ACROSS THE INLAND ICE FROM NORTH GREENLAND 1912-13 UNDER THE LEADERSHIP OF CAPTAIN J.P. KOCH

by

Colonel J.P. Koch † and Prof., Dr. A. Wegener

KØBENHAVN GRAZ

Section I

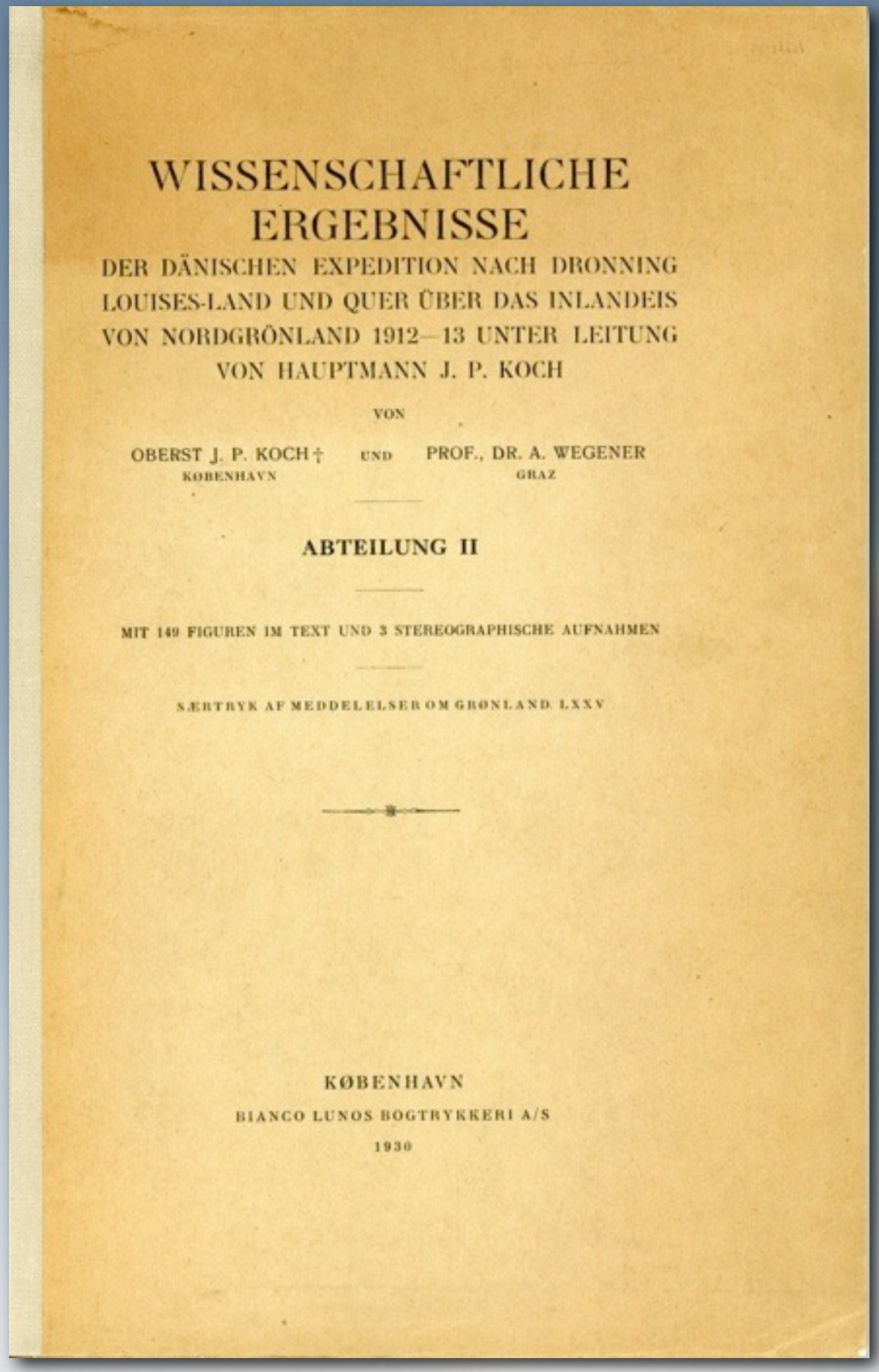
WITH 240 FIGURES IN THE TEXT, 1 POTRAIT AND 4 CHARTS

REPRINT OF MEDDELELSER OM GRØNLAND VOL. LXXV

KØBENHAVN

BIANCO LUNOS BOGTRYKKERI A/S

1930



WISSENSCHAFTLICHE ERGEBNISSE

DER DÄNISCHEN EXPEDITION NACH DRONNING LOUISES-LAND UND QUER ÜBER DAS INLANDEIS VON NORDGRÖNLAND 1912—13 UNTER LEITUNG VON HAUPTMANN J. P. KOCH

VON

OBERST J. P. KOCH † KØBENHAVN UND PROF., DR. A. WEGENER GRAZ

ABTEILUNG II

MIT 149 FIGUREN IM TEXT UND 3 STEREOGRAPHISCHE AUFNAHMEN

SÆRTRYK AF MEDDELELSER OM GRØNLAND LXXV

KØBENHAVN

BIANCO LUNOS BOGTRYKKERI A/S

1930

Scientific Results

OF THE DANISH EXPEDITION TO DRONNING LOUISES-LAND AND ACROSS THE INLAND ICE FROM NORTH GREENLAND 1912-13 UNDER THE LEADERSHIP OF CAPTAIN J.P. KOCH

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KØBENHAVN GRAZ

Section II

WITH 140 FIGURES IN THE TEXT AND 3 STEREOGRAPHIC IMAGES

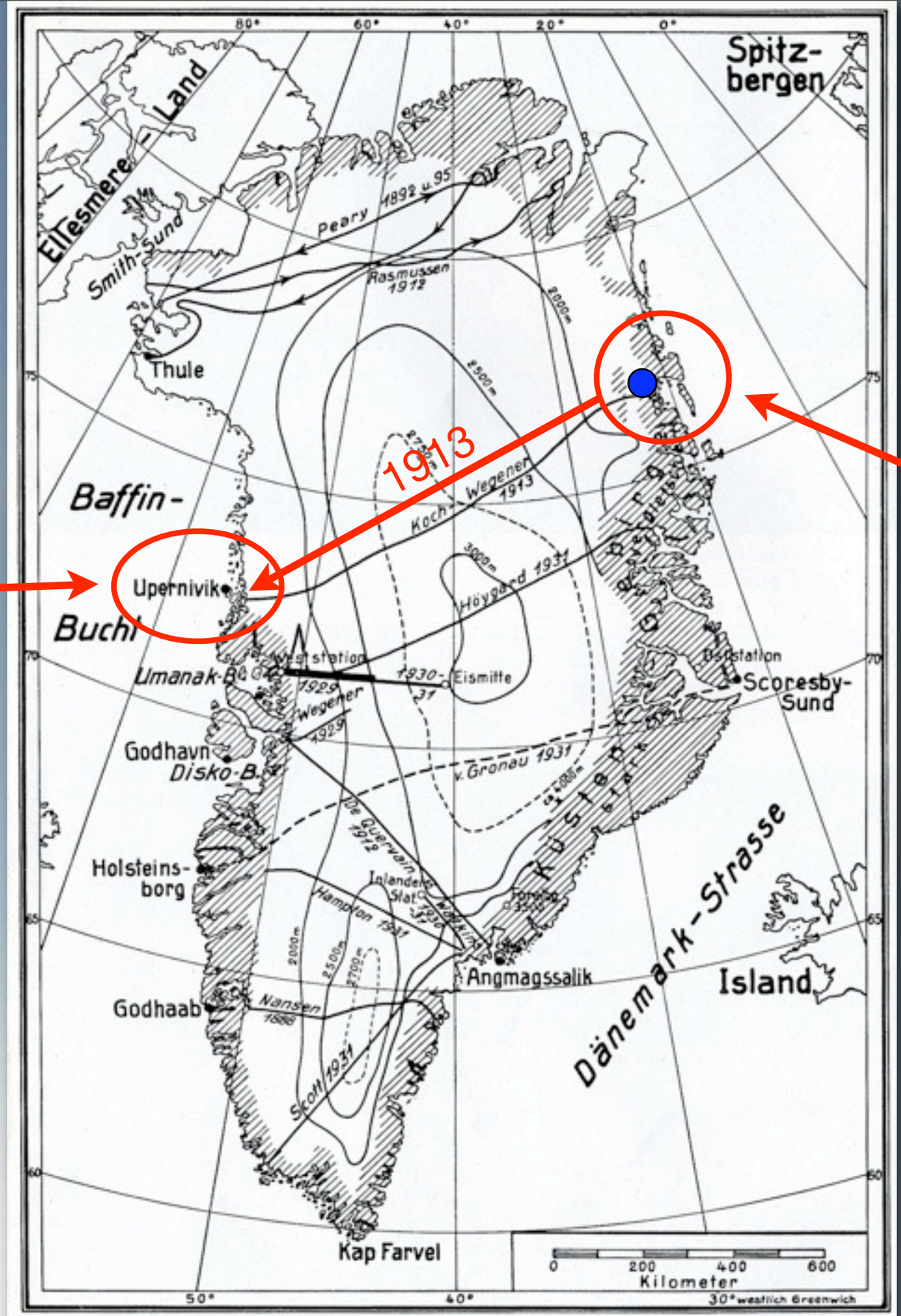
REPRINT OF MEDDELELSER OM GRØNLAND VOL. LXXV

KØBENHAVN

BIANCO LUNOS BOGTRYKKERI A/S

1930

1912-1913
Koch & Wegener, Wintering over and Crossing of the Inland ice



Übersichtskarte von Grönland entworfen von Dr. F. Loewe 1933

aus: J. Georgi (1933)

Upernavik

Germanialand

Borg station for wintering over

Stable for horses within the firn (Snow)

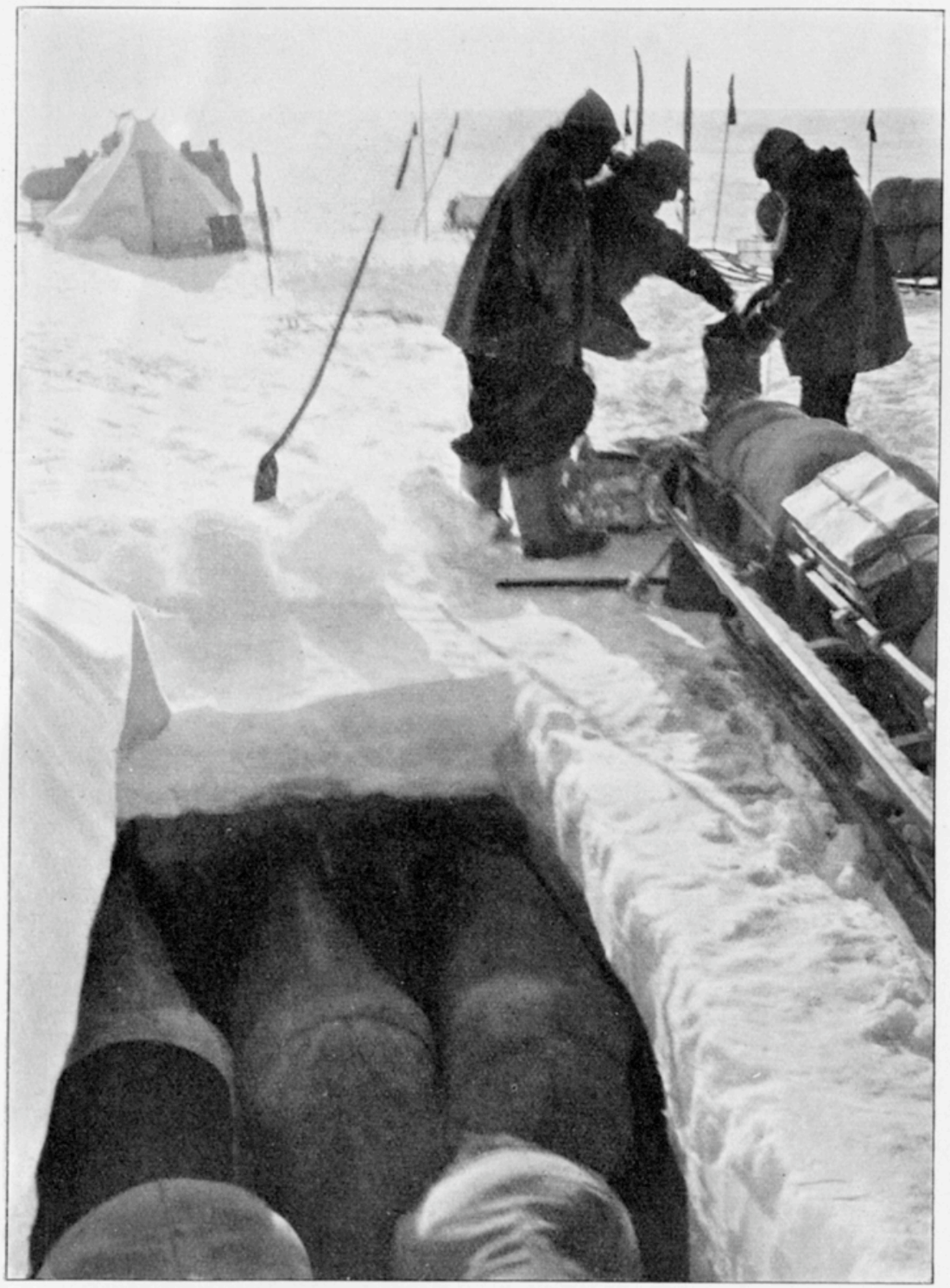


Fig. 10. Pferdestall im Firn.

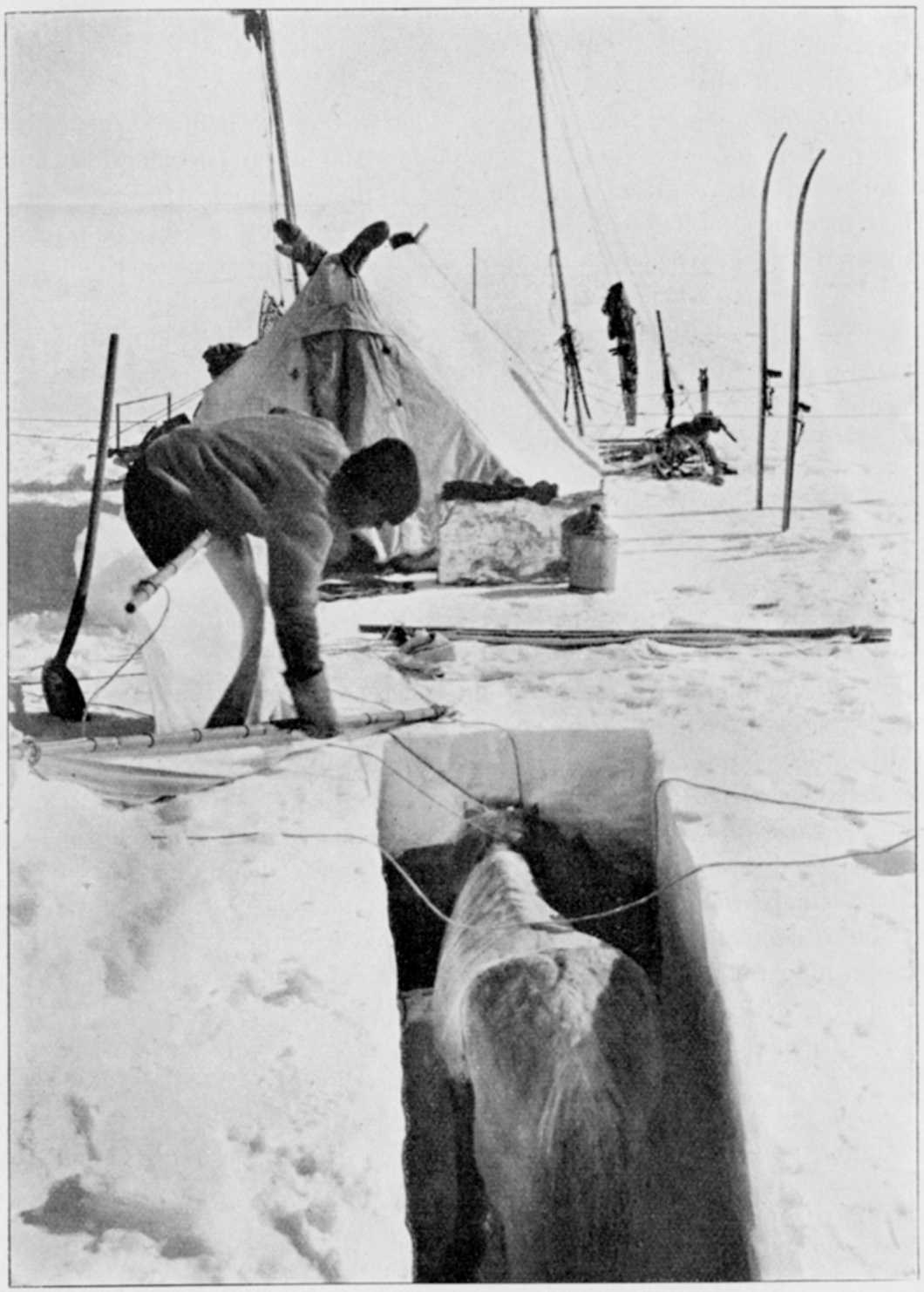


Fig. 11. Pferdestall im Firn.

from: Koch & Wegener (1930)

Snow pit

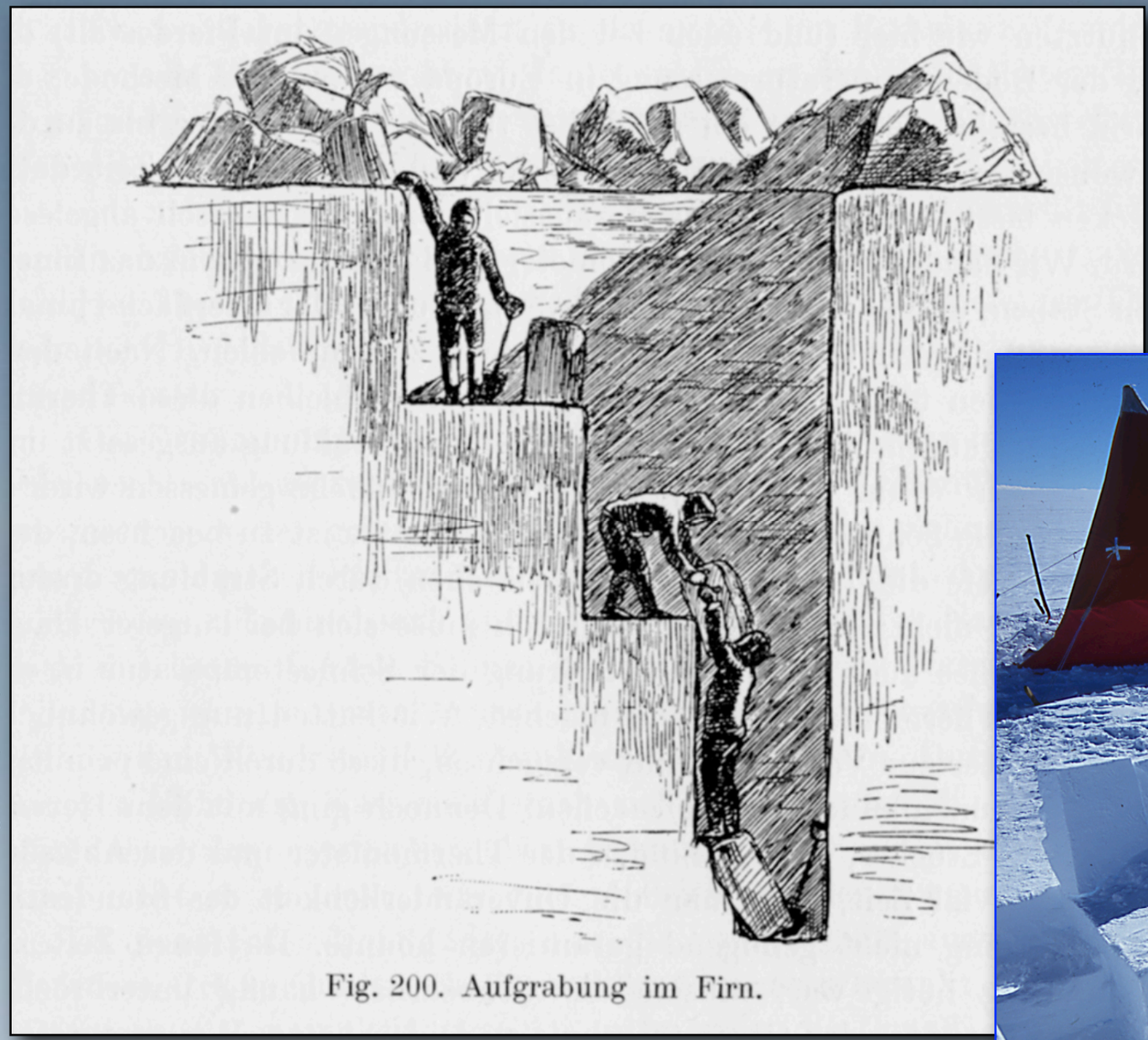


Fig. 200. Aufgrabung im Firn.

from: Koch & Wegener (1930)

Snow pit in firn

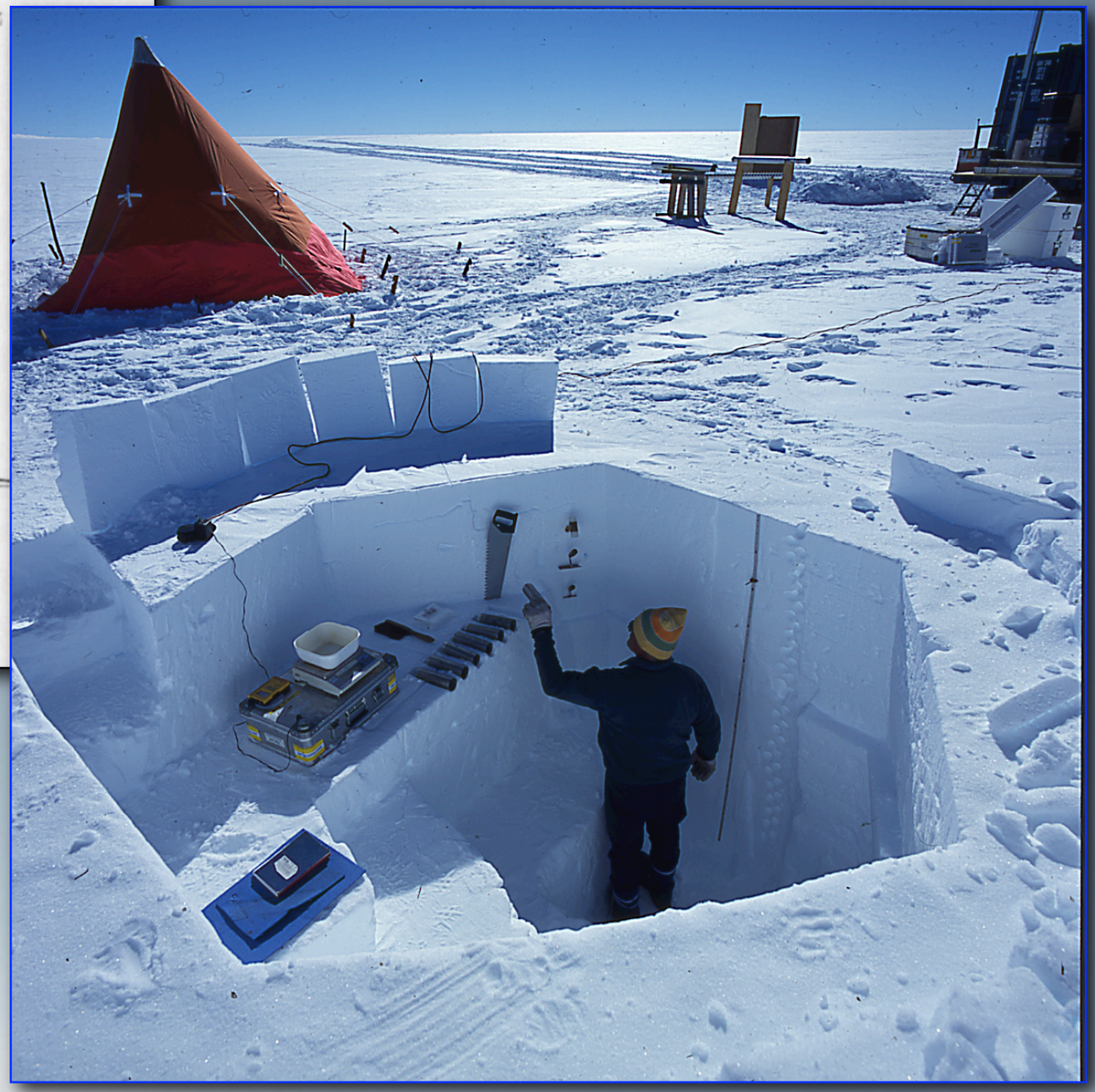


foto: hans oerter, 1998

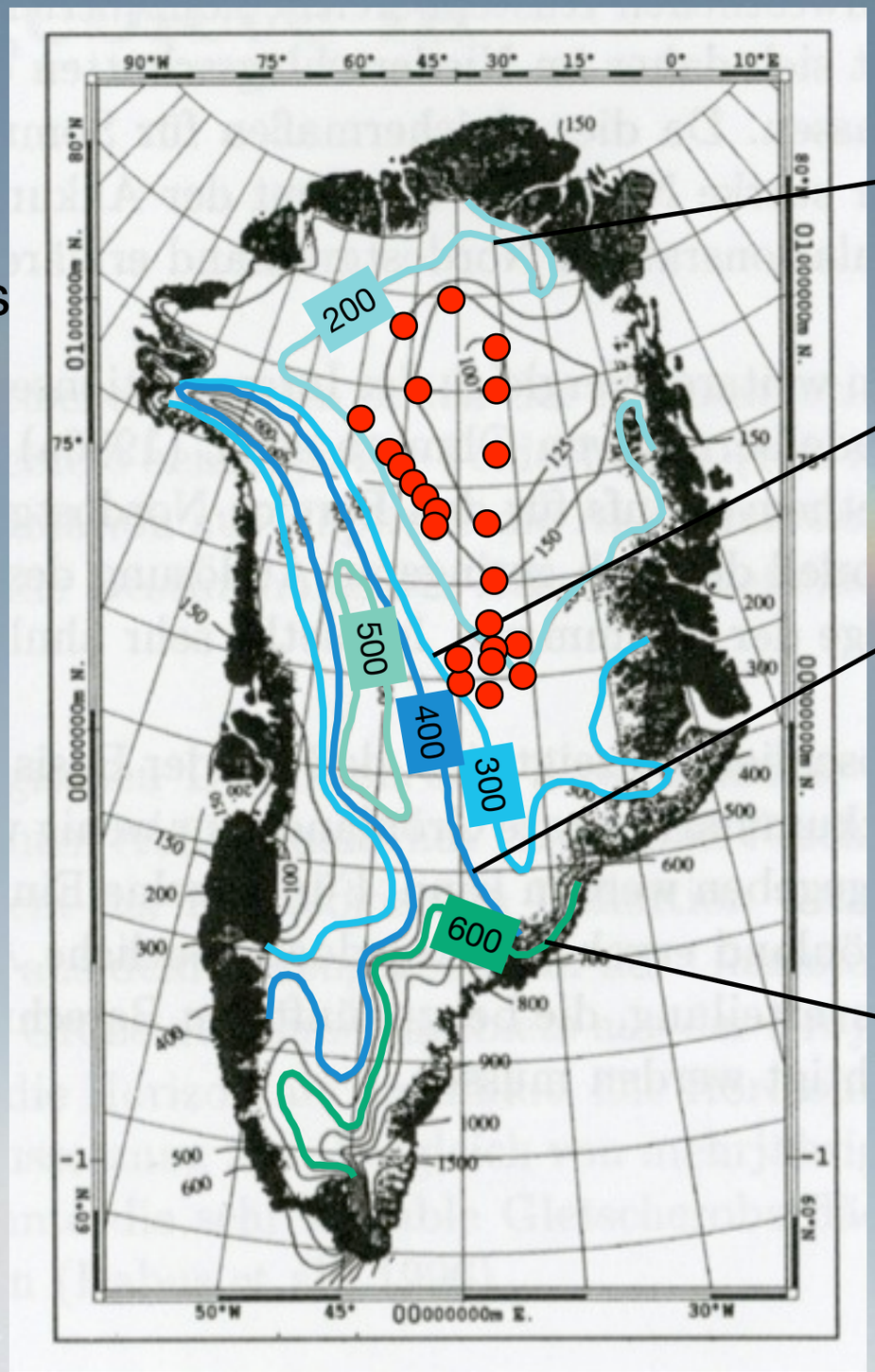
Todays sledge traverse across the inland ice

foto: hans oerter, 1998

Surface mass balance Greenland

AWI points

old data + pit & AWI firn core data



mm w.eq./a =
kg m^{-2} a^{-1}

100 - 200

200 - 300

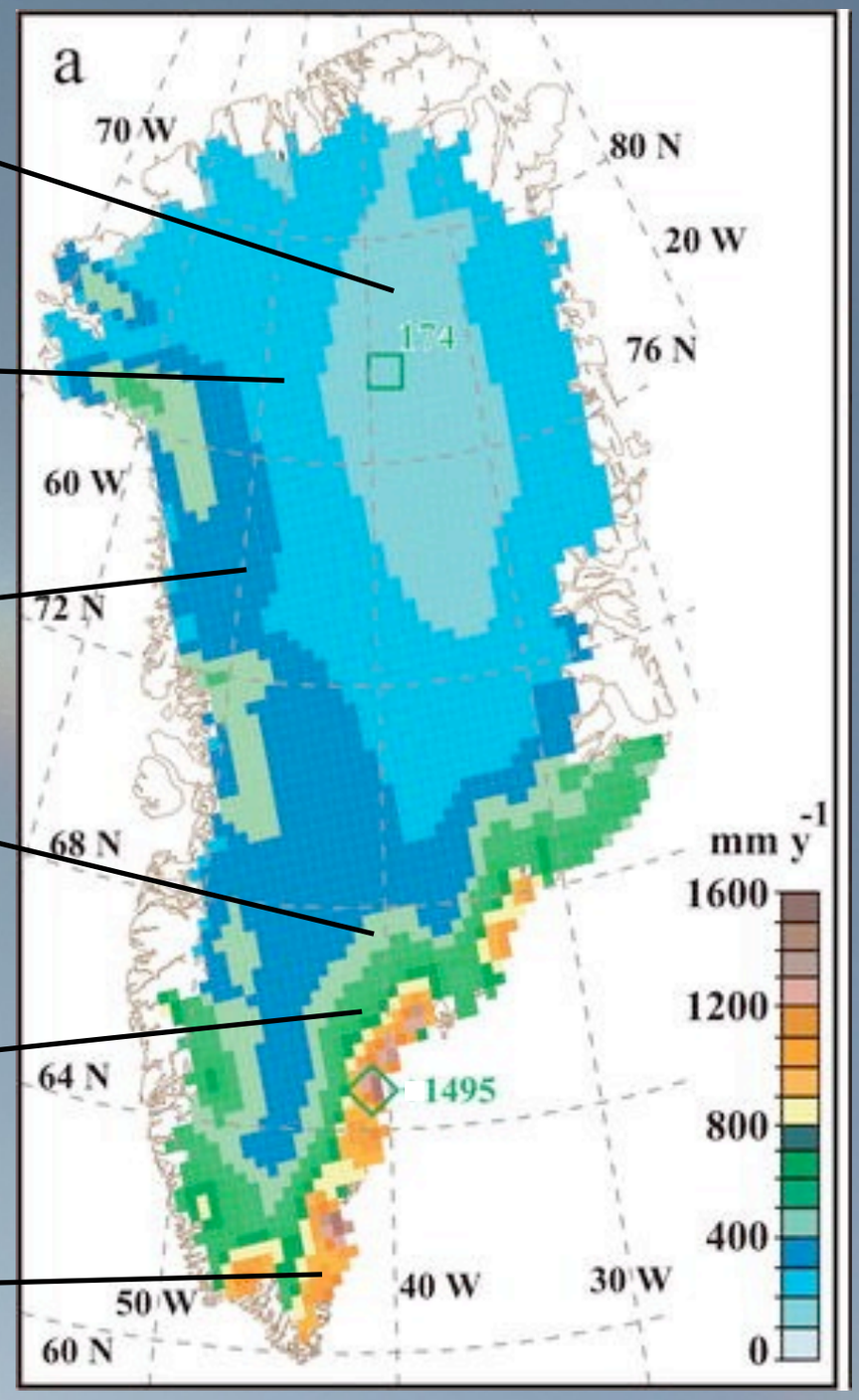
300 - 400

400 - 500

500 - 600

900 - 1000

Mean 1988-2004
by modell



F. Jung-Rothenhäusler: Rep. Polar Res. 280 (1998)

Box, J. E. et al. : J. Climate 19, 2783-2800 (2006)

Who was Alfred Wegener ?

1912-1913 Second Greenland expedition together withJohan Peter Koch, Lars Larsen und Vigfus Sigurdsson
1914-1918 *Soldier in the army in Belgium and France, later meteorologist with weather service of the army*
1919-1924 *Head of department at the „Deutsche Seewarte“ (German marine observatory), lecturer at University Hamburg*
1924-1930 *Professor for Meteorology and Geophysics at University Graz (Austria). Austrian citizenship.*
1929 *Pre-expedition to Greenland*

1930-1931 “Deutsche Grönlandexpedition Alfred Wegener“ (German Greenland expedition Alfred Wegener)

Nov 1930 *Wegener and his companian Villumsen passed away on the Greenland ice sheet*

Der Expeditionsleiter Prof. Dr. A. Wegener 1880 – 1930

from: J. Georgi (1933)

Alfred Wegener 1880 - 1930
Meteorologist and Geophysicist

Alfred Wegener.

1880—1930.

Alfred Wegeners letzte Grönlandfahrt

Die Erlebnisse der deutschen Grönlanderpedition 1930/1931
geschildert von seinen Reisegefährten und nach
Tagebüchern des Forschers

*

Unter Mitwirkung von Dr. Fritz Loewe
herausgegeben von

Else Wegener

*

Mit 5 Rundbildern, 122 Abbildungen
in Kunst- und Kupfertiefdruck, 11 Karten,
Grundrissen und Übersichten

Vorwort von Professor Dr. Kurt Wegener

10. Auflage

F. A. Brockhaus / Leipzig / 1940

First edition publ. in 1932

Dr. Johannes Georgi — Aufnahme E. Sorge

HIDDEN IN THE ICE

Im Eis vergraben

Erlebnisse auf Station „Eismitte"
der letzten Grönland-Expedition
Alfred Wegeners

Narratives from base „Eismitte" of the last Expedition of Alfred Wegener to Greenland

von

Johannes Georgi

Verlag des Blodigschen Alpenkalenders
Paul Müller, München 2 NW 8

1933.

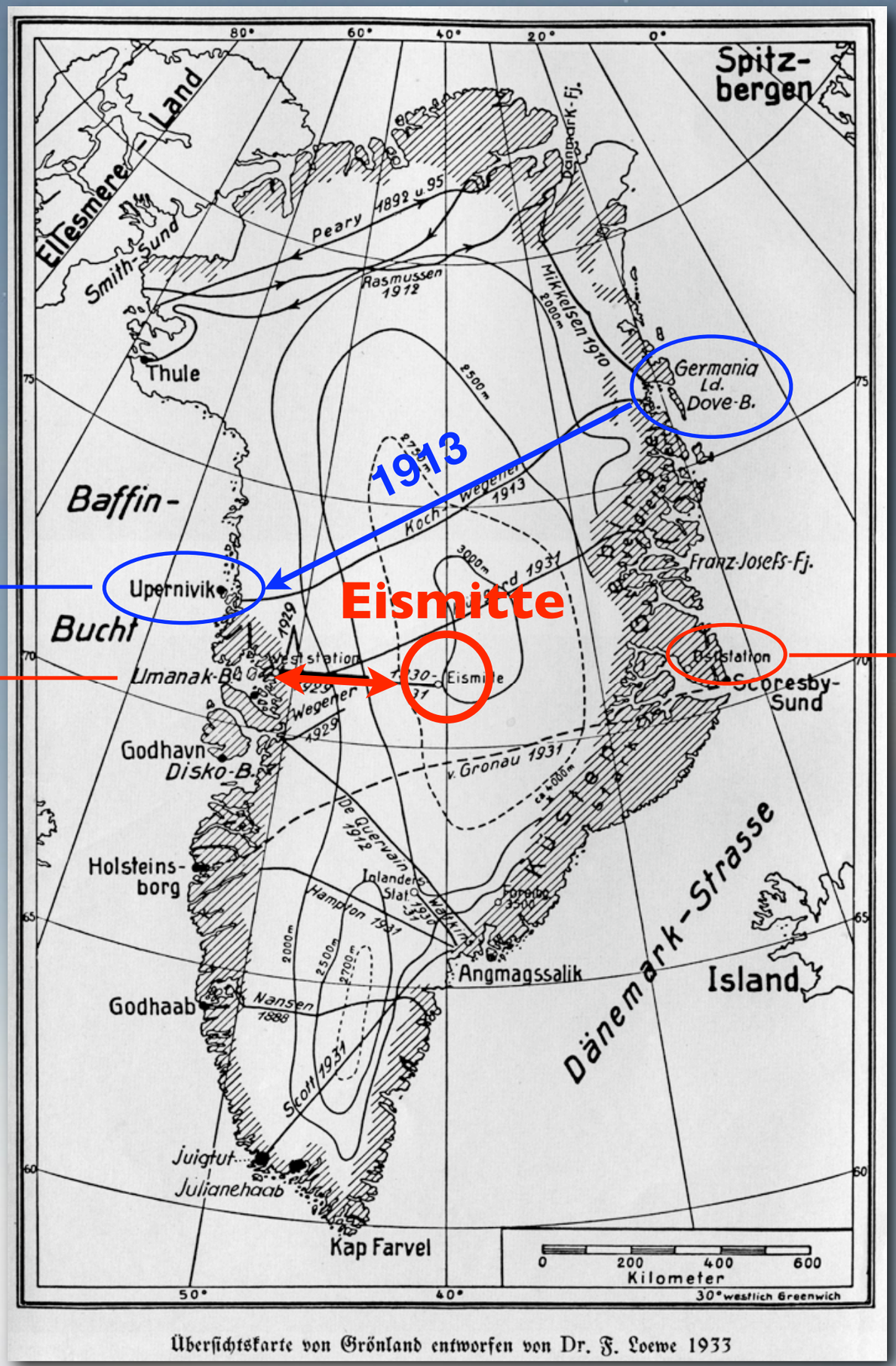
1929
Pre-expedition

1930/31
German Greenland expedition Alfred Wegener

Upernavik

Uummannaq

Oststation



Übersichtskarte von Grönland entworfen von Dr. F. Loewe 1933

aus: J. Georgi (1933)

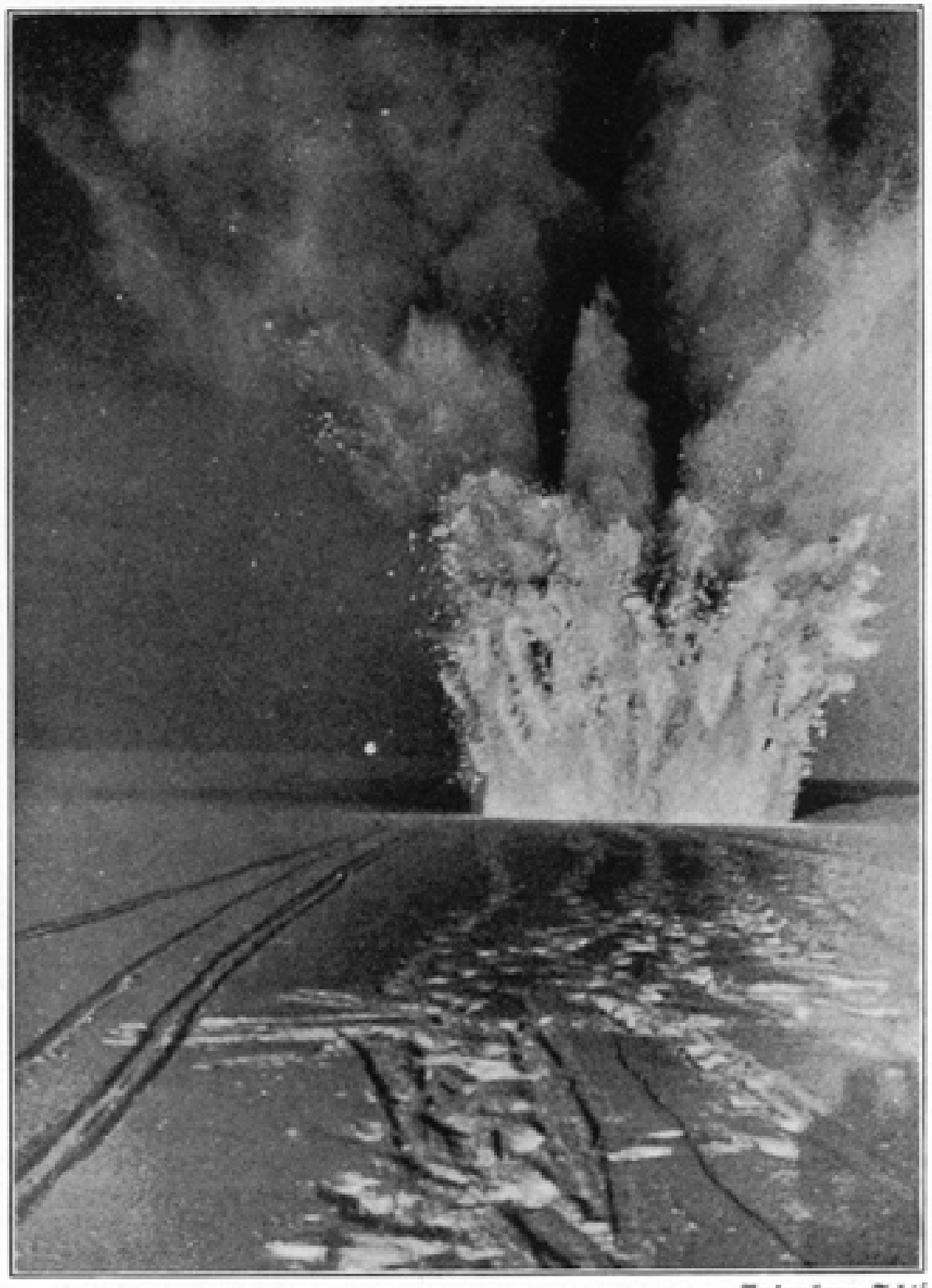
Station Eismitte 1930/31

Photo: Archive AWI

NGRIP drill camp 1996-2003

Photos: S. Kipfstuhl

Seismics for determination of ice thickness



Aufnahme Schif

Sprengung mit 73 kg Trinitrotoluol.

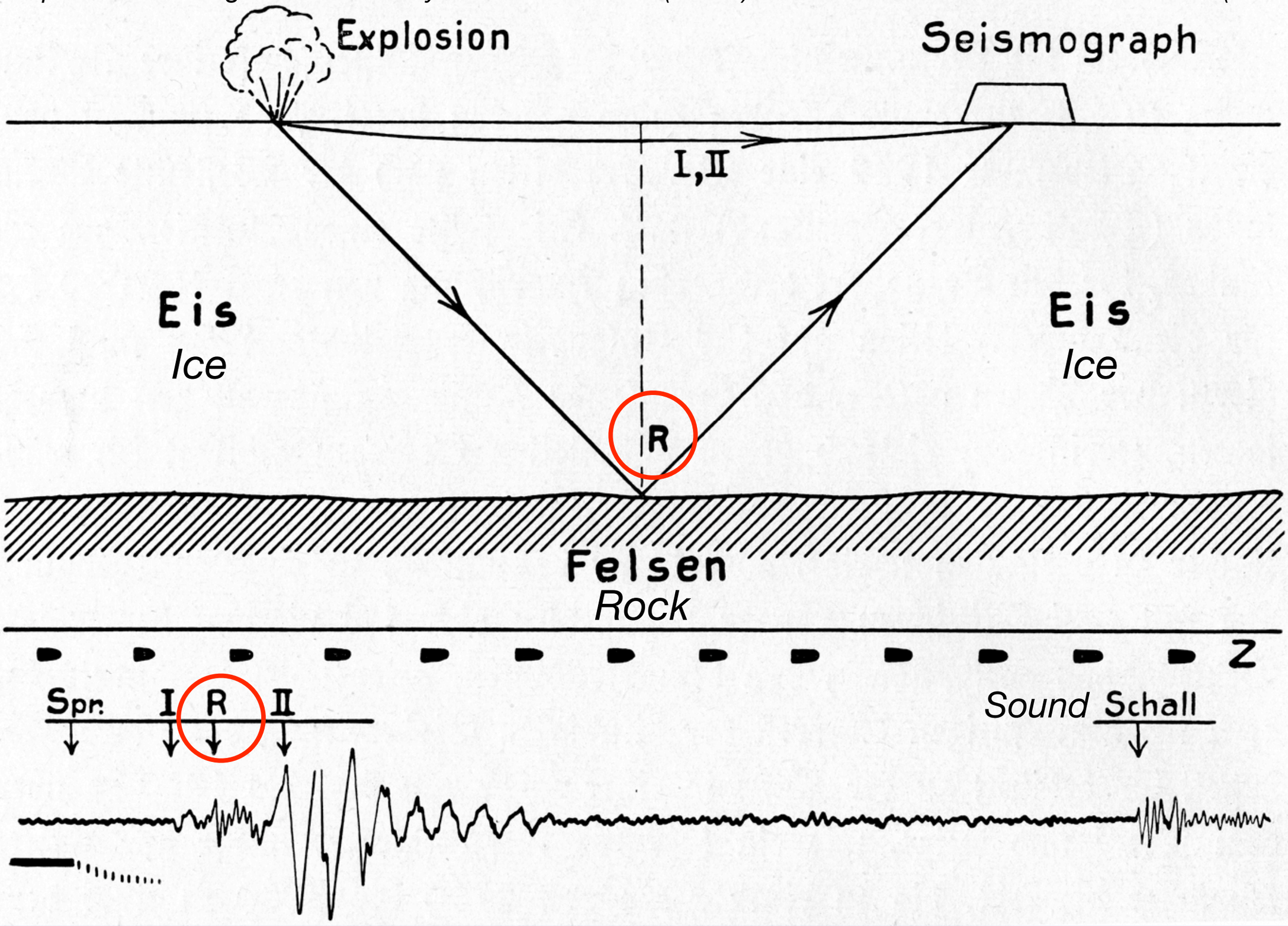
Seite 213.

aus: E. Wegener (ed.) (1933/1940)

Blowing up with 73 kg Trinitrotoluol

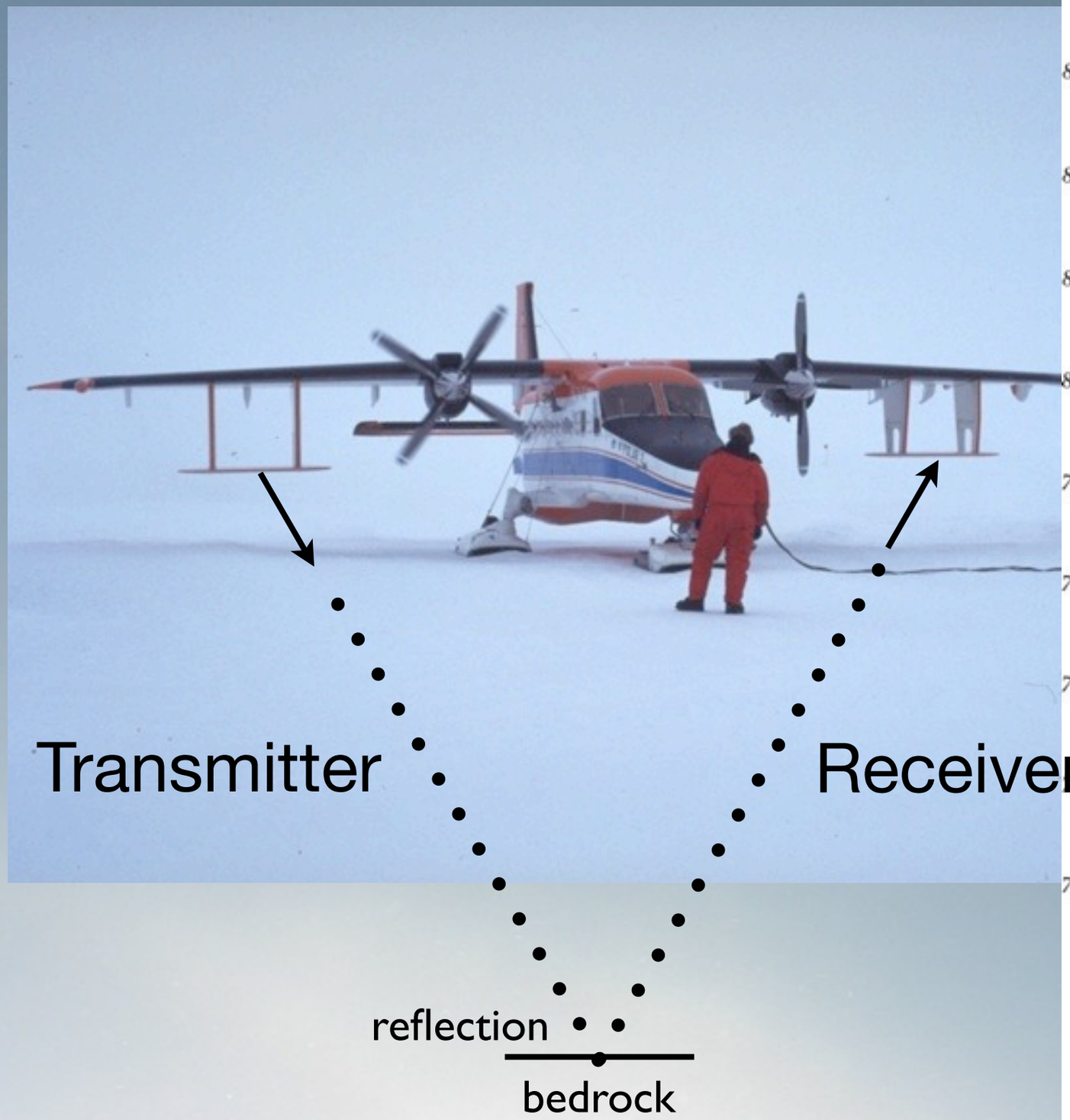
Prinzip der seismischen Eisdickenmessung (oben) und Nachbildung eines Registrierstreifens (unten)

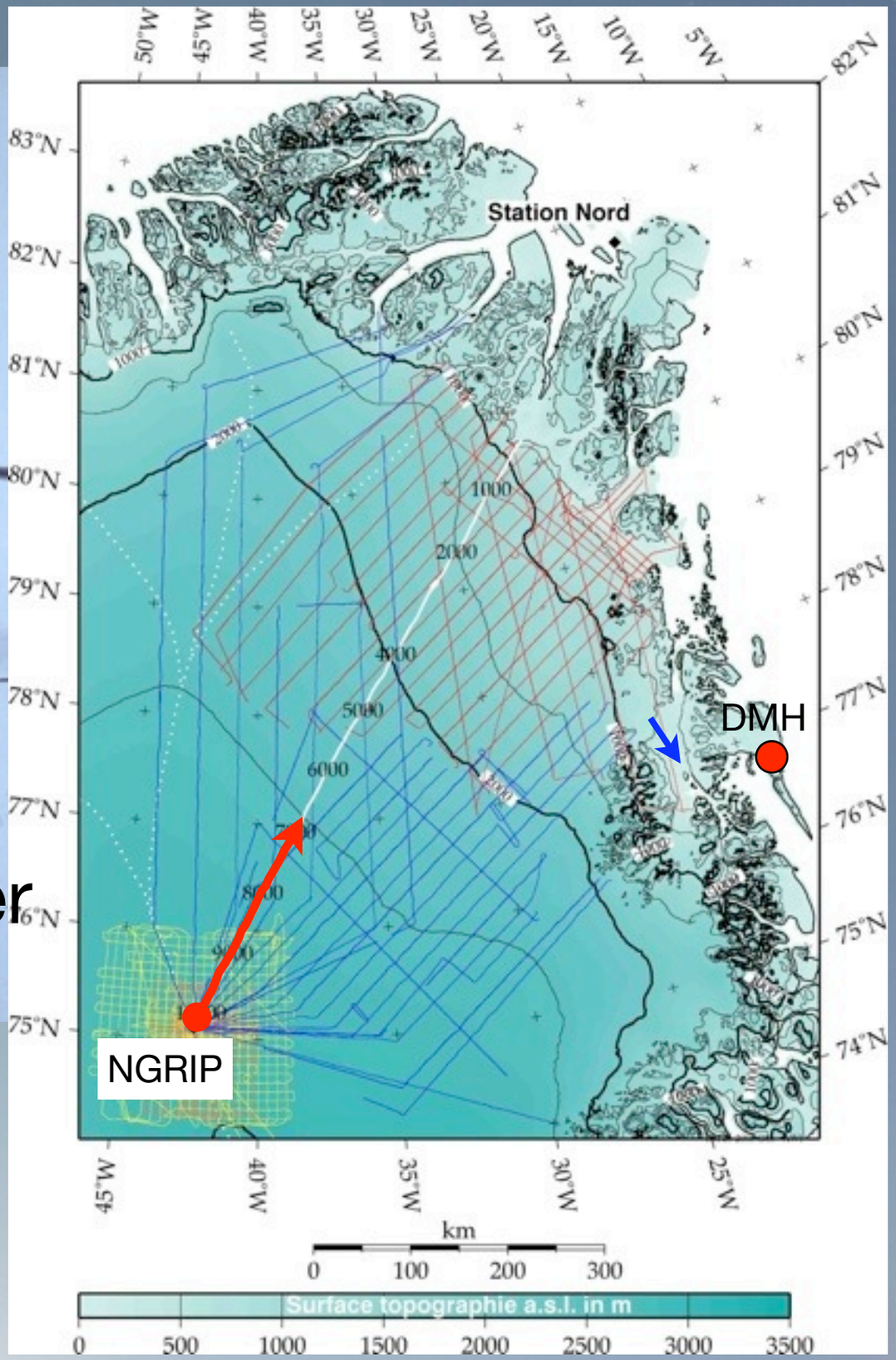
Principle of measuring ice thickness by means if seismics (above) and reconstruction of a seismic record (below)



from: J. Georgi (1933)

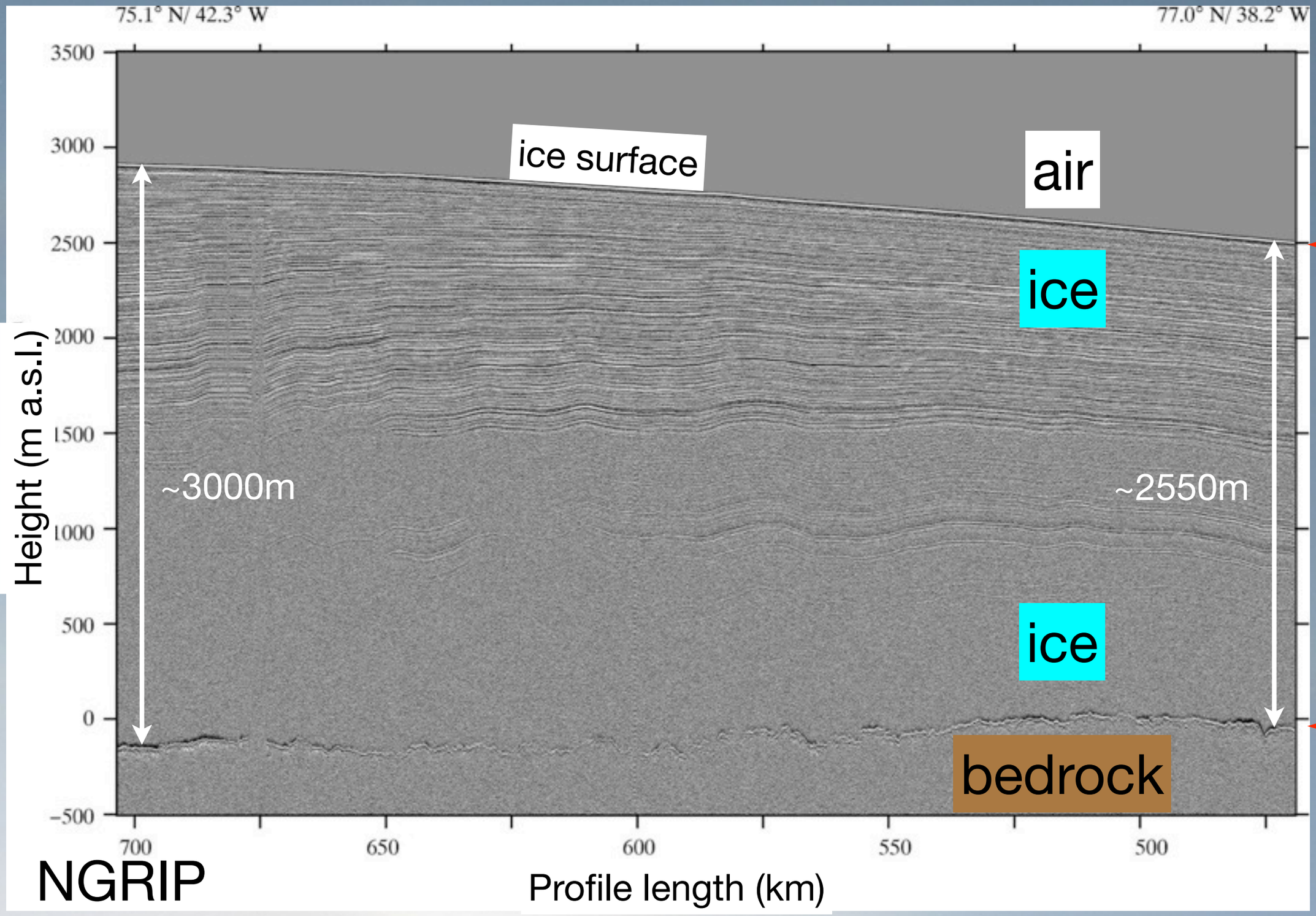
Ice thickness by radio-echosounding

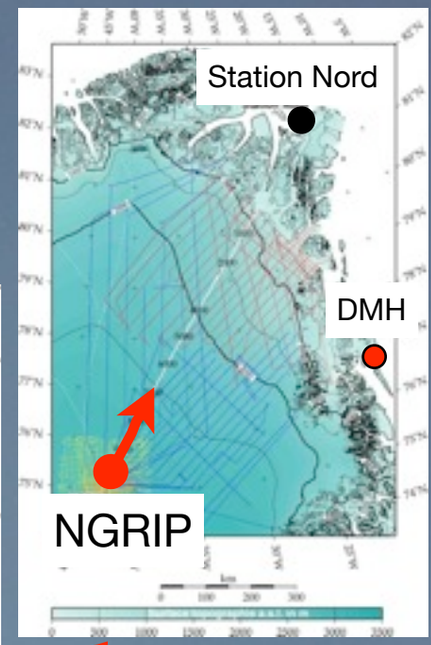




D. Steinhage, AWI, pers. comm. (2010)

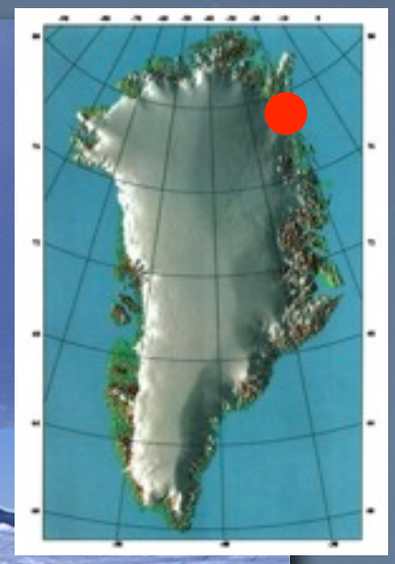
Ice thickness by radio-echosounding





D. Steinhage, AWI, pers. comm. (2010)

Ice thickness by explosive seismics



on the 79°-Glacier, Northeast Greenland

foto: hans oerter, 1998

foto: hans oerter, 1998

foto: hans oerter, 1998

foto: hans oerter, 1998

Results: Ice thickness and depth of Fjord

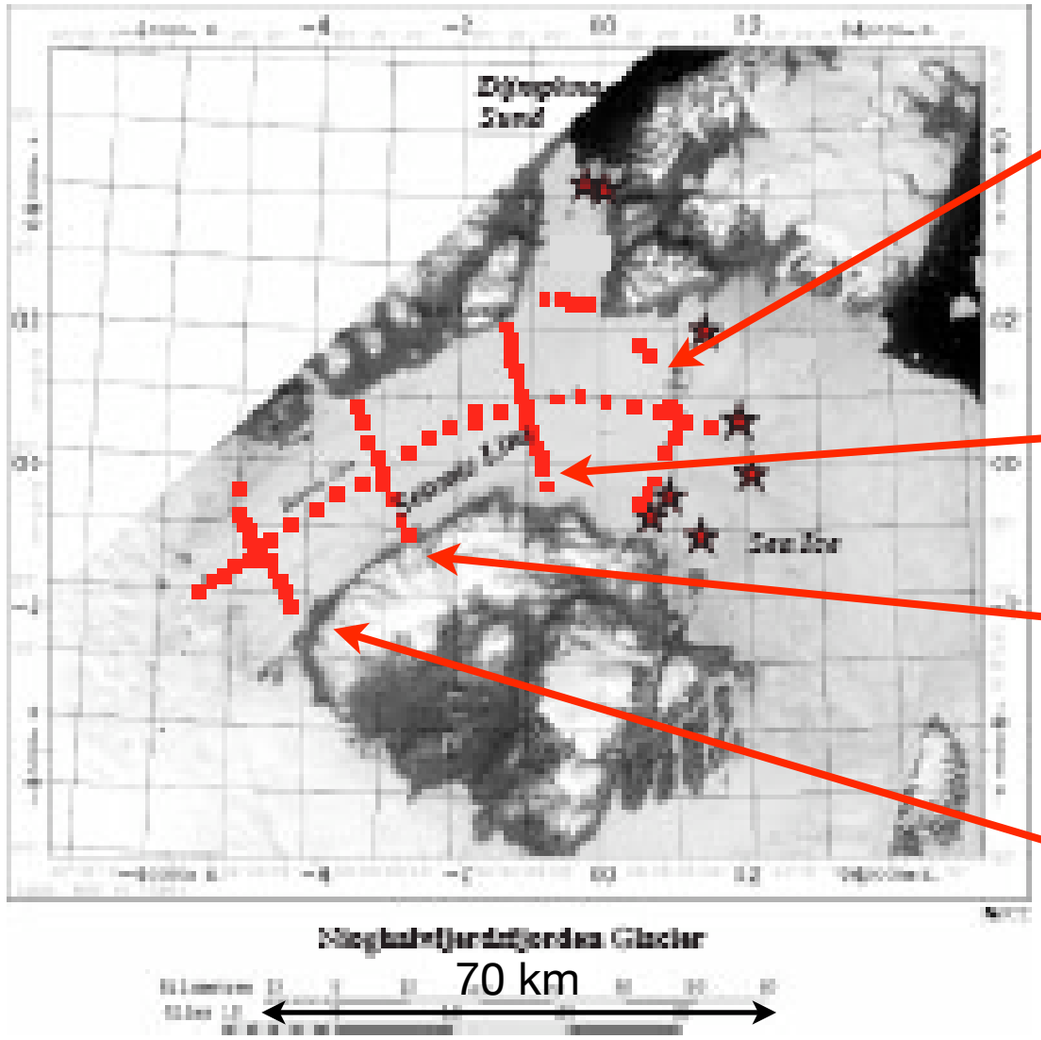


Figure 1. Geocoded Landsat Image of NFG. The dots represent seismic depth soundings, the stars CTD locations. Dijmphna Sund is ice free, whereas east of the glacier a semi-permanent sea ice cover exists.

The same setup was used for each seismic shot: 600 g explosives in 1 m deep boreholes acted as energy source at a

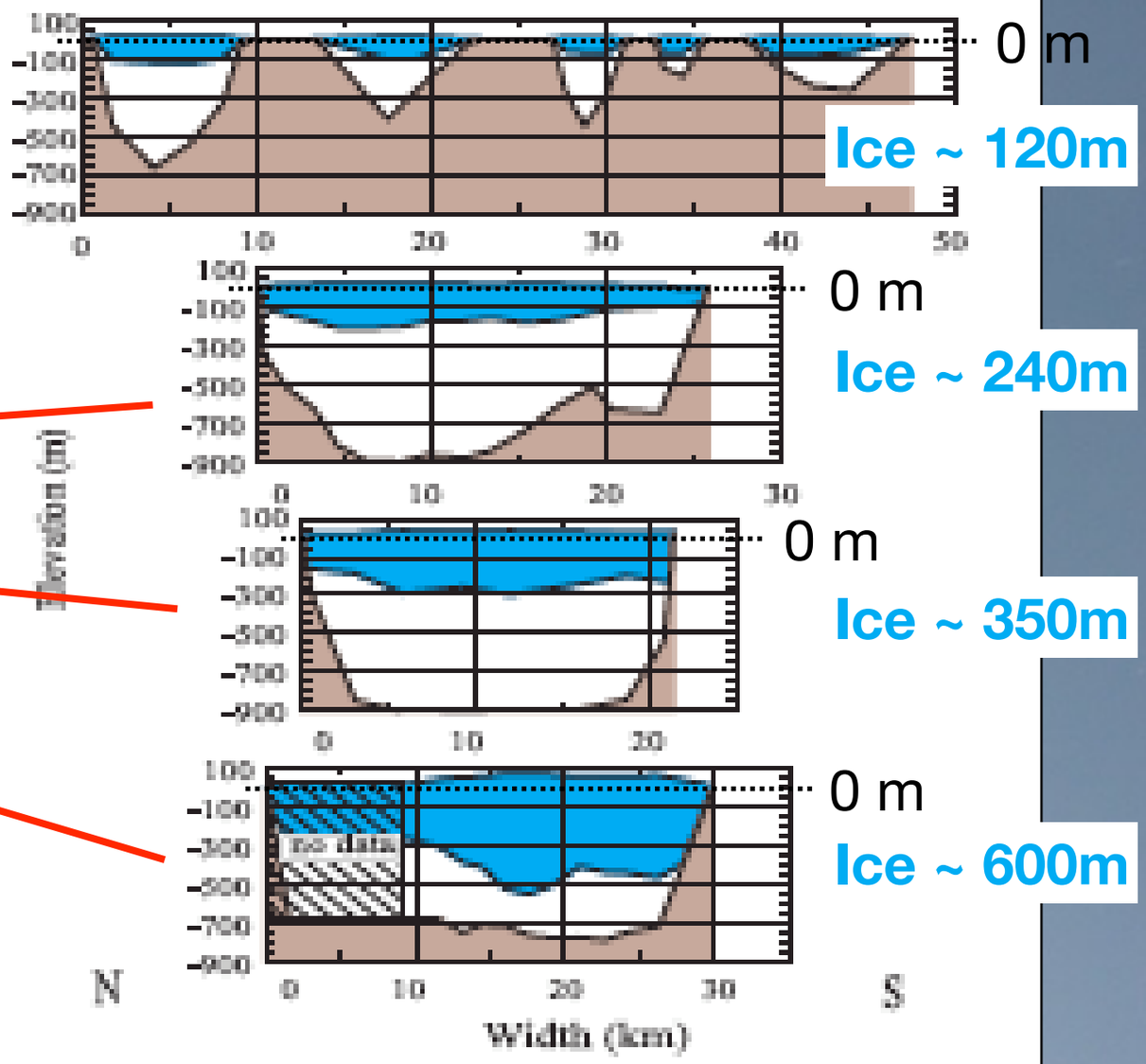


Figure 3. Ice thickness and sea bottom elevation from seismic soundings on fjord cross profiles at the ice front (top), close to Dijmphna Sund (upper middle), about half way of the glacier (lower middle) and close to the grounding line (bottom). Exact locations in Fig. 1.

Geophys.Res.Letters 27(15), 2289-2292 (2000)

Thanks for your attention

foto: hans oerter, 1993

Ice margin Kronprins Christian Land, NE Greenland