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Glacier Inventory of Wohlthat Mountain Chain, Queen Maud Land, Antarctica,

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Abstract

The paper summarises the results of the glacier inventory of Wohlthat mountain chain lying between Long 9°E to 14°E and Lat 71°10'S to 72°S. The inventory is based on 1:250,000 scale topographical map, landsat imagery, reconnaissance vertical aerial photography during 1985-86 expedition, and limited ground checks. A total of 122 glaciers have been identified, numbered and classified.

Introduction

Wohlthat mountains situated about 200 kms due south from the Dakshin Gangtori station forms an imposing mountain chain bordering Antarctica in the Queen Maud Land, extending from Long 9°E to 14°E and Lat 71°10'S to 72°S. Trending in a NE-SW direction, the mountain range is exposed for about 110 kms from East to West, and about 85 kms from South to North. It forms a barrier to the northern flow of the continental ice sheet. The ice tongues emanating from the ice sheet in the form of outlet glaciers dissect the Wohlthat mountain chain into independent blocks, each block being bounded by independent glaciers such as Deildebreen, Humboldt Sokket and Somoveken. Each of these blocks supports an independent system of remnant glaciers which have their own regime, different from the main continental ice sheet. These glaciers have defined boundaries and are not dependent on the flow of main outlet glaciers surrounding the blocks, or the polar ice sheet. These are regarded as the remnants of the polar ice sheet which was much thicker in these areas during the past. Among these glaciers there are few which are confined to the limits of exposed ground itself, whereas others cascade or flow into the outlet glaciers as tributaries. These glaciers are of different outlines and varied physical dimensions. An attempt here has been made to record their parameters and prepare their inventory. Rabassa et a/. (1982) carried out inventory of James Ross and Vega Island, situated on the eastern side of the northern most tip of the Antarctic peninsula. The present attempt is, therefore, perhaps the first such attempt to prepare an inventory of mountain glaciers on the main Antarctic continent.

The compilation of inventory of Antarctic glaciers of such types are beset with many difficulties, the main hurdle being the non-availability of good quality reliable maps and aerial photographs and scarcity of imageries. There are also limitations of ground checks due to terrain, approach and inhospitable weather.

The source material for the present compilation has been the Norwegian topographical map (1958-59) on 1:250,000 scale aided by the Landsat imageries in band 4 and 7; the vertical aerial photographs (Fig. 1) taken with the aid of Agflite camera mounted on Chetak helicopters during Fifth Indian Expedition

Fig. 1. A remnant glacier in the Petermann ranges picked up by aerial photography during the Fifth Indian Expedition

(1985-86), and oblique air photographs (Fig. 2). Ground checks were carried out during the course of geological mapping of the Wohlthat range and aerial reconnaissance and field checks during the search for meteorites in the area.

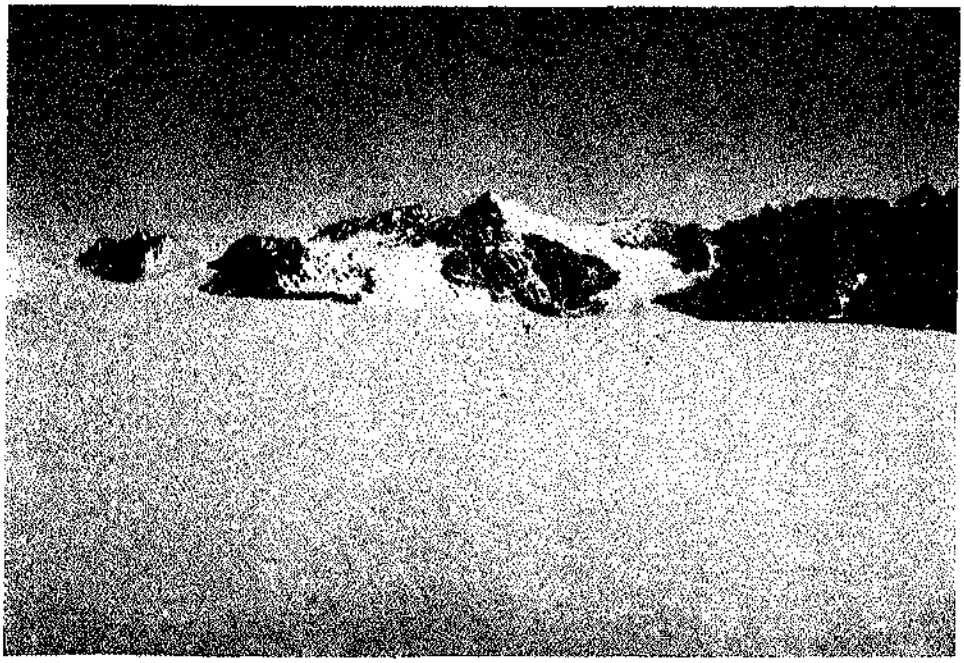

Fig. *2. Oblique air photograph showing mountain glaciers merging with polar ice.*

Methodology

The inventory was carried out as per the instructions contained in the manual of Temporary Technical Secretariat (TTS) of world glacier inventory (Muller 1977, 1978).

Unlike the inventory of the glaciers in Himalayan terrain the inventory of glaciers in mountainous terrains of Antarctica has its own limitations. To offset these limitations and to present a reasonably clear picture of the remnant ice masses on the mountains the following methods were employed:

i. Demarcation of Drainage Basin—The Wohlthat mountains are not a continuous chain. These have been dissected by outlet glaciers into different hill ranges. The exposed portions offer a typical arid topography of cold desert with bare and precipitous slopes, aretes and horns and

vast morainic stretches. In individual nunataks or mountains, there is no clearcut demarcation of the drainage basin because of absence of parameters delineating a basin or sub-basin. In the present inventory the whole of the Wohlthat mountains have been divided into four drainage blocks as defined by the outlet glaciers, originating from the polar ice sheet and draining through the Wohlthat ranges, i.e., Gruber, Petermann, Humboldt and Orvin blocks.

ii. Numbering of the Glaciers—Each of the four mountain groups (Blocks) has been considered as a single drainage unit and the glaciers present were numbered in clockwise direction starting from north. Each of these blocks was given separate number. In these blocks besides the main mountain range whenever there are closely spaced nunataks, each unit was considered independently from north to south and glaciers numbered in clockwise direction.

iii. Classification and area of the glacier—The type and form of the glacier was classified as defined in TTS, World glacier inventory. In cases where the glacier flows out and forms a tributary to the main outlet glacier, the lowest limit was marked by the present extent of moraines, or else by the logical limit of the mountain range through which the glacier flows.

iv. Within the Ice sheet itself near Humboldt group there were few water sheds from which the ice flows in all directions but since the topography below ice was not known, such feature could not be classified.

Glacier Inventory

The four mountain blocks thus identified are (i) Gruber group (ii) Petermann group (iii) Humboldt group-and (iv) Orvin group. For each group the glaciers have been classified with respect to type, form, orientation and aerial extension (Table I-IV).

i. *Gruber Group*—Gruber group is the easternmost range of mountains. It occupies about 170 km^2 of area. The highest point in the range is 2791 m.a.s.1. and lowest exposed point is 580 m.a.s.l. on the rock outcrop. The general elevation of the outlet glacier ranges from 1900 m.a.s.l. in south to 700 m.a.s.l. in the north. Within the ambit of glacierisation of Gruber, 19 glaciers of different orientation and dimension were identified.

ii. *Petermann Group-It* is the largest of the four groups occupying about 355 km of area, dissected into numerous closely spaced nunataks. The highest point in the range is 2947 m.a.s.l. in southern part, the lowest point being 1000 m.a.s.l. towards north. The general elevation of the outlet glacier is 2300 m.a.s.l. in the south to 1000 m.a.s.l. in north. There are 45 glaciers in this group.

Table I. Glacier Orientation

Glacier Direction	Gruber No	Gruber %	Petermann No.	Petermann %	Humboldt No.	Humboldt %	Orvin No.	Orvin %
N	5	26.31	8	17.77	1	2.43	1	5.88
NE	2	10.52	1	2.22	3	7.31	—	—
E	1	5.26	2	4.44	4	9.75	1	5.88
SE	1	5.26	1	2.22	4	9.75	3	17.64
S	—	—	1	2.22	3	7.31	—	—
SW	—	—	4	8.88	1	2.43	1	5.88
W	2	10.52	11	24.44	12	29.26	6	35.29
NW	8	42.10	17	37.77	13	31.70	5	29.41

Table II. Glacier Classification

Type*	Gruber No	Gruber %	Petermann No.	Petermann %	Humboldt No.	Humboldt %	Orvin No.	Orvin %
43	3	15.70						
44	—							
51	—		1	2.22				
52	2	10.52	4	8.88	2	4.87	3	17.64
53	6	31.57	10	22.22	5	12.19	9	52.94
62	1	5.26	—	—	3	7.31	—	—
63	3	15.78	16	35.55	14	34.14	1	5.88
64	3	15.78	—	—	7	17.07	2	11.76
67	1	5.26	14	31.11	10	24.39	2	11.76

***As per T.T.S., World Glacier Inventory, 1977.**

iii. *Humboldt Group*—The highest point in the group, which occupies 237 km^2 of the area, is 2885 m.a.s.l. in southern part, the lowest being 1700 m.a.s.l. towards north. The general elevation of outlet glacier (and the ice sheet) is 2100 m.a.s.l. in the south to 1000 m.a.s.l. in the north. There are 41 number of glaciers in this group.

iv. *Orvin Group*—It forms the westernmost group of the Wohlthat range occupying about 92 km^2 of the area. The general elevation of the outlet glacier being 2100 m.a.s.l. to 1700 m.a.s.l. from south to north; The highest point in the range is 3053 m.a.s.l. and lowest 1600 m'.a.s.l. It has 17 number of glaciers.

Table III. Mean Glacier Elevation

Contour Interval (m.a.s.l.)	Gruber No.	Gruber %	Petermann No.	Petermann %	Humboldt No.	Humboldt %	Orvin No.	Orvin %
600-700	1	5.26						
700-800	1	5.26						
800-900								
900-1000								
1000-1100								
1100-1200			1	2.22				
1200-1300	2	10.52	2	4.44				
1300-1400	2	10.52	3	6.66				
1400-1500	4	21.05	6	13.33	3	7.31		
1500-1600	2	10.52	6	13.33	2	4.87		
1600-1700	1	5.26	3	6.66	6	14.63	1	5.88
1700-1800	2	10.52	4	8.88	6	14.63	2	11.76
1800-1900	1	5.26	4	8.88	3	7.31	4	23.52
1900-2000	2	10.52	3	6.66	3	7.31	3	17.64
2000-2100	—	—	3	6.66	2	4.87	—	~
2100-2200	—	—	1	2.22	3	7.31	—	—
2200-2300	—	—	5	11.11	4	9.75	1	5.88
2300-2400	1	5.26	1	2.22	4	9.75	*2*	11.76
2400-2500	—	—	1	2.22	2	4.87	1	5.88
2500-2600	—	—	2	4.44	3	7.31	2	11.76
2600-2700	—	—	_	_ _	_	_	1	588

Table IV. Glacier Area Distribution

Class* km^2	Gruber **No.**	Gruber %	Petermann No.	Petermann %	Humboldt No.	Humboldt %	Orvin **No.**	Orvin %
0-1	10	52.63	30	66.66	21	51.21	9	52.94
1-2	3	15.78	7	15.55	4	9.75	5	29.41
2-4	1	5.26	3	6.66	9	21.95	2	11.76
4-8	5	26.31	5	11.11	4	9.75	1	5.88
8-16					3	7.31		

»AJ per T.T.S., World Glacier Inventory, *1977*.

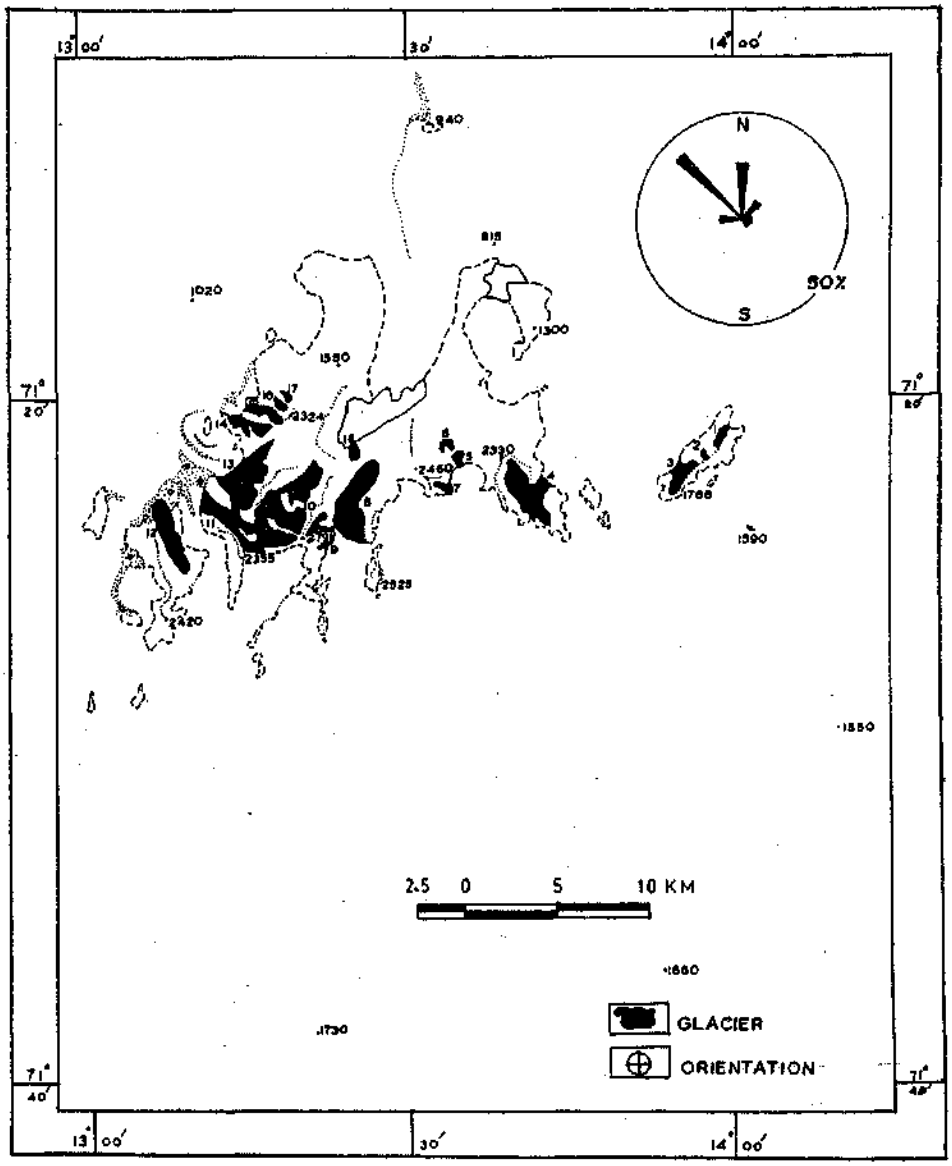

Fig. 3. Glacier map of Gruber range, Wohlthat Mountains, Antarctica

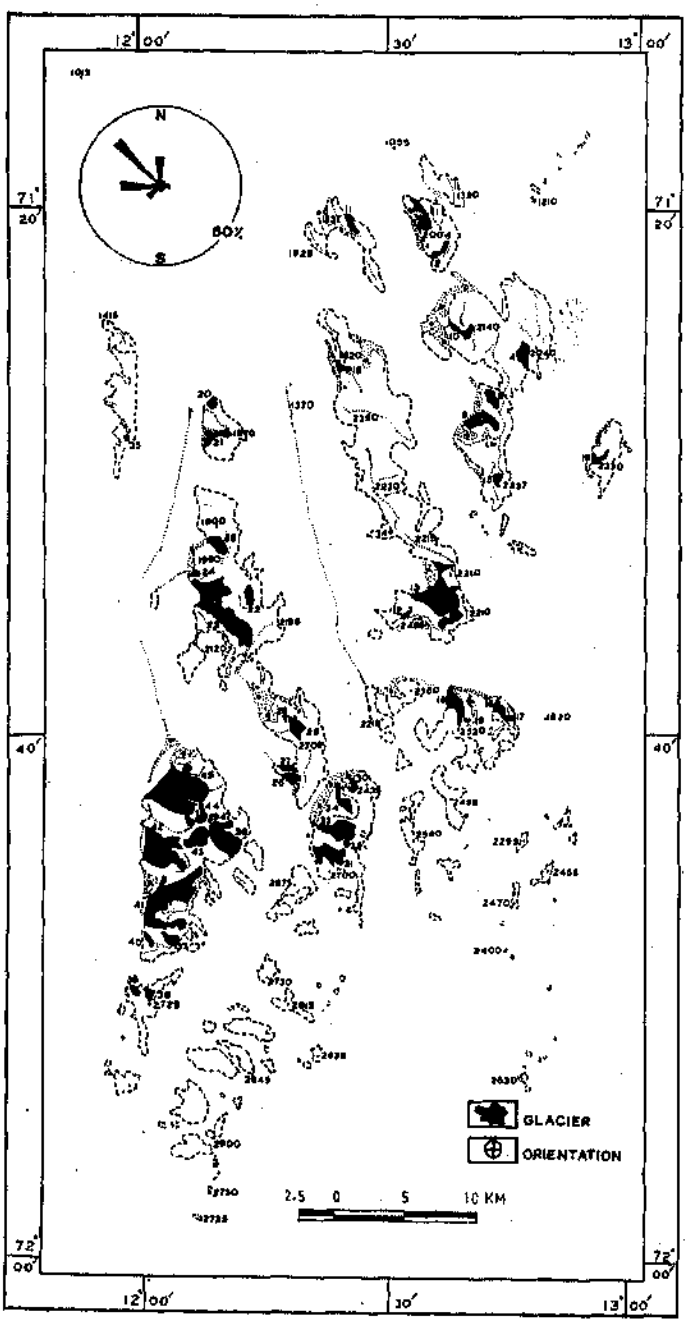

Fig. 4. Glacier map of Petermann range, Wohlthat Mountains, Antarctica

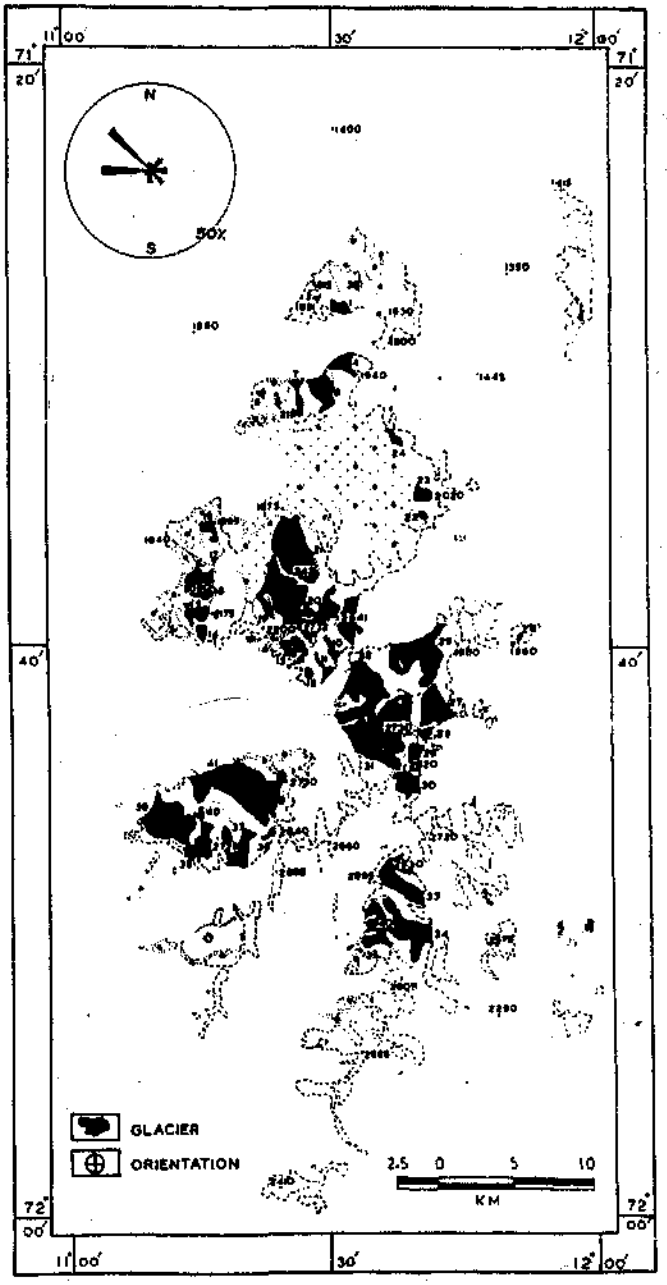

Fig. 5. Glacier map of Humboldt range, Wohlthat Mountains, Antarctica

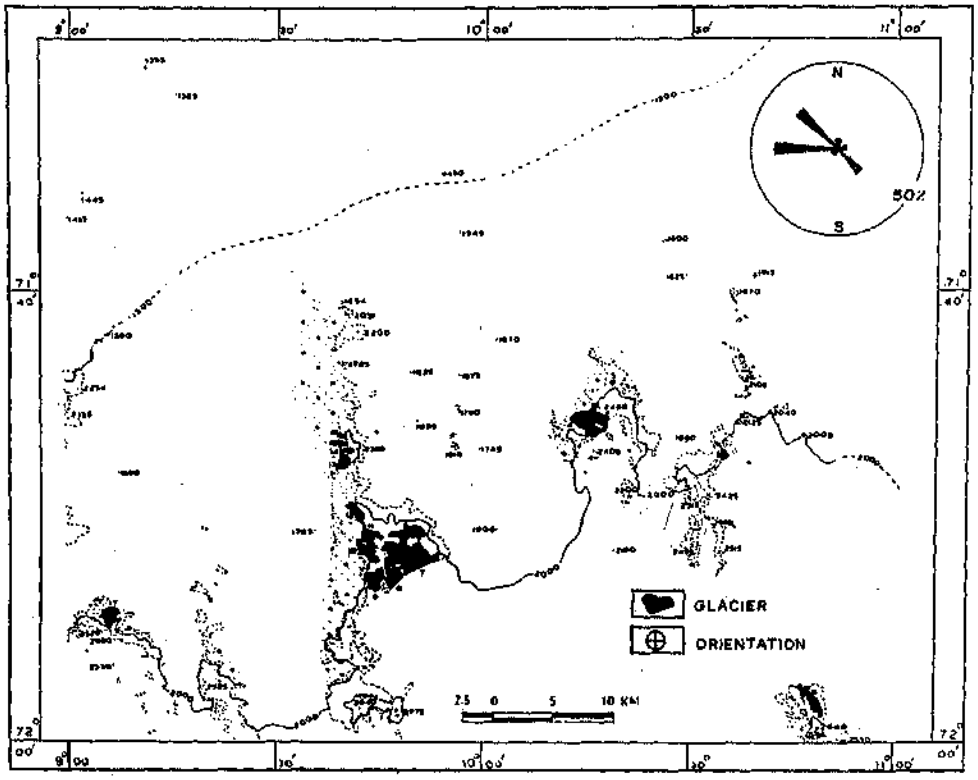

Fig. 6. Glacier map of Orvin range, Wohlthat Mountains, Antarctica

Conclusion

The Wohlthat mountain range has been divided into four drainage blocks for the purpose of this inventory. There are 122 glaciers of different types and dimensions (Fig. 3-6). More than 50% of the glaciers are oriented in northwest and west direction. Maximum number of glaciers are of small dimension i.e. upto one km^2 area. The mean glacier elevation ranges from 700 m.a.s.I. to about 2600 m.a.s.I. However, maximum number of glaciers have mean glacier elevation between 1400 m.a.s.l. and 2000 m.a.s.l. In general, the glaciers are of mountain glacier type occurring either in the form of ice aprons or flowing in a simple basin.

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