

# REPORT ON THE WORK OF HEINRICH BÜTLER IN THE YEARS 1933–34, 1936, AND 1938

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## I. Objects of Investigation and Working Field.

From the summer of 1933 to the autumn of 1934 BÜTLER was a member of the Danish Three-year Expedition to East Greenland, staying as a geologist at the Ella Ø station. He undertook to investigate the stratigraphy of the Devonian deposits between Kejser Franz Josephs Fjord and northern Scoresby Land. The object of his work in the field was to link up with the investigations of the areas of Caledonides in the inner parts of the fjords made in the years 1932 and 1933 by E. WEGMANN.

Folds in the Devonian sandstones had been observed by NATHORST, KOCH, and WEGMANN east of the Caledonian rocks, between Sofia Sund and Kongeborgen. The age, structure, and movements of these post-Caledonian folds were to be cleared up through special investigations. In addition, the earlier observations made by KULLING, ORVIN, and others on the sedimentation of the East Greenland Old Red were to be enlarged, and the relations between the Caledonian as a supply area of the débris and the space for the deposition of the Devonian sandstones and conglomerates were to be traced.

Investigations and mapping of the Caledonides in the inner fjord areas had previously been made by BACKLUND, TEICHERT, and WEGMANN. BÜTLER was now, by mapping of the Devonian areas situated farther eastward, to prepare a geological map as complete as possible for later geological investigations of the outer coast. The Devonian deposits form a central block, in some way the connection between the ancient Caledonian peneplain in the inner parts of the fjord which is not covered by younger rocks, and the areas of younger sediments and eruptives of the outer coast.

At the time BÜTLER commenced his work, great and important palæontological and stratigraphical investigations of the Devonian of East Greenland were in progress. Chiefly on the Gauss Halvø and in the eastern part of Ymers Ø large collections of fossils had been made

by G. SÄVE-SÖDERBERGH, and a number of results of the work in the field and the laboratory were already available or so nearly finished that BÜTLER could concentrate his investigations on the tectonical and lithological problems.

With these objects in view BÜTLER's working field came to extend along the western boundary of the Devonian, from the southern part of Strindbergs Land by Kejser Franz Josephs Fjord southwards across Ymers Ø and along Kong Oscars Fjord to Mesters Vig in the north of Scoresby Land. From this western boundary transverse sections could be drawn eastward through the outer part of Kejser Franz Josephs Fjord, Duséns Fjord, Sofia Sund, and Vega Sund. In the course of the investigations it turned out that only a few small Devonian remnants were visible in northern Scoresby Land, and they could give no clue to the elucidation of the Devonian questions, but farther northward, in Moskusoksefjord, in Hudson Land, and Ole Rømers Land, very important results might be expected. The investigations in the summer months of 1934 and during the Two-Year Expedition 1936—38 were therefore carried out in the northern areas; thus in the summer of 1936 the interior of Hudson Land, and in the summer of 1938 the area between the lower parts of Waltershausen Gl. and Wordies Gl. were investigated. The fine weather in the late summer of 1936 rendered it further possible to stay for some days in Nathorsts Fjord in order to study the Devonian of Canning Land and Wegeners Halvø, where the southernmost undoubted Devonian deposits of the east coast of Greenland occur *in situ*.

As early as the summer of 1933 the geodesist stationed at Ella Ø could supply BÜTLER with the first outline sketches of the new mapping, without topography, for his work in the field; in the summer of 1934 the first preliminary topographical maps made by the Danish Geodetic Institute were available. This meant that the geologists were able to pass from the more extensive method hitherto practised, aiming at ascertaining the conditions over vast tracts, to a more areally limited investigation. The net of observations had to be given much smaller meshes, the detail observations had to be more numerous, and the conditions to be more accurately fixed. This change in the working method required also a different working and travelling technique. Depots of provisions had to be established at comparatively small intervals during the journeys, so that halts could be made at various points which could not be determined beforehand, and detailed investigations could be made without it being necessary to carry up additional supplies.

## II. Extract of Diary. Summer 1933.

### a) First impression of the geology of East Greenland.

After a very rapid crossing of the pack-ice belt, the expedition ship the "Godthaab" arrived at Scoresbysund on

June 25th, 1933.—It was not yet possible to proceed farther northward. The stay in Scoresby Sund was used for linking up with the geology of Liverpool Land under the leadership of Professor H. G. BACKLUND.

June 26th to July 5th.—Stayed with BACKLUND on the outer coast of southern Liverpool Land and in Hurry Fjord, in company with the two assistants RASMUSSEN and BÜRGI, who were later to be WEGMANN'S assistants.

July 6th to 20th.—Collection of fossils and measuring of sections at Nathorsts Fjeld and Harris Fjeld on the west side of Hurry Fjord. First camp at the southeastern foot of Nathorsts Fjeld, second camp at the eastern foot of Harris Fjeld. Companions: BÜRGI and from July 14th to 20th further RASMUSSEN.

July 21st to 26th.—Camp on the east side of Hurry Fjord at the mouth of Gubbedal. Investigations in Gubbedal and Nøkkedal, ascent of a mountain top of Roscoe Bjerger, near the Tvillingerne, across Grete Gl. (1400 m).

July 27th.—Stay on the "Godthaab", voyage northward.

Aug. 2nd.—Arrival at the station of Ella Ø.

Aug. 5th to 19th.—Accompanied Dr. E. WEGMANN on a crossing of Suess Land and on motorboat voyages in the inner parts of Kempes Fjord.

During this period until August 19th BÜTLER became provisionally acquainted with the geological conditions and problems of East Greenland, especially those of the Caledonides, the working methods and travelling technique, and the experiences made by people who had already been at work in East Greenland for a longer or shorter time.

### b) Field Work and Travelling in the Summer and Autumn of 1933.

Aug. 19th.—Commenced independent field work in the Devonian area within the western part of Vega Sund and Sofia Sund and at Svedenborgs Bjerger.

Aug. 19th.—In the evening departure from the station of Ella Ø in a small open motorboat ("Lise") accompanied by the Greenlander BARNABAS to Vega Sund. Camp at the southwestern point of Svedenborgs Bjerger (Geograph. Society Ø) (1).

Aug. 20th—21st.—Investigations of the shores of Vega Sund as far as c. 30 km east of Kong Oscars Fjord. At times strong wind (2 and 3).

Aug. 22nd.—Returned into Kong Oscars Fjord. Investigations on the shore of Svedenborgs Bjerg and around the entrance of Sofia Sund. Camped on the south side of Sofia Sund opposite Rødebjerg (4).

Aug. 23rd.—The motorboat was too heavy to be dragged ashore in the night and too small to sleep in. At ebb-tide in the night the boat ran ashore and owing to the high waves it was partially filled with water. Strong wind prevented further voyage eastward. Crossed the sound to Karl Jakobsens Bugt, where investigations were made at the southern foot of Rødebjerg (5).

Aug. 24th.—Returned to Ella Ø.

Aug. 25th—30th.—Stayed at the station. Conversations with the various geologists of the expedition before the departure of the ship (August 28th).

Aug. 31st.—Voyage in the motorboat the "Imara" accompanied by DE LEMOS and the Greenlander JØRGEN PETERSEN, called JÛLUT. Establishment of provision depots at Kap Dufva and on Menanders Øer.

Sept. 2nd—4th.—Stayed at the station. Rain, storm, and snowfall.

Sept. 5th—8th.—Trip in the "Imara" to lay out depots of provisions (accompanied by DE LEMOS and JØRGEN BARNABAS) and to gain a general view of the northern part of the working area. Sailed through Antarctic Sund, and anchored behind Teufelsschloss (6). On the second day a depot was laid out during storm and rain on the north side of Gunnar Anderssons Land at the mouth of Zoolgdalen. The strong foehn wind compelled them to go eastward, since shelter was nowhere to be found along the coast. During this voyage the jolly-boat was filled with water and got loose, and the rope by which it was tied was entangled in the propeller so that the motorboat stopped. The situation was critical. However, they succeeded in getting the rope free from the propeller and in emptying the boat of water, the jolly-boat was secured and after passing Kap Graah reached a place sheltered from the wind (7). The weather continued bad, the snow lay right down to the water's edge. A depot was established in the interior of Duséns Fjord. A second foehn storm forced them to halt at Kap Humboldt (8). Return through Sofia Sund to Ella Ø in the late evening of September 8th.

Sept. 9th—10th.—Stayed at the station.

Sept. 11th.—Laid out a depot south of Lemmingbugt on Ella Ø and at the northwestern point of Kongeborgen.

Sept. 12th.—Stayed at the station.

Sept. 13th.—Three large depots for the work in the spring were laid out on the coasts of Kongeborgen.

Sept. 14th—17th.—Stayed at the station. Storm and snow.

Sept. 18th.—Trip to Ymers Ø. Landed a depot in Karl Jacobsens Bugt on the south side of the island (10). The boat returned to Ella Ø,

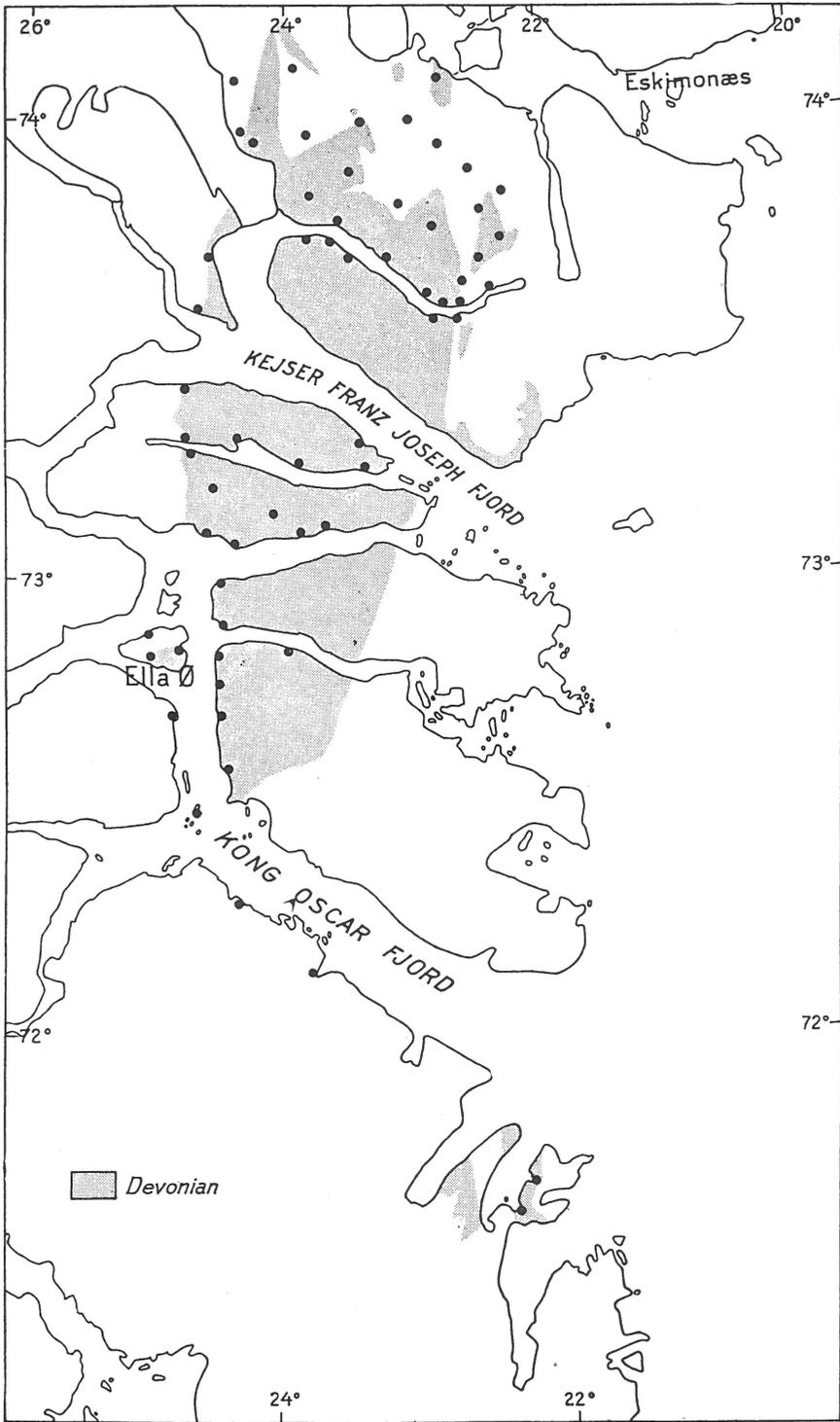


Fig. 185. The black dots indicate Bütler's most important working fields.

BÜTLER alone remained on Ymers Ø in order to investigate the area between Rødebjerg and Munotbjerg. A thin layer of snow already covered the land right down to the sea.

Sept. 22nd.—Arrival of the motorboat "Imara" with DE LEMOS, JÛLUT, and BARNABAS. Successful hunting near the southern outlet of Margeries Dal. Returned to Ella Ø in the evening.

Sept. 23rd—Oct. 2nd.—Stayed at the station. The boats were hauled on to the shore. Heavy snowfall and gale, the temperature but a few degrees below zero.

Oct. 3rd.—Went on skis across the mountain to the depot south of Lemmingbugt, and camped there. Investigation of the Devonian conglomerate and its substratum. Clear weather, rather cold in the night (—10—15° C).

Oct. 8th.—Return to the station. For the time being no possibilities for travelling. Not till the night between October 22nd and 23rd did the fjord freeze definitively over, but fairly mild weather set in again, and not till after two weeks was the ice thick enough for travelling on it. Minor geological investigations were made in the neighbourhood of the station of Ella Ø.

Nov. 7th.—First trial trip on sledge across Kempes Fjord to Ørkendal.

Nov. 9th—10th.—Trip in two sledges (BARNABAS and BÜTLER) into the western part of Sofia Sund. Weather overcast, c. —15° C. The working time during which observations could be made with certainty was now only about four hours a day. Returned to the Ella Ø station

Nov. 15th.—Short sledge trip to Kap Elisabeth and Maria Ø with two sledges accompanied by BARNABAS. Geological investigations.

Nov. 16th.—Journey around Ella Ø with three sledges (JÛLUT, BARNABAS, BÜTLER) accompanied by DE LEMOS.

Nov. 21st—Dec. 5th.—Journey to the substation Kap Brown to fetch goods for EKLUND and mail, brought there from Scoresbysund. Started on November 21st with three sledges (JÛLUT, BARNABAS, BÜTLER) and DE LEMOS as passenger.

Travelled the first day to Kap Lagerberg (Lyells Land) (Camp 2), the second day to the trappers' hut Solstrand at Noret north of Mesters Vig. The ice on the fjord did not support the sledges everywhere, and some large transverse crevasses across the fjord gave some difficulty (Camp 3).

On the third day the party reached Antartics Havn. There was much pack-ice between Mesters Vig and Kap Syenit. Spent the night with the Norwegians at the trappers' station (Camp 4).

4th day. Heavy snowfall, temperature —7° C. A gale blew in the outer fjord, and open water was visible in Davy Sund. Remained

during the day at the Norwegian station. BÜTLER and BARNABAS took a view of the crossing over land to Fleming Fjord.

5th day. Travelled in foggy weather over land to Fleming Fjord and to the station at Kap Brown, where four Greenlanders from Scoresbysund with their sledges (JOSUA, MANASSE, MICHAEL, and JONAS) awaited them. Fifty-eight dogs were now assembled here, 33 from Scoresbysund and 25 from Ella Ø (Camp 5).

6th day (Nov. 26th). Fog, wind, and driving snow. Stayed at the station. In the night it cleared up and grew cold.

7th day (Nov. 27th). The Greenlanders left for Scoresbysund.

8th day. Again overcast. Started at noon on the return journey in light snowfall and with heavily loaded sledges. Spent the night north of the delta of Ørsteds Dal (Camp 6).

9th day. Drove over land to Antarcics Havn in thick fog.

10th—11th days (Nov. 30th and Dec. 1st). Rested at the Norwegian station Antarcics Havn, as a heavy snowfall and fog prevented further progress (Camp 7).

12th day (Dec. 2nd). Travelled in overcast weather and over c. 30 cm of new-fallen snow as far as Solstrand (Camp 8).

13th day. Drove to Kap Peterséns.

14th day. Reached Kap Elisabeth (Ella Ø).

15th day. Returned to the station of Ella Ø, where DRASTRUP and BENJAMIN of the Eskimonæs station awaited our arrival in order to carry their part of the mail and goods onwards on two sledges.

Dec. 8th.—Accompanied the two sledges from Eskimonæs to Antarcics Sund (Camp 11).

Dec. 9th—10th.—Successful hunting in Margeries Dal, Ymers Ø (BÜTLER, BARNABAS, JÛLUT). Returned to Ella Ø.

### c. Summary.

BÜTLER'S work in the summer and autumn of 1933:

- 1) He became familiar with the geological field work and the travelling technique in East Greenland; accompanying Professor BACKLUND (13 days) and WEGMANN (13 days), he acquired a knowledge of the Caledonian rocks and the Eleonore Bay Formation in the area of Kempes Fjord; and made observations and measured sections within the Cambro-Silurian of Ella Ø during his stay there during the winter.
- 2) Collecting of fossils and measuring of sections within the Lias and the Dogger of Jameson Land (10 days).
- 3) On long motorboat trips for laying out depots to serve for the sledge

journeys he gained a first view of the tectonical, stratigraphical, and topographical conditions of the Devonian areas (9 days).

- 4) Field work in the Devonian in some important localities (17 days).
- 5) He learned the technique of travelling by sledge (the Kap Brown journey) at the beginning of the winter, when the season was unfavourable for work in the field (14 days).

### III. The Winter at the Station of Ella Ø.

The staff of the Ella Ø station in the winter of 1933—34 consisted of the following expedition members:

A. DE LEMOS, wireless operator  
 H. BÜTLER, geologist  
 F. SØGAARD ANDERSEN, zoologist

and the two Greenlanders:

JØRGEN PETERSEN (called JÛLUT) and  
 JØRGEN BARNABAS.

The nearly three months' stay at the station was utilised by BÜTLER for making geological observations in the neighbourhood of the station, for development of films taken during the past summer, drawing of geological sections in so far as the field investigations allowed, preparation of some topographical diagrams on the basis of the air photos, examination of a number of sand and rock samples, and drawing of enlarged route maps as far as the available maps allowed. The most important geological papers published in the "Meddelelser om Grønland" were found at the station, and BÜTLER had abundant time for reading them. Moreover BÜTLER was responsible for the sledge dog teams. In January he made a three days' hunting trip to Ymers Ø accompanied by the two Greenlanders in order to secure fresh meat, and every third week he did the cooking at the station.

### IV. Sledge Journeys in the Spring of 1934.

- a) A short sledge trip for the purpose of gaining some knowledge of the surroundings of Angelins Bjerg on Ymers Ø and of securing some fresh meat for the men who were to remain at the station when the sledge parties left.

March 12th.—Started with three sledges accompanied by the two Greenlanders to the depot at Karl Jakobsens Bugt, then up the JÛluts Dal in deep snow. Camped south of Point 945 m (12).

March 13th.—Camp at the southeastern foot of Angelins Bjerg, height 475 m.

March 14th.—Climbed the peak northeast of Angelins Bjerg to a height of c. 1650 m. In the meantime the two Greenlanders went out hunting.

March 15th.—Climbed the southeastern crest of Angelins Bjerg to c. 1400 m altitude. The snow caused great trouble, but the weather was clear and calm.

March 16th.—Returned to the station of Ella Ø.

During this journey the temperature ranged between  $-15^{\circ}$  and  $-30^{\circ}$  C. It was clear weather and generally calm. In Jûluts Dal the snow was rather deep, with a hard crust, but it could not support the sledges. It was an exhausting journey.

b) On a longer sledge journey the stratification of the Devonian series along its western boundary across Ymers Ø, around Kejser Franz Josephs Fjord, and farther northward was to be investigated and mapped. The party left Ella Ø on March 22nd with three dog sledges driven by BÜTLER and the two Greenlanders respectively. As the elder of the two Greenlanders (JÛLUT) only reluctantly moved away from the house and constantly would return home when the weather grew bad, and during the drive took no account of his travelling companions, BÜTLER had to drive his sledge. Consequently rather short distances were covered at a time, and BÜTLER had then to carry out his geological investigations on ski excursions from the camps.

March 22nd.—Drove from Ella Ø to the depot at Karl Jakobsens Bugt on Ymers Ø. Investigations in the lower part of Jûluts Dal (Camp 14).

March 23rd.—Proceeded northward through the valley. Camped at Point 275 m. Sledging was troublesome, deep snow alternating with snow-free stretches (Camp 15).

March 24th.—Wind and snow. Work only possible for a short time near the camp.

March 25th.—Climbed the mountain west of Point 1723 m up to 1400 m altitude.

March 26th.—Proceeded on the journey (steep descent) through Duséns Fjord. Investigations in the valley (on skis) at the northern base of Angelins Bjerg (16).

March 27th.—Proceeded westward into Duséns Fjord. Camped at the eastern foot of the mountain at 890 m (17). Investigations in the valley ravines and the surrounding mountain sides.

March 29th.—The camp was removed to the north side of the fjord, opposite Point 261. Some snowfall and strong wind (18).

March 30th.—Clear weather, which was utilised for the drawing of various sketches.

March 31st.—Travelled eastward, in Duséns Fjord, to the southern outlet of Zoologdalen. Investigation of the different valley sections (19).

April 1st, 1934.—Climbed the mountain northwest of the camp. Favourable weather for drawing.

April 2nd.—Travelled northward through Zoologdalen to Kejser Franz Josephs Fjord. The depot at the northern outlet of the valley had been visited by bears, but thanks to the good packing, the damage was inconsiderable. Proceeded westward and camped at the northern base of Hammeren, Point 1427 m, opposite Kap Weber.

April 4th.—Started at noon to Bjørneø at the entrance to Geologfjord (21).

April 5th.—Investigations at Solstrand and Porten, Strindbergs Land. Warm weather caused the snow to melt. The Greenlanders had successful seal hunting.

April 6th.—Drove to Kap Ovibos. Investigation of the southernmost cape of Strindbergs Land.

April 7th.—Bear hunting in Kejser Franz Josephs Fjord. Investigations on the east side of Strindbergs Land. Drove to the substation Nordfjord (23).

April 8th—10th.—Investigations in the surroundings of the station (on April 9th a heavy gale).

April 11th.—Travelled into Moskusoksefjord, and camped c. 12 km east of Kap Kolthoff. Clear and calm (24).

April 12th.—Fog and wind, in the evening clear. Camp near Hoelsbo (25).

April 13th.—Returned westward along the north side of Moskusoksefjord. Camped near the large valley east of Torbern Bergmans Bjerg (26). Investigation of the Devonian volcanos.

April 14th.—Drove back to Nordfjord along Waltershausen Gl. Fine weather (27).

April 15th.—Investigations along Lakseelv near Nordfjord. Fine weather.

April 16th.—Travelled southward through Gunnar Anderssons Land (Zoologdalen) to Duséns Fjord and eastward as far as the southern foot of Blaskbjerg. Overcast weather (28).

April 17th.—Investigations of the red sandstone series.

April 18th.—Proceeded eastward. Investigations in the surroundings of Kap Graah. Fairly good weather (29).

April 19th—20th.—Travelled across Vinterøer to Kap Humboldt. A strong, cold wind was blowing (30).

April 21st.—Calm and hazy. Drove from Kap Humboldt, through Sofia Sund to the outlet of Barnabas Dal on the south side of Ymers Ø (31).

April 22nd.—Returned to the station on Ella Ø.

## Summary.

Of the thirty-two working and travelling days of this second journey, nineteen were good for the season, ten unfavourable though with some possibility for working in the open, and three bad (as regards the weather). It was possible to carry out an investigation of the stratification and deposition of the Devonian along its western boundary; in addition various cross sections were measured. Devonian volcanoes and Devonian eruptives were ascertained for the first time in the Devonian of East Greenland. The excursion into Moskusoksefjord moreover showed that complicated tectonical and stratigraphical structures were present in the apparently uncomplicatedly deposited Devonian series, and that these complicated structures originated from young folding activity in the Caledonian substratum.

- c) On a third sledge journey the same problems were to be investigated in the areas south of Ella Ø to some distance into Scoresby Land. In the autumn pemmican, other provisions, and fuel had been deposited at Kap Dufva and on Menanders Øer.

April 30th, 1934.—Departure from the Ella Ø station with the two Greenlanders and three sledge teams up through Narhvalsund. Investigated the steep rock walls on the southwest side of Ella Ø. Camped at the northern outlet of Polhems Dal (32).

May 2nd.—Reached Kap Dufva. Thick weather. Field work in the surroundings of the cape (33).

May 4th.—Drove to Kap Lagerberg in fine, cold weather. Fairly much soft snow along the coast. Investigated the coast stretches and Hammars Ø (34).

May 5th.—Travelled across Aakerbloms Ø to Kap Peterséns. Snowfall the previous night, in the day the temperature at times rose above zero, and the snow was sticky and wet (35).

May 6th.—Drove to the southern end of Syltoppene, and camped at the south point of Menanders Øer. Heavy snowfall, wet, the water dropped through the roof of the tent. Field work impossible (36).

May 7th.—Continuous snowfall. In the evening a high wind came up, drifting the snow. Field work only possible for a short time. In the night a dog that had got loose carried a ptarmigan poisoned by the Norwegian trappers into the camp (it was found about 100 m away), and in the morning four dogs lay dead in the snow. So the sledge teams had to be reduced from three to two and part of the sledge loads had to be left behind.

May 8th.—Fog, temperature above zero, at times snowfall. In the evening the party went into Skeldal along the southeastern margin of

Syltoppene (37). Water had already formed on the river ice below the snow. It was hardly possible to drive on the shore owing to the deep, soft snow, so the party reached only about 6 km up the valley, when it was impossible to proceed.

May 9th.—Continuous snowfall all day.

May 10th.—It cleared somewhat, but the summits of the mountains were concealed in fog. The temperature was somewhat above zero. Investigations were made on skis along the southern edge of Syltoppene, but owing to the deep, soft snow walking was very time-consuming and laborious.

May 11th.—At times clear weather, temperature some degrees above zero, there was much water in the valley, and even on skis it was impossible to push farther up the valley.

May 12th.—Return journey along the shore, driving southward on the fjord ice as far as Solstrand. It grew colder and more easy to move on the snow. Investigations in the neighbourhood of Solstrand (near Archers Øer) (38).

May 14th.—Travelled in fine weather and on a good surface of the snow to the head of Mesters Vig. Successful seal and musk-ox hunting (39).

May 15th.—Went on skis south and southwestward up the main valley across the glacier as far as the watershed towards the streams flowing to Schucherts Flod at c. 2000 m altitude. Travelling only possible on the glacier on account of the large masses of loose new-fallen snow. Transverse section through the eruptive mass (later investigated by BIERTHER) measured.

May 16th.—Investigations in some small valleys southwest of Mesters Vig at Point 1100.

May 17th.—Went on skis through the large valley northwestward to the watershed towards Skeldal. View of the Caledonian of the northern Staunings Alper.

May 18th.—Returned to Menanders Øer (40).

May 19th.—Proceeded to Aakerbloms Ø (41). Detailed investigation (May 20th) of the Devonian deposits and the tectonics.

May 21st.—Return to the station Ella Ø.

#### Summary.

Of the twenty-two days which this journey lasted, twelve had favourable weather, seven were unfavourable but with a limited possibility for work in the open, and three had bad weather (stay in the tent). The season was too advanced to allow moving about in the valleys (water on the river ice), on the other hand the valleys were filled with deep, wet snow, so that even on skis the range of action was short.

Only on the large valley glaciers was it possible to push into the interior of the land. The margin of the Caledonian rocks from Ella Ø to Syltoppene, the stratification and superposition of the Devonian, and the crossing by the Devonian boundary of the different stratigraphic and tectonical members of the Caledonian were traced. In the interior of Mesters Vig a cross section through an ancient basic and a younger grey eruptive mass was measured. However, owing to the limited possibilities of moving about and the thick snow-covering BÜTLER did not succeed in clearing up the stratigraphic conditions of the post-Devonian sediments and eruptives south of Syltoppene.

#### IV. Work in the Early Summer.

It might be expected that the sledge journeys on the fjord ice would have to be stopped at the beginning of June. In order to take advantage of the clear and warm period during the melting of the snow and ice, BÜTLER had laid out, in the autumn, four depots on the coast west of Kongeborgen as well as a larger depot at the north end and the south end of the cliff, and between them, two smaller depots at the mouth of ravines. Each depot contained fuel and provisions, cases and packing materials for the rock samples, so that on moving from one camp to another the goods (sleeping bag, skins, rubber boots, instruments, etc.) could be transported in rucksacks in two turns. This arrangement turned out very profitable, each camping site being in this way provided with the most necessary things.

May 28th, 1934.—At 10 p.m. BÜTLER left Ella Ø with two sledges (with the two Greenlanders as drivers) and travelled to the northern end of Kongeborgen at the northwestern point of Traill Ø. From that point the party went southward along the coast, inspecting everywhere whether the depots laid out were still present, and depositing a tent in each of these places. Thanks to the strong packing and stone covering the depots had remained intact, and the first camp could be erected at the southern end of Kongeborgen c. 5 km northwest of Holms Bugt. Next day the two Greenlanders returned with the sledges to the station, while BÜTLER remained alone for six and a half weeks on the coast of Kongeborgen. In this first camp a small, solidly built Norwegian hut served him as a house and guarded him in the night against unexpected visits by bears. However, the two Norwegians stationed at Kap Peterséns had in the course of the winter killed most of the bears passing along this stretch by trap-guns or poison.

In the first two weeks it was possible to move on the fjord ice, at first with and later without skis, during investigations of the coast,

whereas skis could hardly be used on the land any more as the snow was melting rapidly on all southward facing slopes; on crossing rivulets or patches affected by solifluction, BÜTLER used rubber boots, which were usually deposited at the foot of the rocks and hills, at greater altitudes (rocky and stony ground) he used mountain boots. From Camp I detailed investigations were made of the Devonian beds along the coast northward and the large fault in the northeast, further, as far as Points 1716 and 1879, and southward in the Carboniferous area as far as the basalts of Holms Bugt. During the extensive melting of the snow the work in the field had mostly to be carried out in the light night hours. The stay in this place, which was convenient for moving about in many directions, lasted from May 29th to June 18th. On twelve of the seventeen days spent in the field the weather was fine, while on five it was bad (fog, strong wind, light downfalls). Three days had to be spent in camp.

On June 18th the first transport was made to Camp II (43) about 15 km farther northward, near the delta of the first large valley, and on June 19th the final removal took place. A good tent site was found in a dry terrace recess sheltered from the wind. Sections were measured along the coast, in the valley to the east, and on both sides of the valley as far as the top (e. g. to Points 1090, 1306). BÜTLER's stay in this camp lasted till June 29th. Of the ten days, five had fine weather, four unfavourable (though with some possibility for work in the open), and one bad (heavy rain).

Camp III (44), c. 10 km north of Camp II, was erected on June 29th, and BÜTLER stayed there till July 3rd. During the whole stay there the weather was fine. Investigations were made of the large mountain wall; the narrow ravinous valleys were inaccessible for one man and there was danger of slides of débris. However, many structural details of the inverted fold traversing Kongeborgen could be observed in the short visible valley entrances, at any rate much shortened perspective owing to the nearby low-lying point at which the observer stood.

Camp IV (45), on the south side of the mouth of the mountain stream which empties into Kong Oscars Fjord at the northwesternmost cape of Traill Ø, was established on July 3rd. Here there were better possibilities for moving about. In the night, at low water, it was sometimes possible to cross the torrential river (in rubber boots), and the hills on either side of the river were easy to climb, and from them the upper part of the valley could be reached. The coast stretches towards and along Vega Sund were passable and allowed observation of the rock walls from some horizontal distance. From some altitude (especially from Point 1563) a good view was taken of the transverse profile of Swedenborgs

Bjerg (south slope) along Vega Sund. Here it was possible to clear up the tectonics as well as the succession of the lithological series. On July 9th the motorboat of the Ella Ø station appeared to fetch BÜTLER; however, on her arrival BÜTLER was working in the mountains, and as the ice again blocked the shore, the boat had to return to Ella Ø before his return. On July 12th the boat made another attempt to push through the ice floes and reached BÜTLER's camp in the morning just as he was about to start out, and he returned with the boat to Ella Ø. During his stay in Camp IV the weather was fine, so that he could utilise the seven days for intensive field work.

#### Summary.

The object of investigation on this journey was to examine the stratigraphic conditions of the Devonian sandstones along the steep coast cliffs of Kongeborgen. This investigation was encumbered with considerable technical difficulties, travelling along the foot of the large rock walls, which in places were separated from the sea only by steep talus slopes, being rather laborious or very time-consuming and troublesome. The axes of the folds moreover run parallel with the coast, only small portions of the transverse profile could be seen in recesses in the rock wall and the poorly accessible openings of the ravines, and from too small distances.

However, when all the visible structural details had been sketched and linked up with each other for the whole coast, a continuous picture of the apparently simple, but actually rather complicated tectonical structure of the wall of Kongeborgen was gained. To BÜTLER this work in the field had the great advantage that step by step he could make detailed observations along the coast and note them down, which was otherwise impossible when the usual travelling technique (motorboats or sledges) was applied owing to the limited time. As similar structures occur throughout the area of folded or displaced Devonian deposits, the observations and details noted down were of value for the investigations of the other working fields, also.

#### V. Voyages in Motorboat in the Summer of 1934.

When BÜTLER returned to the station, the expedition ship was already on her way to Greenland, consequently, and as he did not know how long the large motorboat of the station would be at his disposal, he set out again on July 14th accompanied by DE LEMOS and BARNABAS. The object was to fetch the rock samples and depots deposited on the northern sledge journey, to make observations in various places which had not been visible or accessible during the winter, and to give some

days to the interesting discoveries in the central and western parts of Moskusoksefjord.

The sky was overcast, it rained now and then, but it was fairly calm. The boat went through Antarcitics Sund and Kejser Franz Josephs Fjord to the entrance of Geologfjord, and the party spent the night in the bay off Solstrand at the south side of Strindbergs Land (1). On July 15th the motorboat sailed to the station Nordfjord, while BÜTLER went on foot across the high plateau, along the Devonian boundary across Porten, past Gunvors Bjerg to the station Nordfjord. Overcast and rainy weather (2).

July 16th.—In the forenoon investigations in the lower part of Brogetdal, in the afternoon the party left the station and sailed into Moskusoksefjord. Spent the night (in the boat) by the south side of the fjord near the mouth of the valley (3).

July 17th.—Kap Bull. Investigations around the "inlier" on the south side of the fjord. Various Devonian series rest unconformably on the crystalline and the Devonian basal conglomerates of the inlier.

July 18th—21st.—Interior of Moskusoksefjord. Investigations in the area between Sederholms Bjerg, Ramsays Bjerg, Ankerbjerg and Högboms Bjerg. Ascertained the presence of new younger unconformable Devonian series and Devonian folding zones, as also of late-Caledonian, Devonian eruptives in this zone (4, 5, 6, 7).

July 21st.—Return voyage. Short investigation at the inlier on the north side of the fjord. Proceeded to Nordfjord. Successful salmon fishing at the mouth of Lakselv (8).

July 22nd.—Sailed through Kejser Franz Josephs Fjord to Blomsterbugten (west side of Ymers Ø (9).

July 23rd.—Returned to Ella Ø through Antarcitics Sund.

July 24th.—Stay at the station.

July 25th.—Start southward in the large motorboat (BÜTLER, DE LEMOS, BARNABAS) to fetch the depots at Kap Dufva, on Menanders Øer, and at Kongeborgen. Sailed west of the Bastionen to Narhvalsund and southward (10).

July 26th.—Returned to the station.

July 27th—31st.—Stayed at the station, packing. Some supplementary investigations were made on the island till the arrival of the expedition ship.

It was BÜTLER's plan to conclude the working year by a careful mapping of the large fault which cuts off the Devonian in the east, starting from Sofia Sund and Vega Sund, in order to limit the work exactly towards the east. On arrival of the ship, however, it turned out that G. SÄVE-SÖDERBERGH, too, had planned to investigate this fault zone. It was then agreed upon that SÄVE-SÖDERBERGH should make

that investigation, while BÜTLER was to return to Moskusoksefjord in order to make a further study of the tectonical problems. However, an exact investigation of the course of the fault on Geographical Society Ø and Traill Ø was not made.

#### Extract of Diary.

Aug. 1st, 1934.—With the expedition ship "Gustav Holm" to Moskusoksefjord.

Aug. 2nd.—Excursion to Prospektal (11). Investigations of the Carboniferous.

Aug. 3rd.—Flight across Moskusoksefjord, southern Strindbergs Land, across Ymers Ø to Duséns Fjord, onwards to Kap Graah, and across Gauss Halvø back to Prospektal. — In motorboat (old Police boat), accompanied by LIND and BARNABAS, to the eastern part of Moskusoksefjord. Camp at the eastern foot of Ankerbjerg.

Aug. 4th—12th.—Fog and rain. Investigations in Moskusoksefjord.

Aug. 12th.—Went out of the fjord and spent the night in the boat, in dense fog, near the west coast of Gauss Halvø (12).

Aug. 13th.—Went to the north coast of Gunnar Anderssons Land towards Kap Graah (13). Investigated volcanic tuffs and effusives interbedded in the Devonian.

Aug. 14th.—In Duséns Fjord. Investigations of the interior of the fjord. Fetched the depot in Zoologdalen (14).

Aug. 15th.—Sailed round Kap Humboldt to Sofia Sund (15).

Aug. 16th.—Investigations of the Devonian eruptives west of Celsius Bjerg. Visit by Dr. KOCH.

Aug. 17th.—Investigations on the south side of the fjord in the area of Rudbecks Bjerg. Went westward to Barbanas Dal (16).

Aug. 18th.—Investigations in the mountains east of Rødebjerg on Ymers Ø.

Aug. 19th.—Return voyage to Ella Ø in dense fog.

The investigations, especially of the regional connections of the Devonian structures, were much impeded by the continuous low-lying fog. The last few days were used for a revision visit to the westernmost part of Sofia Sund and Vega Sund.

Aug. 21st—22nd.—Start from Ella Ø in the old Police boat accompanied by LIND. Investigations between Karl Jakobsens Bugt (17) and Rødebjerg as also on Geographical Society Ø on the opposite side of the fjord. A strong southerly gale compelled the party to spend the night in the boat in the shelter of a small delta at the coast of Svedenborgs Bjerg (18).

Aug. 23rd.—Vega Sund. Ascertained the course of the fault along

the eastern boundary of the Devonian area in so far as this was possible from the sea on two small excursions (19).

Aug. 24th.—Returned late in the evening to Ella Ø. End of the field work in the summer of 1934.

Aug. 26th.—Departure from Ella Ø in the expedition ship "Gustav Holm". Stormy voyage to Reykjavik.

WEGMANN and BÜTLER went in the "Boothia" via Edinburgh to Copenhagen.

## Two-Year Expedition 1936—38.

### I. Object of Work in the Summer of 1936.

The investigations in the spring and summer of 1934 in the area of the outer Kejser Franz Josephs Fjord and in Moskusoksefjord had shown that the broad folds of the Devonian sandstone which extend northward from Kejser Franz Josephs Fjord, rise through Gauss Halvø. This causes that deeper-lying Devonian series are exposed in the banks of Moskusoksefjord, in which highly folded and uplifted series of strata and strongly developed unconformities could be ascertained. The Devonian age and the succession in time of the different phases of folding could be determined by means of the unconformable series of strata, whereas the deeper-lying folds were not visible, so no clear idea of the folding mechanics was obtained. Since, however, the axial uplift of the Devonian folds of Moskusoksefjord continues northward into Hudson Land, it may be supposed that the deeper members of the Devonian folds crop out there, and that the connection with the deformations of the Caledonian substratum of the Devonian might be visible. The journeys through some of the largest valleys of Hudson Land in August, 1936, were made for the purpose: of analysing the deeper portions of the Devonian folds in order to form a synthesis of the course of movements and the mechanics of folding.

### II. Planning.

When the programmes for the journeys were made, the provisional prints of the maps of Hudson Land prepared by the Danish Geodetic Institute were already available, from which the course of the valleys, the distances, the heights of the mountains, etc., could be gathered. A close inspection of the air photos in addition gave good information about the passability of the terrain. BÜTLER's own observations in the summer of 1934 at the mouth of some valleys had moreover shown that the vegetation of the largest valleys was so abundant that travelling

over land with Icelandic ponies would be possible. Thus there was a possibility of pushing into the mountain valleys of Hudson Land with a small working party, the provisions and camping outfit being carried by two or three ponies; the success would, of course, depend on the reliability and endurance of the members of the party and on whether they were well trained in mountain-climbing and marching. For the greater part of the daily transport and work in the camp had to be entrusted to them, in order that BÜTLER could devote himself as far as possible to geological work.

Two young geologists, HANS STAUBER, Zürich, and HANSPETER SCHAUB, Basel, were chosen to accompany BÜTLER. They could moreover make experiences as to the technique of summer travelling and the working methods, which would be useful to them as they were to be at work in East Greenland during the winter.

### III. Carrying out of the Work.

July 21st, 1936.—Started from Akureyri in the "Gustav Holm" for Greenland.

July 24th.—Arrived at Ella Ø about midnight.

July 25th.—BÜTLER went ashore with HEINRICHSON to show him his working field. In the evening the ship proceeded northward.

July 26th.—In the evening the ship cast anchor off Prospektal in Moskusoksefjord.

July 27th.—In the morning BÜTLER's party was set ashore (BÜTLER, STAUBER, SCHAUB, two Icelandic ponies). In the afternoon start into the Ankerbjerg valley, where an auxiliary camp was erected between Högboms Bjerg and Sernanders Bjerg. IB POULSEN and the Greenlander THOMAS remained in a camp on the shore at the mouth of Prospektal. They were to take care of the motorboat (old Police boat), which, when the party returned from the excursion inland, was to take them to certain places along the fjord which in 1934 could be only cursorily visited, thus especially the opposite side of the fjord near Ramsays Bjerg, Gastisdal, and La Cours Bjerg.

July 28th.—STAUBER and SCHAUB transported the remainder of the goods on the ponies from the shore to the auxiliary camp (Camp No.1), while BÜTLER investigated the surrounding areas (northeastern corner of Högboms Bjerg and southern portion of Sernanders Bjerg).

July 29th.—Broke the camp to travel up to the Ankerbjerg valley. At first the way led across the level valley bottom, but subsequently the valley narrowed, and stretches of boulders and rock fragments, some moraine ridges, and several rivers had to be crossed. In the evening the party had to walk around a ravinous unpassable stretch of the valley,

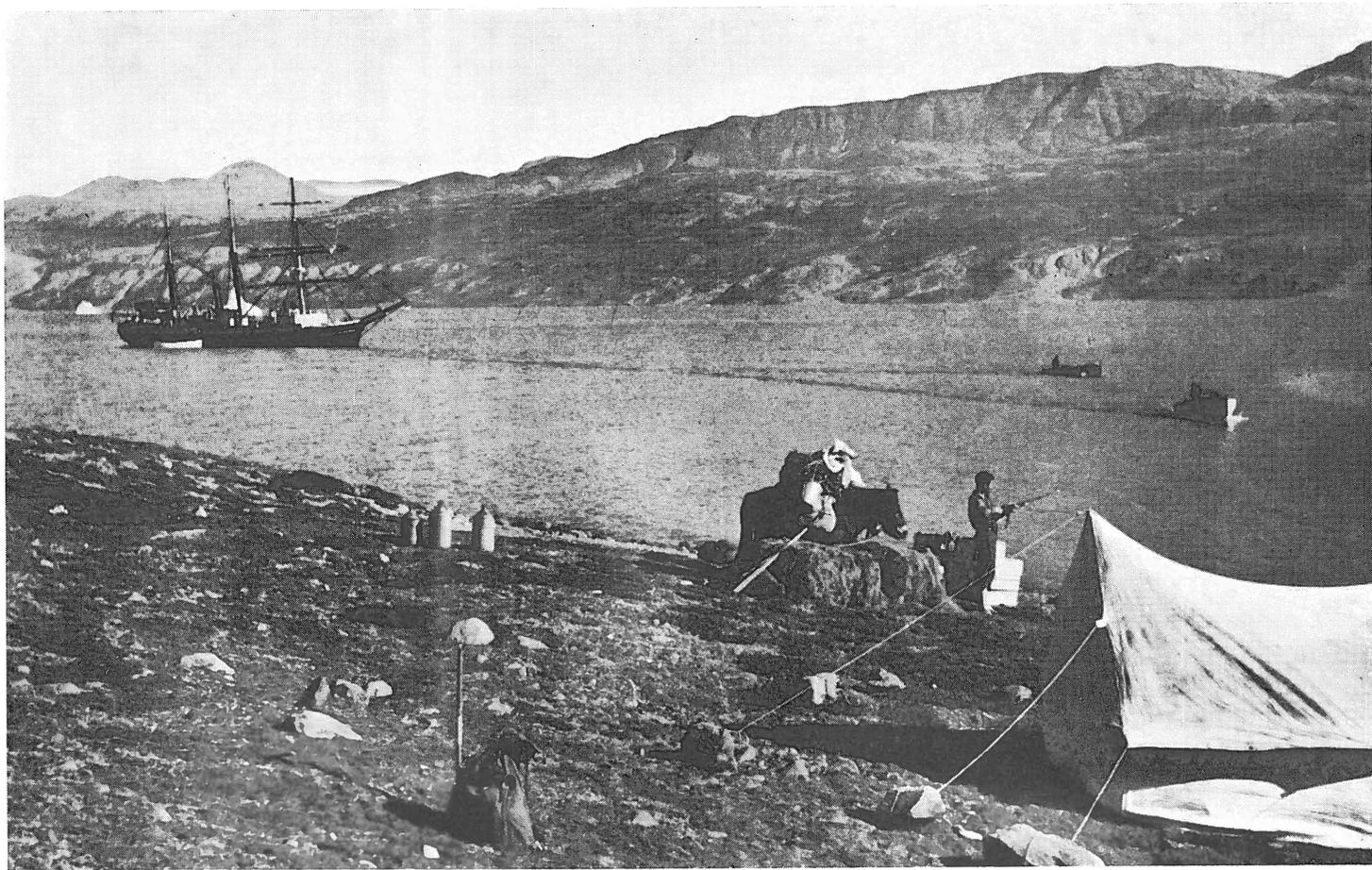


Fig. 186. Setting ashore of BÜTLER'S camp in Moskusoksefjord.

which rose steeply in the mountain side on the south side of the river; subsequently they climbed again up the valley to the head of the river. Camp 2 was erected about 15 km from Camp 1 on the south side of the main river, below the point where it was joined by a large mountain rivulet, the water of which was coloured brown by the sand and mud particles of the weathering red Devonian sandstone.

July 30th.—Climbed the heights north and south of the camp (intermittent snow drift and rain). Measuring of sections, sketching, and mapping. As the weather was cold all day owing to the overcast sky, it was easy to cross the mountain streams with rubber boots.

July 31st.—The camp was moved farther up the valley to the southwestern base of Collets Bjerg (Camp 3). Here in the upper part the bottom of the valley was again broad and level, and sufficient vegetation for grazing of the ponies was found on its damp soil. This camp provided good possibilities for moving about in the surrounding; (on foot) and for making investigations: on the ridge of Vergys, with a magnificent view into Dybendal and the Whittards Bjerg massif, on Collets Bjerg, Uomopasset, Laffons Bjerg, Klippedal, Hochwacht, everywhere securing good information and with good views of the valleys. Investigations were made on July 31st, and August 1st—3rd; during this period SCHAUH led a transport of extra supplies from Camp 1 to this camp.

Aug. 4th.—Breaking oi Camp 3, and starting across Uomopasset with only a slight ascent from Ankerbjergelvs valley, but a very steep ascent partly across rocky terrain to Ritomsø. However, the ponies had already become accustomed to the stony and mountainous land and accompanied the party with their loads without slipping, westward along the south side of Ritomsø, over the bottom of the valley, across the low water-shed, and then down the valley to Camp 4 in Visp valley between Schalchs Bjerg and Favres Bjerg. The vegetation was very sparse here and allowed no long stay in this place.

Aug. 5th.—Investigations in the zone of overthrusting of the inlier crystalline over the limestones of the Eleonore Bay Formation of Schalchs Bjerg. Afterwards return to Ritomsø, along its northern bank to the eastern end of the lake. Camp 5 at the Klus north of Collets Bjerg. Here several valleys open out so that a good view of the structure of this mountain landscape could be obtained

Aug 6th.—Investigations of the folding structure of the Eleonore Bay Formation of Collets Bjerg, at first frontally on the northwest side of the mountain, subsequently across to the overlying beds at the northern foot and in the Devonian series adjoining them eastward in Dybendal. Camp 6 at the foot of a large terminal moraine of a glacier coming from the branch valley northwest of Parkinsons Bjerg; the moraine extended into the main valley. In the evening rain.

Aug. 7th.—Rain all day. Collected rock samples, and arranged notes and drawings.

Aug. 8th.—Overcast weather, but no rain. Proceeded down the valley on the south side of Granitelv (Dybendal). Near the edge of the mountain in the east the valley grows narrower, and the river has cut down into a ravine. Going was rather hard, across slopes of debris and boulders, but no great obstacles were encountered. Beyond the large fault near the eastern edge of Parkinsons Bjerg the valley widened. The party travelled down the valley for about 5 km, but then, at the point where Granitelv swerves towards the east, went through a low pass between Vuachebjerg and Point 600 and camped (Camp 7) on the high plateau of the southwest side of Vuachebjerg.

Aug. 9th.—Investigations in the area around the camp, then return to the sea, travelling eastward past Salèvebjerg to the mouth of Ankerbjergselv and along Moskusoksefjord to the main camp near Prospektal (I), where IB POULSEN and THOMAS were found to be all right though a couple of nights before their tent had been visited by bears.

#### Summary.

This first journey over land, which lasted for two weeks, was favoured by fine weather. On July 30th the work in the mountains was impeded by drifting snow, on August 7th it rained all day, but on all the other days the work in the field and the journey could be continued. The party succeeded in walking through the two mountain valleys of Ankerbjergselv and Granitelv step by step, measuring sections and carrying out mapping. The supposition that the deeper-lying tectonical series cropped out here, was fully confirmed, and BÜTLER succeeded in delimiting the different Devonian structural elements even in the crystalline and the Eleonore Bay Formation of the Caledonian substratum.

#### Extract of Diary.

Aug. 10th—13th.—Investigations from the shore camp (I) near Prospektal. It was BÜTLER's plan to investigate the tectonics of the eastern part of Moskusoksefjord for some days by the aid of the motor-boat. It turned out, however, that the motor of the boat was all but reliable and that consequently long voyages were impossible. He therefore had to be content to cross the fjord in the boat (partly with, partly without the aid of the motor) to the other side and then to cover on foot the great distances as far as possible.

Aug. 10th.—Investigations were made from the camp in the Carboniferous trough of Prospektal.



Fig. 187. Crossing a river in the interior of Hudson Land.

Aug. 11th.—Went across to Gastisdal, and some kilometres up this valley, and from its west side on to La Cours Bjerg. Descended in the late evening through the upper part of the valley on the east side of the mountain and onwards to the shore. Returned in the boat to the camp.

Aug. 12th.—Went again into Gastisdal. Investigation of the east side of Ramsays Bjerg and the trough fault in the lower and middle portions of Gastisdal.

Aug. 13th.—An attempt was made to sail in the motorboat along the coast to Ulvedal. However, the boat proceeded very slowly, at times stopping entirely, so BÜTLER could only make short visits ashore in two places. Returned to the camp, and departed with the ponies to the auxiliary camp in the lower part of the Ankerbjergselv valley, accompanied by STAUBER and SCHAUB.

Aug. 14th.—On the return journey to the shore on August 9th BÜTLER had ascertained that complicated folding, faulting, and transgressions were found in the area between Nordhoeks Bjerg and Ankerbjerg. Since the unreliable motorboat rendered good results of work impossible, BÜTLER decided instead to go inland with the reliable ponies into this hitherto slightly investigated area, viz. the eastern down-faulted block of Hudson Land. It must be of interest to connect the folding structures there, cut off by the fault, with those of the elevated block.—Started from the auxiliary Camp 1 on the south side of Salève-

bjerg (Camp 8). Investigation of the Devonian deposits and the quartzite of the Eleonore Bay Formation. In the evening fog, rain, and wind, and at higher levels snowfall.

Aug. 15th.—It rained till noon. In the afternoon some hours' work in the open, in the evening rain again.

Aug. 16th.—Broke camp early in the morning and went across Salèvebjerg to Arve. Measured sections along the river as far as the large main fault. As the river was very full of water owing to the melting snow, it could not be crossed in the evening. Grey and foggy weather (Camp 9).

Aug. 17th.—In the early morning the party crossed the river and removed the camp some kilometres northward to the camping site (7) of August 8th—9th. Investigations along the large fault on the east side of Sernanders, Fuchs, and Parkinsons Bjerg.

Aug. 18th.—Started from the same camp, investigations near Vuachebjerg, up the valley along Granitelv, and the slopes at the southwestern foot of Nordhoeks Bjerg.

Aug. 19th.—Returned to the camp on the shore (I) in overcast rainy weather.

Aug. 20th.—Traced the eruptive dykes in the Carboniferous of Prospektal, the eastern slope of Högboms Bjerg.

Aug. 21st.—As the weather was calm, one more attempt was made to go with the motorboat into the eastern part of the fjord. However, the boat proceeded so slowly that the voyage out and back took nearly the whole day, and BÜTLER could only make short visits ashore in two places.

Aug. 22nd.—Investigations in the area around Högboms Bjerg.

Aug. 23rd.—Investigations along the shore north and northeast of La Cours Bjerg. The auxiliary camp in the Ankerbjergselv valley had in the meantime been removed to the shore by STAUBER and SCHAUB.

Aug. 24th.—Started with STAUBER, SCHAUB, and the ponies westward along the shore of Moskukoksefjord. In the hours of calm weather the boat with IB POULSEN and THOMAS, the camping outfit and the cases with goods likewise went westward and reached the party in the night some distance west of Högboms Bjerg (Camp 10). Geological investigations were made along the shore to supplement earlier work.

Aug. 25th.—Travelled along the shores of the fjord as far as the delta of Genvejsdalen, the large valley east of Torbern Bergmans Bjerg. The motorboat had already arrived there (Camp 11).

Aug. 26th.—Climbed the upper part of Genvejsdalen across the mountain sides east of Torbern Bergmans Bjerg. Crossed a deep ravine. Ascertained the age of some limestone cliffs on the northeast side of the inlier and various unconformable Devonian series. However, time



Fig. 188. From the interior of Hudson Land.

did not suffice for clearing up the tectonical details. The "Gustav Holm" had already entered the fjord and on

Aug. 27th—fetched the party and its camping outfit, and subsequently proceeded to Ella Ø.

#### Summary.

The object of the work: an analysis of the deep-lying structures of the Devonian folds and the deformations of the Caledonian substratum, had been carried out. The structures of the substratum observed turned out to be much more complicated than might be gathered from the comparatively simple forms of folding and thrusting of the thrust series near Moskusoksefjord.

On August 4th and 5th BÜTLER reached the western margin of the Devonian thrusting zone of Hudson Land. From this place it could be ascertained that a zone of Caledonian rocks was found in the northwest which formed the foreland of the Devonian folds and had likewise been affected by the movements. This land area between Waltershausen Gl. and Wordies Gl. was moreover slightly known geologically, and it was tempting to push further on. However, BÜTLER nevertheless started the



Fig. 189. From the interior of Hudson Land.

return journey from this place in order to carry out the working programme and to complete the geological mapping of Hudson Land along Moskusoksefjord.

After the arrival of the expedition ship to Ella Ø it was necessary for it to go once more to Clavering Ø (owing to the loss of the large motorboat of the station, which had to be replaced by the new police boat). As weather conditions were favourable, and hardly any ice was present in the southern part of Davy Sund, there was a possibility that the geologists who took an interest in such a visit, could go in the large motorboat of the Ella Ø station to Canning Land and stay there till the return of the expedition ship, making observations in this southernmost Devonian area of East Greenland.

It was agreed that G. SÄVE-SÖDERBERGH and his assistants were to take care of the stratigraphic investigations and the collecting of fossils, while BÜTLER was to clear up the tectonics. BÜTLER was interested in ascertaining the superposition of the Devonian beds on their substratum, the relation of the eruptive Kap Fletcher series to the Devonian and the Caledonian, and the stratigraphical disturbances of the post-Caledonian sediments. The time at his disposal was too short for detailed studies, so the object was in the first instance to gain, in a few days, a general idea of the regional conditions.

### Progress of Work.

Aug. 29th.—Started from Ella Ø in the large motorboat sailed by DE LEMOS and carrying SÄVE-SÖDERBERGH and his party and BÜTLER, while STAUBER and SCHAUB were set ashore by KAMMAN in Drømmebugten, where they were later fetched by DE LEMOS on his return voyage to Ella Ø. — After a rather troublesome crossing from Drømmebugten to Nathorsts Fjord owing to a heavy swell and high wind, the boat cast anchor in Doubletvigen on the north side of Canning Land. SÄVE-SÖDERBERGH and his party camped on the south side of the bay, while DE LEMOS and BÜTLER spent the nights in the motorboat.

Aug. 30th.—BÜTLER went on foot from Doubletvigen to Aarhus Bugt, thence towards Kap Tyrrell, across the glacier to Snevigen, and along the shore back to Doubletvigen. Studied the stratigraphy of the Eleonore Bay Formation.

Aug. 31st.—Started from Doubletvigen walking along the Devonian boundary to Aalborg Fjord and the Kap Fletcher eruptives. Investigated the superposition of the Devonian and the Kap Fletcher series.

Sept. 1st.—Investigation of Porfyrbjerg.

Sept. 2nd.—Walked from Doubletvigen along the shore to Kollen. The boat changed its anchorage to the bay north of this mountain.

Sept. 3rd.—Went in the motorboat to the eastern part of Wegeners Halvø, and was fetched again in the evening.

Sept. 4th.—In the motorboat to the interior of Nathorsts Fjord (Jameson Elv), and was fetched in the evening.

Sept. 5th.—Went on foot to Carlsberg Fjord and the Kap Fletcher peninsula, and back.

Sept. 6th.—Investigations around Kollen. In the evening collected Permian fossils at Kollen in company with Dr. KOCH. Subsequently on board the "Gustav Holm".

Sept. 7th.—The ship left East Greenland to go to Iceland.

### Object of Work in the Summer of 1938.

In continuation of the field work in the summer of 1936 BÜTLER reached the western margin of the Devonian folded area of Hudson Land in Visp valley. He ascertained that between Waltershausen Gl. and Wordies Gl. there was an area which must be of very great geological interest. This area must be intersected by the continuation of the Caledonian sedimentary zone (Eleonore Bay Formation—Cambro-Silurian) of Andrées and Strindbergs Lands, which zone included remnants of the Devonian beds and formed the western foreland of the Devonian Hudson Land folds. Thus there were a number of stratigraphical and

tectonical problems to solve. Thanks to VISCHER's and MAYNC's work along the outer coast and BÜTLER's work in Hudson Land, the geological sections could be drawn as far as Ole Rømers Land, and they were now to be continued in this place as far as the inner crystalline zone in order in this way to obtain connection with the more southern regions that had already been investigated.

### Planning.

The maps of the Danish Geodetic Institute on a scale of 1:250,000 and the air photos were very useful in planning the travelling routes. It might be expected that the valleys of Ole Rømers Land would contain sufficient vegetation to provide food for the Icelandic ponies for a fairly long period. The terrain seemed altogether to be more easily passable than that of Hudson Land. However, some difficulties were to be expected. The shortest route to the working field led through Genvejsdalen (first valley east of Torbern Bergmans Bjerg in the western part of Moskusoksefjord). On BÜTLER's last excursion on foot in the summer of 1936 to the northern part of the inlier of Moskusoksefjord he had ascertained that it would be possible to go inland by way of this valley. However, a deep ravine with steep walls would have to be crossed in the upper part of the valley; this crossing must be very difficult for the ponies, especially since it was the first journey and the ponies had not yet become accustomed to steady going in the mountains. However, BÜTLER had discovered a place where a musk-ox path led over the steep rocks and ledges.—In the interior of the land there were large rivers full of water which would have to be crossed. If men, provisions, camping and photo outfit were to be carried safely across, a small rubber boat with rudder and sails must be included in the outfit. Furthermore the provisions would have to be packed in sacks; in the summer of 1936 the cases with provisions had proved unsuitable for steep ascents and passages on steep mountain walls.

As travelling companions BÜTLER was to have the petrographer Dr. W. MITTELHOLZER, who was afterwards to continue the field work from Clavering Ø as a wintering geologist, and as assistant H. BACHMANN, a trained Swiss mountaineer, and to tend to the ponies P. GUNNARSSON (Iceland).

The plan was to measure a section across Ole Rømers Land parallel with Waltershausen Gl., and subsequently another cross section farther northward, as well as one along the lower part of Wordies Gl., and, if possible, to supplement the section across Hudson Land by investigations in the upper part of Stordal.

## Progress of Work.

July 6th, 1938.—Departure from Copenhagen, by railway via Oslo to Bergen.

July 7th.—Departure in the "Lyra" to Iceland.

July 11th.—Arrival in Reykjavik.

July 12th.—In motor car across Iceland.

July 13th.—Arrival at Akureyri, where the "Gustav Holm" was ready to start.

July 14th.—Departure of the "Gustav Holm" from Akureyri. Great loss of time in the ice.

July 30th.—Arrival in Moskusoksefjord. The party with six ponies and outfit was landed in the delta of Genvejsdalen east of Torbern Bergmans Bjerg.

July 31st.—First transport (carried out in the night) of provisions took place to an auxiliary camp in the upper part of the valley (S. of Summit 1310 m). Since this first passage was very difficult, leading through a steep ravine, some men of the crew assisted as leaders of the horses. Nevertheless two ponies tumbled down on passing from the ravine up on to the steep rock ledges; one of them lost its load, but got up again, though frightened and somewhat injured, while the other tumbled with its load to the bottom of the ravine, where it lay with all its legs broken and had to be shot. All the loads were deposited in the mountain beyond the ravine. The return to the sea with the ponies, now deprived of their loads, took place without mishaps.

Aug. 1st.—In the seaplane during a strong gale to Krumme Langsø. A small depot of fuel and provisions was erected on the east side of the large curve. A shore camp (No.1) was erected in Moskusoksefjord, in which all superfluous outfit was left.

Aug. 2nd.—Second transport and journey inland (BÜTLER, MITTELHOLZER, BACHMANN, GUNNARSSON). This time the difficult place was passed without mishap (Camp 2).

Aug. 3rd.—The camp was removed some distance farther inland (Camp 3). Geological investigations on the ridge of the "inlier".

Aug. 4th.—Excursion on Torbern Bergmans Bjerg and northward back to the camp. Proceeded in the evening at first up the valley past the two small lakes, then northward, crossing the high ridges, and descended into Visp valley. Camped at the northwestern foot of Schalchs Bjerg (Camp 4).

Aug. 5th.—Investigation of the two valley sides, the main valley, and the branch valleys southwest of Schalchs Bjerg. Climbed the plateau west of Snehvide to a height of about 1300 m.

Aug. 6th.—Travelled down the valley, first on the south side of

the Visp, then across the river above the ravinous cut in its lower part. Camped in Johan Davidsens Dal on the east side of Vrangelveu opposite Point 283 near the end of the lake (Camp 5). Some hundred metres farther down the river forms eddies and waterfalls. Strong foehn wind. Investigations of the Eleonore Bay Formation north of the Visp.

Aug. 7th.—The investigations of the previous day were continued. In the evening the camp was removed to the other side of the river. BÜTLER at first rowed across in the rubber boat, drawing a rope after him. Then a ferry was made and all the camping outfit hauled over, the ponies were driven into the river and swam across. At last GUNNARSSON was hauled over in the boat (Camp 6).—The vegetation in this large valley, dried out by frequent winds, was very sparse, so that a long stay with the ponies would be impossible.

Aug. 8th.—Proceeded on the journey, at first along Vrangelveu (north side), then climbing northward, south of Point 965 passing into a high valley. Camped at the upper end of Nells Sø. A troublesome day's journey. In the high valley a swampy bottom, abundant vegetation, and numerous musk-oxen were encountered (Camp 7).

Aug. 9th.—Climbed to the mountain Posten (1145 m), which is made up of a wedge of Silurian limestone thrust across the Devonian. In the evening measuring of sections on the western bank of Nells Sø.

Aug. 10th.—Removal of the camp to the lower end of Aasesøen (Camp 8), western bank. Descent through the ravine to Waltershausen Gl. Measurement of profiles of the Eleonore Bay Formation, the tillites, and the Cambrian, on the western edge of the large trough-fault filled with Devonian deposits.

Aug. 11th.—Travelled northward from Aasesøen across the plateau along the western margin of the Devonian trough. Steep ascent towards the upper end of Krumme Langsø, then down the valley to a camping site at the middle one of the three lakes near Waltershausen Gl. (Camp 9).

Aug. 12th.—Investigations between the upper end of Krumme Langsø and Waltershausen Gl., south of Vogts Bjerg. Very sparse vegetation.

Aug. 13th.—Proceeded towards Vibekes Sø. In the early morning, at low water, the party waded across the large rivers flowing towards Krumme Langsø. The party always succeeded in finding a place where the water was not very deep, so that the whole caravan could wade across. They then continued along a former glacier valley which ran parallel with the upper part of Krumme Langsø (north of Point 611 m). Camped at a small lake c. 3 km west of Vibekes Sø (Camp 10). Here, too, the vegetation was very sparse owing to excessive drought.

Aug. 14th.—Excursion from the camp up the mountain marked 940 (northwestern end of the bank of the lake), which was made up of

limestones of the Kap Weber Formation. Had a good view of the eastern bank of Vibekes Sø and of Stenos Land. Measured profiles and collected fossils at the northern foot of the mountain.

Aug. 15th.—Proceeded on the journey, at first southwards to the northern bank of Krumme Langsø and then eastward along the bank. However, soon the way was barred by steep rocks rising directly from the lake, so the party had to skirt the steepest rocky areas by going up the mountains, but here struck terrain which was very difficult for the ponies, so they had to be led very slowly and cautiously across these stretches. Subsequently the party again descended towards the lake, but westward had again to ascend (towards Point 900). In vain the members looked for a descent towards the south; they had to spend the night on the plateau (Camp 11).

Aug. 16th.—In the morning the party found a place where they could descend towards the east, leading along the tillites, steeply down into Promenadedal. Camped at the southern end of the small lake at Point 454 m, at the watershed between Promenadedal and Johan Davidsens Dal. In this place, also, hardly any vegetation was present (Camp 12).

Aug. 17th.—Investigation of the mountain slopes between Points 1222 and 1258. Part of the outfit was left in the camp, and in the afternoon the camp was removed eastward. At first the party travelled along the river of Promenadedal, then they climbed the large terraces on the south side of the river and turned southward into Stordal, and spent the night near the watershed at the entrance of this valley, where the ponies found good grazing (Camp 13).

Aug. 18th.—Foggy. The camp was broken and removed into Stordal, to the southern end of the upper lake (Camp 14). They were now again at the western boundary of the crystalline upthrust of Hudson Land. Investigations around Points 1210 and 1760.

Aug. 19th.—Excursion from the camp to the north side of the valley; in the afternoon march down along the river to some distance beyond the third lake of the valley. Along the route small detours to the left and right sides of the valley (Camp 15).

Aug. 20th.—Proceeded down the valley. Owing to the increased steepness and height of the valley sides the talus slopes among which the way led at the edge of the narrow bottom of the valley developed into block fields, making the march very laborious for men and horses. Near the lowermost lake in the valley the caravane reached the end of a narrow mountain valley. They crossed the large fault in the east side of Nørlunds Alper and reached again a broad valley, when they turned northward and camped in the valley east of Point 1760 m (Camp 16). Investigations of the Carboniferous of the fault zone.

Aug. 21st.—Rapid return march to Stordal to Camp 13 at the watershed towards Promenadedal (17th—18th August). Very hard and laborious walk. Had successful hunting, and the ponies likewise found good grazing here.

Aug. 22nd.—Strong foehn wind. Travelled along Wordies Gl. through Promenadedal, partly across the mountain side, partly in the dry part of the river bed, which was covered with coarse pebbles. Camped south of Point 224, where Vibekes Elv approaches the side of the glacier (Camp 17). Here the ground was entirely dry, and also in the branch valleys leading towards the mountains no grass was to be seen. Investigations in the valley south of, and the mountains southwest of Point 224.

Aug. 23rd.—Excursion along the river towards Wordies Bugt. Since the ponies failed to find any food in the branch valley into which they had been driven, they made their way up the mountains although their legs had been tied together, and several hours were lost in gathering them again. Towards evening the camp was broken, and a rapid march took the party to the earlier camp site between Promenadedal and Johan Davidsens Dal near Point 454 (Camp 12), where part of the outfit had been deposited.

Aug. 24th.—Travelled southwestward along Krumme Langsø to its lower end to the camp site of August 6th—7th. It rained, for the first time during the journey, and the rain gradually changed into snow. The rock samples left there were loaded on to the ponies, and owing to the bad weather the return journey was immediately started. The party at first travelled through Visp valley, then climbed the eastern slope of Yngvar Knudtzons Fjeld, and walked all night, in heavy snowfall, to the camping site north of Torbern Bergmans Bjerg (Camp 3), which was reached at 4 a.m., when the members were very tired and hungry. Some hay had been deposited here, so the starving horses, also, had some food. The party rested all day. The weather was clearing again, the strong frost decreased, and the greater part of the snow thawed in the course of the day.

Aug. 26th.—In the forenoon some detail investigations, and packing of the camping outfit. In the afternoon the camp was broken, and the party descended to Moskusoksefjord. The difficult passage through the ravine was now covered without difficulty, the ponies being now accustomed to travelling in the mountains. In the evening arrival at the shore camp (No. 1), where all was found to be in good order. Thus the journey had come to an end without mishap and, apart from the first day, without loss of ponies. This time also the Icelandic ponies had proved to be extremely reliable means of transport in rather difficult terrain. Also the companions of the journey had proved to be enduring in walking.

The following outfit had turned out to be indispensable: strong mountain shoes (2 pairs), high rubber boots, a rubber boat, and glacier pick-axe (light model) for use during ascent and descent of steep talus slopes.

Aug. 27th.—Investigations of the crystalline of the “inlier” and the Devonian basal conglomerates.

Aug. 28th.—Investigations of the volcanic series towards Hoelsbo. In the afternoon the seaplane arrived, taking BACHMANN to Clavering Ø. In the evening the ship arrived, and all men and outfit were taken on board. MITTELHOLZER went by air to Clavering Ø.

Aug. 29th.—In the expedition ship to Ella Ø.

Aug. 30th.—The ship proceeded through Davy Sund with all the geologists of the years 1936—38 on board. Very calm voyage to Iceland.

Sept. 2nd.—Arrival at Akureyri, where a fairly long stay was made. Visited Godafoss and other places.

Sept. 9th.—Went by motor car to Borgarnes and in the night, in stormy weather, with the ferry to Reykjavik. Stay in Reykjavik. Visits to Thingvellir, Gullfoss, and Geysir-Gryla.

Sept. 12th.—Departure in the “Dronning Alexandrine” for Copenhagen.

Sept. 17th.—Arrival in Copenhagen.

#### Summary.

Thanks to the fine and dry weather, the working and travelling programme could be carried out according to plan. On only one of twenty-six working and travelling days the field work was much impeded by the weather. Consequently the tectonic and stratigraphical connections with the areas in the south and east could be cleared up; two cross sections through the whole area were measured, and on numerous excursions, which were made from the camps or from the travelling route, the geological mapping was completed. The connection of the many faults could not be completely ascertained; this would have required a flight across the area after the field work had been finished.

As regards the travelling technique it was demonstrated that it is possible to move about with Icelandic ponies (whereas travelling with carriage or carts is impossible in this terrain). In mountainous terrain the speed of travelling was not very great; it should, however, be borne in mind that geological observations were made and noted down along the route, and the caravan had to set its march speed according to this. On difficult passages and on terrain rather hidden to the eye all men had to lend a hand to get the caravan across; however, this took only a small part of the time of the geologists during the journey. The total distance covered by the caravan amounted to about 300 km, the many

small detours and zigzag routes in the mountains as well as the many excursions made by the geologists, in most cases one man apart, from the camp or the travelling route not being included.

In the large valleys of Ole Rømers Land, especially in Johan Davidssens Dal and Promenadedal, the vegetation was very sparse, the numerous strong winds without rain having entirely dried out the ground. However, the summer of 1938 was extraordinarily dry, in normal years it may be expected that on every travelling day one or more grazing places may be encountered, so that in a working period of four weeks it will be necessary to carry spare food for the horses for a few days only.

The composition of the working group, also, had proved fortunate: two scientists, who were able to lend a hand to the ordinary work if necessary, and two assistants, who could divide the work between them and generally lead the caravan alone. The five ponies carried sufficient provisions, fuel, and camping outfit (two tents) so that the scientists had sufficient room for writing and sketching, and need not be troubled by fear lest they should be in lack of provisions. It would have been possible to feed on game, thus musk-oxen were met with throughout the area. In the valleys fairly rich in vegetation the musk-ox tracks were so frequent that they often presented obstacles to the geologists on their excursions.

BÜTLER's publications resulting from the different investigations:

- 1) Some new investigations of the Devonian stratigraphy and tectonics of East Greenland. — Medd. om Grøn. Bd. 103, Nr. 2, Copenhagen 1935. 35 pp. 17 figs.
  - 2) Die Mächtigkeit der kaledonischen Molasse in Ostgrönland. — Mitt. der Naturf. Ges. Schaffhausen XII. Heft Nr. 3, 1935. 17 Seiten, 4 Tafeln, 2 Textfiguren, 1 Tabelle.
  - 3) Die geologische Position des Canninglandes in Ostgrönland. — Mitt. d. Naturf. Ges. Schaffhausen 1937 XIII. Heft Nr. 1. 7 Seiten, 1 Textfigur.
  - 4) Erläuterungen zu einigen Bildern der Ellänsel in Ostgrönland. — Mitt. d. Naturf. Ges. Schaffhausen 1937 Heft Nr. 2. 5 Seiten, 4 Tafeln mit 8 Figuren.
  - 5) Die tektonischen Strukturelemente des östlichen Moschusochsenfjordes. — Medd. om Grøn. Bd. 103, Nr. 5, 1938. 6 pp., 1 Textfig.
  - 6) Das devonische Faltungsgebiet nördlich des Moskusoksefjordes in Ostgrönland. Medd. om Grøn. Bd. 114 Nr. 3, 1940. 32 Seiten, 10 Tafeln mit 2 Karten und 14 Figuren.
  - 7) Uebersicht der devonischen Bildungen nördlich des Davysundes in Ostgrönland. — Mitt. d. Naturf. Ges. Schaffhausen Bd. XVI Nr. 5, 1939. 27 Seiten, 8 Figuren.
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