Geofysiske bidrag 4

The Vertical Movement of Eastern Greenland (Angmagssalik)

by

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Abstract

Repeat-measurements of the old bench-marks at Gustav Holms Ø near Angmagssalik indicate an annual uplift of 7 mm during the period 1950 to 1957 thus confirming that an uplift of Greenland has taken place for the last 15 to 20 years.

In a previous paper (SAXOV 1958) the vertical movement of western Greenland has been discussed and an annual uplift at the rate of about 14 mm for the time 1940 to 1957 was found. The stations investigated covered the Disko Bay region from 68°.7 N to 70°.0 N and from 51°.2 W to 53°.5 W. In the paper it was also shown that a sinking took place during the period 1897–1940 the annual rate being about 14 mm for the stations Godhavn and Egedesminde in the Disko Bay area. FRODA (1925) gave previously an average sinking of Godhavn during 1897 to 1923 to be 5.8 mm and EGEDAL (1947) found an annual subsidence rate of 10.8 mm for the same station from 1897 to 1946. It has been underlined by EGEDAL (1940) that it should be remembered that the sinking of the land is not to be expected to be equal in all parts of Greenland. This statement is confirmed by measurements in Nanortalik (60°.1 N and 45°.2 W) in 1883–85 and 1932–33 (HOLM and GARDE 1889; GABEL-JØRGENSEN and EGEDAL 1940) the result being an annual sinking of 3.9 mm.

Only at a single station at the eastern coast of Greenland observations regarding the vertical movement have been undertaken and NIELSEN (1952) reports of an annual sinking of 2.7 mm for the period 1885–1950. In order to examine if the subsidence continued or if it was replaced by an uplift as is the case in western Greenland it was desirable to repeat the measurements. An opportunity occurred in 1957 when geodetic operations were carried out in the Angmagssalik region. The geodesist in charge, KNUD PODER, M.Sc., succeeded during the season to make repeat measurements at the older stations and furthermore he established a new station in the ordinary way, the station being a usual cutted mark in the rocks and a bronze plate as reference point.

When the GUSTAV HOLM expedition in umiaks in the winter 1884–85 arrived at the Angmagssalik region they did not winter in the place where the present Angmagssalik is situated but on a peninsula, Tasîssârssik Kitdleq. This peninsula is often called "GUSTAV HOLMS Ø" and is situated 11 km ENE off Angmagssalik on the northwestern side of the mouth of Angmagssalik fjord. HOLM established a station (65° 37′ N and 37° 24′ W), a cutted cross in the rocks and lead cast in the centre of the cross; he gives the height of the point as 42.35 Danish feet, the mean sea level being determined by readings of 40 high tides and 38 low tides.

In the summer 1949 NIELSEN visited GUSTAV HOLMS Ø and the old station was found again. The carved cross was easily recognizable but the lead cast in the centre of the cross had disappeared and instead there was a hole about 2 cm deep. In order to be able to find again the fixed point which NIELSEN characterized as station F a cairn was erected above it. NIELSEN then established a new fixed point, H, a hole about 2 cm deep carved through by a cross about 5 cm broad was cutted in on the nearby horizontal surface of the rock near the edge. About 25 cm east of this H station another point K was fixed. The K point is the intersecting point between a white stripe in the rocks passing over the edge and the edge rocks itself. Based on 92 readings of the tides NIELSEN gave the height of F as 12.962 m while the result from 1885 was 13.140 m giving a subsidence of 2.7 mm per year.

Let us name the new point made by PODER in 1957 station P. PODER carried out a double levelling between F and H, H and K, and H and P. The results are given below together with the figures obtained by NIELSEN.

	Nielsen	Poder
From F to H.....	−11.813 m±4 mm	−11.822 m±3 mm
From H to K.....	− 0.166 1	− 0.162 9
From H to P bronze plate...		+ 3.441
From H to P cutted mark...		+ 3.425

It is seen that F, H, and K have been well-established points. Due to restrictions of time it was impossible for PODER to carry out tidal observations. However, in western Greenland levelling has to a large extent been based on balanus stripes (SAXOV 1958). Unfortunately no balanus stripes were found at GUSTAV HOLMS Ø but well-defined seaweed lines were at hand. Seaweed lines have been used previously by STEENSTRUP (1893) and FRODA (1925) to fix the height of ring bolts and points marked by cutting in the rocks. In recent time KEJLSØ (1958) has studied the height of the upper edge of the seaweed over the mean sea level by comparisons with water gauges in Egedesminde, Godhavn, Godthaab, Holsteinsborg, Ivigtut, and Julianehaab. He has found that the seaweed line is 0.7 m above the mean sea level. PODER observed the upper edge of the seaweed at six localities and his results are

from H to seaweed upper edge: −0.487 m±0.029 m

The survey may be summarized in the following way

	1885	1950	1957
Height of point F	13.140 m	12.962 m	13.009 m
Vertical movement	Subsidence		Uplift
Annual rate	2.7 mm		7 mm
Height of point P plate			4.628 m
– – – P mark			4.612 -
– – – H –			1.187 -
– – – K –			1.025 -

The uplift-figure found is only half the size of the corresponding figure for the Disko Bay area at the western coast. It is probable that the change from subsidence to uplift has occurred almost at the same time at both coasts. Anyway investigations of the temperature conditions in Jakobshavn and Angmagssalik show the same main trend in the rising temperature. Let us therefore suppose that the upheavel took place already in 1946 and that the annual rate has been constant in recent years. That would give a height of point F in 1946 of 12.934 m or a subsidence from 1885 to 1946 of 206 mm. That means an annual sinking rate of 3.4 mm, a figure which is only half of the present uplift value.

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DANSK RESUMÉ

I en tidligere artikel her i tidsskriftet (SAXOV 1958) er for 4 stationer i Disko Bugt området udfra balanmålinger påvist, at siden omkring 1940 har en landhævning på ca. 14 mm årligt fundet sted. Målinger af gamle ringbolte i Jakobshavn og Umanak giver lignende resultater. I tiden før 1940 har Grønland været udsat for en sænkning; FRODA (1925) fandt 5.8 mm/år for 1897–1923, EGEDAL (1947) 10.8 mm/år for 1897–1946, og SAXOV (1958) ca. 14 mm for 1897/1940.

Som rimeligt er, kan man næppe forvente samme sænkning eller hævning langs hele kysten, hvad også tidligere er påpeget af EGEDAL (1940), og hans målinger i Nanortalik bekræfter dette, idet Nanortalik udviser en årlig sænkning på 3.9 mm fra 1883/85 til 1932/33.

Hvad østkysten angår har NIELSEN (1952) påvist en sænkning af GUSTAV HOLMS Ø ved Angmagssalik på 2.7 mm fra 1885 til 1950. I 1957 lykkedes det KNUD PODER, som opholdt sig i Angmagssalik området på andet geodætisk arbejde, at genmåle de gamle punkter og etablere en ny station af lignende art som de på vestkysten eksisterende stationer. Nivellementet mellem de gamle stationer viser, at disse er stabile.

Da PODER af tidshensyn ikke kunne foretage vandstandsmålinger, benyttede han sig af tangranden; balanstriber fandtes desværre ikke. Tangranden er tidligere benyttet som referenslinie til nivellement, og KEJLSØ (1958) har gennem en større måleserie påvist, at tangrandens øvre kant ligger 7 dm over normal vandstand.

Udfra måling af 6 lokaliteter af tangranden får man, at der siden 1950 har været en årlig hævning af GUSTAV HOLMS Ø på 7 mm.

Det er tænkeligt, at hævningsfænomenet begyndte tidligere end i 1950. Således viser undersøgelser af temperaturforholdene i Jakobshavn og Angmagssalik den samme tendens. Dette betyder, at sænkningen ved Angmagssalik må være større end 2.7 mm pr. år; regner vi tilbage til 1946, fås 3.4 mm pr. år, en størrelse som kun er halvt så stor som den fundne hævning.

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