Survey and Some Considerations on the Antarctic Ice Sheet

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1. Preface

This paper presents the procedures used for the determination of geographic position and ice surface elevation along the traverse route, subsequently considered on its ice surface topography which is subdivided into five areas. Position data shown in Table 1 were obtained by Y. YOSHIDA on the segment between Syowa Station and the Plateau Station during the 1967-68 traverse and by S. KAKINUMA on the segment of Plateau-South Pole during the 1968-69 traverse. Measurement of ice surface elevation and topographic observations, *i.e.*, surveying of surface slope and surface relief in sight, were mainly carried out by K. FUJIWARA and these results are summarized in Fig. 2.

2. Determination of Position

Measurement of astro-fixed stations along the traverse route between Syowa Station and the South Pole was made at intervals of about 1° in latitude by the taking use of Wild T2 theodolite. But only the latitude was measured near the point approximately half-way between the each astro-fixed station along the traverse route from the Plateau Station to the South Pole. The crystal clock was adjusted by the standard time WWVH every day in order to keep the time accurate to within 1 second. It seems that errors of measurment are within the range of $\pm 0.1'$ regarding the latitude, but are a little over $0.1'$ regarding the longitude because of the difficulties of measurement on an unstable and soft snow surface.

Position of minor stations at intervals 4 km and intermediate points between them, shown in Table 1, were determined by the interpolation using direction and distance from adjacent astro-fixed stations. The errors of determination by the interpolation are probably within the range of $\pm 1'$. Generally speaking, the accuracy of measurement mentioned above, is almost sufficient for the determination of positions on the traverse across the inland plateau, except the case of setting up the scientific station or the strain nets for glaciological studies.

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Instruments used are as follows:

a) Theodolites

Wild T2 (Reading directly to 1 second of arc): Wild T2 was used for the solar observation on the traverse, and there was no trouble in temperatures below −50°C.

Kern DKM2: Prepared as a spare theodolite.

b) Crystal clock: Two portable types for electric power; the source of one was supplied from a dry battery (4.5 V), and the other from the snow vehicle (12 V).

c) Astro-compass: Astro-compass was installed on roof of the snow vehicle but was not used during the traverse.

d) Chronometer: Pocket type

e) Prismatic compass

3. Measurement of Elevation

Surface elevation was measured by Paulin barometric altimeters, at intervals of 4 km along the traverse route. On the way to the South Pole, the interval method of barometric altimetry was used, which involved simultaneous readings of pair of altimeters located at adjacent minor stations (BENTLEY, 1962). In case the interval method did not work well because of trouble in radio communication between two snow vehicles, the single point method was adopted, with which temporary elevations were calculated. The temporary elevations were corrected on the return trip from the South Pole. The elevations which were corrected for air temperature and barometric change already by the above method, were additionally corrected for the pressure gradient estimated by the daily surface and upper air pressure at three stations, *i.e.*, Syowa, the Plateau, and the South Pole. For example, the pressure gradient between St. 70 and St. 170 was 1.36 m/4 km, but those between St. 170 and St. 304, and betweet St. 304 and St. 552 were 0.84 m/4 km and 0.28 m/4 km, respectively. As a result of correction for pressure gradient, elevation of the Plateau Station came to 3,633 m. It was 9 m higher than the officially recognized elevation of the Station (3,624 m), that is, a closure error between Syowa Station and the Plateau Station was +9 m.

The pressure gradient between the Plateau Station and the South Pole were estimated roughly from the monthly mean pressure of January and December at both stations, because the record on daily air pressure at the South Pole was not available. Next, using the rough correction for pressure gradient, the elevation of minor stations from the Plateau Station to the South Pole were calculated with a starting value of 3,624 m at the Plateau Station. It came to 2,856 m and was 56 m higher than the official elevation of the South Pole (2,800 m), that is, a closure error between the Plateau Station and the South Pole was +56 m. Closure errors on the two segments, Syowa—Plateau and Plateau—South Pole were distributed equally to the elevation of every minor station. Surface elevation which was determined with the procedures mentioned above, is shown in Table 1 and Figs. 1a and 1b.

Table 1. Position and elevation of stations along the route of the JARE South Pole Traverse 1968–69.

A mark of * is an astro-fixed value. A mark of ( ) is an interpolated elevation, which is measured by the JARE traverse 1967–68, based on elevations at adjacent minor stations.

Station No.	Latitude	Longitude	Elevation	Station No.	Latitude	Longitude	Elevation
1	69°02′0S	39°43′E	(39) m	36	69°04′8S	40°56′E	1042 m
2	69 01.7	39 44	(76)	37	69 04.8	40 59	(1057)
3	69 01.5	39 45	(134)	38	69 04.9	41 02	1073
4	69 01.3	39 46	(169)	39	69 04.8	41 05	(1083)
5	69 01.2	39 47	(211)	40	69 04.7	41 07	1098
6	69 01.5	39 49	(256)	41	69 04.6	41 10	(1113)
7	69 01.5	39 50	(271)	42	69 04.6	41 13	1128
8	69 01.6	39 52	(305)	43	69 04.5	41 15	(1141)
9	69 01.7	39 53	(322)	44	69 04.3	41 18	1150
10	69 01.8	39 54	(344)	45	69 04.4	41 21	(1169)
11	69 01.9	39 56	(377)	46	69 04.5	41 24	1178
12	69 02.2	39 57	(426)	47	69 04.3	41 26	(1174)
13	69 02.4	39 57	(433)	48	69 04.2	41 29	1193
14	69 02.3	39 59	(457)	49	69 04.2	41 32	(1198)
15	69 02.3	40 00	(485)	50	69 04.2	41 35	1203
16	69 02.2	40 01	523	51	69 04.1	41 37	(1205)
17	69 01.9	40 04	(560)	52	69 04.1	41 40	1214
18	69 01.7	40 07	584	53	69 04.0	41 43	(1221)
19	69 01.5	40 10	(608)	54	69 04.1	41 46	1249
20	69 01.5	40 12	630	55	69 04.2	41 48	(1261)
21	69 01.6	40 15	(677)	56	69 03.7	41 51	1268
22	69 01.7	40 18	720	57	69 03.8	41 54	(1269)
23	69 01.8	40 21	(742)	58	69 04.2	41 57	1279
24	69 01.9	40 24	784	59	69 04.4	41 59	(1297)
25	69 02.2	40 27	(816)	60	69 04.6	42 02	1321
26	69 02.3	40 29	838	61	69 05.0	42 04	(1324)
27	69 02.5	40 32	(866)	62	69 05.2	42 07	1327
28	69 02.7	40 35	892	63	69 05.3	42 09	(1338)
29	69 02.8	40 38	(911)	64	69 05.5	42 12	1343
30	69 03.1	40 40	937	65	69 05.8	42 15	(1352)
31	69 03.3*	40 43*	(961)	66	69 05.9	42 18	1360
32	69 03.6	40 46	969	67	69 06.0	42 21	(1359)
33	69 03.9	40 48	(990)	68	69 06.2	42 23	1377
34	69 04.2	40 51	1006	69	69 06.4	42 26	(1380)
35	69 04.4	40 54	(1018)	70	69 06.9*	42 29*	1393

Station No.	Latitude	Longitude	Elevation
71	69°07′9S	42°29′E	m
72	69 09.0	42 30	1418
73	69 10.0	42 30	
74	69 11.0	42 31	1445
75	69 12.1	42 32	
76	69 13.1	42 32	1472
77	69 14.2	42 33	
78	69 15.2	42 34	1487
79	69 16.2	42 34	
80	69 17.3	42 35	1510
81	69 18.4	42 36	
82	69 19.4	42 36	1529
83	69 20.5	42 37	
84	69 21.5	42 38	1560
85	69 22.5	42 38	
86	69 23.5	42 39	1558
87	69 24.6	42 40	
88	69 25.6	42 41	1578
89	69 26.7	42 41	
90	69 27.7	42 42	1604
91	69 28.8	42 43	
92	69 29.8	42 43	1606
93	69 30.9	42 44	
94	69 31.9	42 45	1623
95	69 32.8	42 46	
96	69 33.9	42 47	1639
97	69 34.9	42 48	
98	69 36.0	42 48	1659
99	69 37.0	42 49	
100	69 38.1	42 50	1675
101	69 39.1	42 50	
102	69 40.1	42 51	1683
103	69 41.1	42 52	
104	69 42.2	42 52	1697
105	69 43.2	42 53	
106	69 44.3	42 54	1715
107	69 45.4	42 55	
108	69 46.4	42 55	1730
109	69 47.5	42 56	
110	69 48.5	42 56	1745

Station No.	Latitude	Longitude	Elevation
111	69°49′5S	42°57′E	m
112	69 50.6	42 58	1779
113	69 51.7	42 59	
114	69 52.7	43 00	1800
115	69 53.8	43 01	
116	69 54.8	43 02	1812
117	69 55.9	43 03	
118	69 56.9	43 03	1846
119	69 58.0	43 04	
120	69 59.0	43 04	1875
121	70 00.1	43 05	
122	70 01.1*	43 06*	1881
123	70 02.1	43 06	
124	70 03.2	43 06	1893
125	70 04.2	43 07	
126	70 05.2	43 07	1913
127	70 06.3	43 06	
128	70 07.3	43 06	1915
129	70 08.4	43 06	
130	70 09.5	43 06	1923
131	70 10.4	43 06	
132	70 11.5	43 06	1942
133	70 12.5	43 06	
134	70 13.5	43 06	1932
135	70 14.6	43 06	
136	70 15.6	43 06	1933
137	70 16.7	43 06	
138	70 17.7	43 06	1949
139	70 18.7	43 06	
140	70 19.8	43 06	1961
141	70 20.9	43 06	
142	70 21.9	43 06	1976
143	70 22.9	43 06	
144	70 24.0	43 06	1982
145	70 25.0	43 06	
146	70 26.1	43 06	1984
147	70 27.1	43 06	
148	70 28.1	43 06	1987
149	70 29.2	43 06	
150	70 30.0	43 04	2001

Station No.	Latitude	Longitude	Elevation
151	70°31′0S*	43°05′E*	(2001) m
152	70 31.9	43 06	2001
153	70 32.9	43 05	
154	70 34.0	43 05	2005
155	70 35.0	43 05	
156	70 36.1	43 06	2005
157	70 37.1	43 06	
158	70 38.2	43 06	2023
159	70 39.2	43 06	
160	70 40.2	43 06	2032
161	70 41.2	43 06	
162	70 42.3	43 06	2045
163	70 43.3	43 07	
164	70 44.3	43 07	2060
165	70 45.3	43 07	
166	70 46.4	43 07	2052
167	70 47.4	43 07	
168	70 48.4	43 07	2054
169	70 49.4	43 07	
170	70 50.5	43 07	2062
171	70 51.1	43 05	
172	70 51.6	43 02	2069
173	70 52.2	43 00	
174	70 52.8	42 57	2044
175	70 53.8	42 56	
176	70 54.8	42 56	2081
177	70 55.8	42 56	
178	70 56.8	42 56	2075
179	70 57.9	42 56	
180	70 58.9	42 57	2087
181	70 59.9	42 57	
182	71 00.9	42 57	2113
183	71 01.9	42 57	
184	71 03.0	42 57	2152
185	71 04.0	42 57	
186	71 05.0	42 58	2172
187	71 06.0	42 58	
188	71 07.0	42 58	2183
189	71 08.1	42 58	(2201)
190	71 09.1	42 58	2210

Station No.	Latitude	Longitude	Elevation
191	71°10′1S	42°58′E	m
192	71 11.2	42 58	2236
193	71 12.2	42 59	
194	71 13.2	42 59	2253
195	71 14.2	42 59	
196	71 15.3	42 59	2275
197	71 16.3	43 00	
198	71 17.3	43 00	2295
199	71 18.3	43 00	
200	71 19.4	43 00	2312
201	71 20.4	43 00	
202	71 21.4	43 00	2311
203	71 22.4	43 01	
204	71 23.5	43 01	2332
205	71 24.5	43 01	
206	71 25.5	43 01	2342
207	71 26.5	43 02	
208	71 27.5	43 02	2348
209	71 28.5	43 02	
210	71 29.6	43 03	2359
211	71 30.6	43 03	
212	71 31.6	43 03	2373
213	71 32.6	43 03	
214	71 33.7	43 03	2394
215	71 34.7	43 04	
216	71 35.7	43 04	2407
217	71 36.7	43 04	
218	71 37.7	43 04	2420
219	71 38.7	43 04	
220	71 39.7	43 04	2427
221	71 40.8	43 05	
222	71 41.8	43 05	2444
223	71 42.8	43 05	
224	71 43.8	43 05	2460
225	71 44.8	43 05	
226	71 45.8	43 06	2478
227	71 46.8	43 06	
228	71 47.8	43 06	2490
229	71 48.9	43 06	
230	71 49.9	43 06	2517

Station No.	Latitude	Longitude	Elevation
231	71°50′9S	43°07′E	m
232	71 51.9	43 07	2523
233	71 53.0	43 07	
234	71 54.0	43 08	2535
235	71 55.0	43 08	
236	71 56.0	43 08	2548
237	71 57.0	43 08	
238	71 58.1	43 08	2569
239	71 59.1	43 08	
240	72 00.1	43 08	2590
241	72 01.1	43 09	
242	72 02.2	43 08	2607
243	72 03.2	43 09	
244	72 04.2*	43 09*	2617
245	72 05.2	43 09	
246	72 06.2	43 09	2622
247	72 07.2	43 09	
248	72 08.2	43 09	2626
249	72 09.2	43 09	(2645)
250	72 10.2	43 09	2654
251	72 11.2	43 08	
252	72 12.2	43 08	2681
253	72 13.2	43 08	
254	72 14.2	43 08	2708
255	72 15.2	43 08	
256	72 16.2	43 07	2710
257	72 17.5	43 07	
258	72 18.2	43 07	2719
259	72 19.2	43 07	
260	72 20.3	43 07	2727
261	72 21.3	43 07	
262	72 22.3	43 07	2734
263	72 23.3	43 07	
264	72 24.3	43 07	2721
265	72 25.3*	43 07*	(2760)
266	72 26.3	43 07	2780
267	72 27.3	43 07	
268	72 28.4	43 06	2790
269	72 29.4	43 06	
270	72 30.4	43 06	2802

Station No.	Latitude	Longitude	Elevation
271	72°31′5S	43°06′E	m
272	72 32.5	43 06	2805
273	72 33.5	43 05	
274	72 34.5	43 05	2804
275	72 35.6	43 06	
276	72 36.6	43 05	2822
277	72 37.7	43 05	
278	72 38.7	43 05	2837
279	73 39.7	43 04	
280	72 40.8	43 04	2841
281	72 41.9	43 04	(2450)
282	72 42.9	43 04	2860
283	72 43.9	43 03	
284	72 44.9	43 03	2887
285	72 46.0	43 03	
286	72 47.0	43 02	2921
287	72 48.1	43 02	
288	72 49.1	43 02	2936
289	72 50.1	43 02	
290	72 51.1	43 02	2942
291	72 52.1	43 01	
292	72 53.1	43 01	2938
293	72 54.2	43 01	
294	72 55.3	43 01	2967
295	72 56.3	43 00	
296	72 57.3	43 00	2966
297	72 58.3	43 00	
298	72 59.3	43 00	2979
299	73 00.4	42 59	
300	73 01.5	42 59	3003
301	73 02.5	42 59	
302	73 03.5*	42 59*	3018
303	73 04.5	42 58	
304	73 05.6	42 57	3038
305	73 06.6	42 57	
306	73 07.7	42 57	3042
307	73 08.7	42 57	
308	73 09.7	42 57	3046
309	73 10.8	42 57	
310	73 11.9	42 57	3054

Station No.	Latitude	Longitude	Elevation
311	73°12′8S	42°57′E	m
312	73 13.9	42 57	3054
313	73 14.9	42 57	
314	73 15.9	42 56	3059
315	73 17.0	42 56	
316	73 18.0	42 56	3069
317	73 19.0	42 56	
318	73 20.1	42 56	3087
319	73 21.1	42 56	
320	73 22.2	42 55	3094
321	73 23.2	42 55	
322	73 24.2	42 55	3120
323	73 25.3	42 55	(3126)
324	73 26.3	42 55	3143
325	73 27.3	42 55	
326	73 28.3	42 55	3150
327	73 29.4	42 55	
328	73 30.4	42 55	3163
329	73 31.5	42 55	
330	73 32.5	42 55	3177
331	73 33.5	42 55	
332	73 34.5	42 55	3180
333	73 35.6	42 55	
334	73 36.6	42 55	3194
335	73 37.7	42 55	
336	73 38.7	42 55	3204
337	73 39.7	42 55	
338	73 40.8	42 55	3210
339	73 41.8	42 55	
340	73 42.8	42 55	3220
341	73 43.9	42 55	
342	73 44.9	42 54	3228
343	73 46.0	42 54	
344	73 47.0*	42 54	3247
345	73 48.0	42 54	
346	73 49.1	42 54	3263
347	73 50.1	42 54	
348	73 51.1	42 54	3278
349	73 52.2	42 54	
350	73 53.3	42 53	3275

Station No.	Latitude	Longitude	Elevation
351	73°54′2S	42°53′E	m
352	73 55.3	42 53	3284
353	73 56.3	42 53	
354	73 57.3	42 53	3294
355	73 58.4	42 53	
356	73 59.4	42 53	3314
357	74 00.4	42 53	
358	74 01.5	42 53	3332
359	74 02.6	42 53	
360	74 03.6	42 53	3333
361	74 04.6	42 53	
362	74 05.6	42 53	3335
363	74 06.7	42 53	
364	74 07.7	42 53	3351
365	74 08.8	42 52	
366	74 09.8	42 52	3353
367	74 10.8*	42 52*	(3360)
368	74 11.9	42 52	3362
369	74 12.9	42 52	
370	74 13.9	42 52	3371
371	74 15.0	42 52	
372	74 16.0	42 52	3387
373	74 17.1	42 52	
374	74 18.1	42 52	3399
375	74 19.1	42 52	
376	74 20.2	42 52	3407
377	74 21.2	42 52	
378	74 22.3	42 52	3416
379	74 23.3	42 52	
380	74 24.3	42 52	3423
381	74 25.4	42 52	
382	74 26.4	42 52	3437
383	74 27.5	42 51	
384	74 28.7	42 51	3437
385	74 29.6	42 51	
386	74 30.6	42 51	3434
387	74 31.6	42 51	
388	74 32.7	42 51	3447
389	74 33.7*	42 51	(3450)
390	74 34.8	42 51	3450

Station No.	Latitude	Longitude	Elevation
391	74°35′8S	42°51′E	m
392	74 36.9	42 51	3457
393	74 37.9	42 51	
394	74 38.9	42 51	3461
395	74 39.9	42 51	
396	74 41.0	42 51	3475
397	74 42.0	42 51	
398	74 43.1	42 51	3480
399	74 44.2	42 51	
400	74 45.2	42 51	3478
401	74 46.2	42 51	
402	74 47.3	42 51	3483
403	74 48.3	42 51	
404	74 49.3	42 51	3483
405	74 50.4	42 51	
406	74 51.4	42 51	3495
407	74 52.5	42 51	
408	74 53.5	42 51	3500
409	74 54.5	42 51	
410	74 55.6	42 51	3499
411	74 56.6	42 51	
412	74 57.7	42 51	3505
413	74 58.7	42 50	
414	74 59.7*	42 50*	3519
415	75 00.7	42 49	
416	75 01.8	42 49	3513
417	75 02.8	42 48	
418	75 03.8	42 48	3514
419	75 04.9	42 47	
420	75 05.9	42 47	3529
421	75 06.9	42 46	
422	75 07.9	42 46	3526
423	75 08.9	42 46	
424	75 10.0	42 44	3537
425	75 11.0	42 44	
426	75 12.0	42 43	3543
427	75 13.1	42 43	
428	75 14.1	42 42	3546
429	75 15.1	42 42	
430	75 16.2	42 41	3547

Station No.	Latitude	Longitude	Elevation
431	75°17′2S	42°41′E	m
432	75 18.2	42 40	3548
433	75 19.3	42 39	
434	75 20.3	42 39	3544
435	75 21.3	42 38	
436	75 22.4	42 38	3548
437	75 23.4	42 38	
438	75 24.4	42 37	3549
439	75 25.4	42 36	
440	75 26.5	42 36	3556
441	75 27.5	42 35	
442	75 28.6	42 35	3555
443	75 29.6	42 35	
444	75 30.6	42 34	3556
445	75 31.7	42 34	
446	75 32.7	42 34	3559
447	75 33.7	42 33	
448	75 34.8	42 33	3569
449	75 35.8	42 33	
450	75 36.9	42 32	3584
451	75 37.9	42 31	
452	75 39.0	42 31	3591
453	75 40.0	42 30	
454	75 41.0	42 29	3594
455	75 42.0	42 29	
456	75 43.1	42 28	3591
457	75 44.1	42 28	
458	75 45.1	42 28	3594
459	75 46.2	42 28	
460	75 47.2	42 28	3604
461	75 48.2	42 28	
462	75 49.2	42 28	3612
463	75 50.3	42 27	
464	75 51.3	42 26	3613
465	75 52.3	42 26	
466	75 53.4	42 25	3614
467	75 54.4*	42 25*	(3616)
468	75 55.4	42 24	3616
469	75 56.4	42 24	
470	75 57.4	42 23	3613

Station No.	Latitude	Longitude	Elevation
471	75°58′4S	42°22′E	m
472	75 59.4	42 22	3617
473	76 00.5	42 21	
474	76 01.6	42 21	3622
475	76 02.6	42 20	
476	76 03.7	42 19	3624
477	76 04.7	42 19	
478	76 05.7	42 19	3629
479	76 06.7	42 18	
480	76 07.7	42 18	3635
481	76 08.8	42 17	
482	76 09.8	42 17	3639
483	76 10.8	42 16	
484	76 11.9	42 16	3642
485	76 12.9	42 16	
486	76 13.9	42 15	3632
487	76 14.9	42 14	
488	76 16.0	42 14	3637
489	76 17.0	42 14	
490	76 18.0	42 13	3642
491	76 19.0	42 13	
492	76 20.1	42 12	3640
493	76 21.1	42 11	
494	76 22.2	42 11	3645
495	76 23.1	42 10	
496	76 24.2	42 09	3646
497	76 25.2	42 09	
498	76 26.2	42 08	3652
499	76 27.3	42 08	
500	76 28.3	42 07	3652
501	76 29.4	42 07	
502	76 30.4	42 06	3648
503	76 31.4	42 05	
504	76 32.4	42 04	3653
505	76 33.4	42 04	
506	76 34.4	42 03	3655
507	76 35.4	42 02	
508	76 36.4	42 02	3672
509	76 37.4	42 01	
510	76 38.4	42 00	3672

Station No.	Latitude	Longitude	Elevation
511	76°39′5S	41°59′E	m
512	76 40.5	41 59	3675
513	76 41.5	41 58	
514	76 42.5	41 58	3673
515	76 43.5	41 57	
516	76 44.5	41 56	3674
517	76 45.6	41 56	
518	76 46.7*	41 55	3675
519	76 47.7	41 55	
520	76 48.7	41 55	3673
521	76 49.7	41 54	
522	76 50.8	41 54	3683
523	76 51.7	41 53	
524	76 52.8	41 52	3694
525	76 53.8	41 51	
526	76 54.9	41 51	3691
527	76 55.9	41 50	
528	76 56.9	41 49	3694
529	76 58.0	41 48	
530	76 59.0	41 48	3696
531	77 00.1	41 47	
532	77 01.1	41 46	3699
533	77 02.2	41 46	
534	77 03.2	41 45	3702
535	77 04.2	41 44	
536	77 05.2	41 44	3698
537	77 06.3	41 43	
538	77 07.4	41 42	3693
539	77 08.2	41 41	
540	77 09.3	41 41	3710
541	77 10.3	41 40	
542	77 11.3	41 39	3709
543	77 12.3*	41 38*	(3707)
544	77 13.3	41 38	3704
545	77 14.4	41 37	
546	77 15.4	41 36	3708
547	77 16.5	41 36	
548	77 17.5	41 35	3712
549	77 18.6	41 35	
550	77 19.7	41 34	3714

Station No.	Latitude	Longitude	Elevation
551	77°20′7S	41°33′E	m
552	77 21.8	41 33	3713
553	77 22.8	41 32	
554	77 23.8	41 32	3714
555	77 24.9	41 32	
556	77 26.0	41 32	3717
557	77 27.0	41 31	
558	77 28.1	41 31	3715
559	77 29.1	41 31	
560	77 30.2	41 30	3714
561	77 31.2	41 29	
562	77 32.2	41 28	3712
563	77 33.3	41 27	
564	77 34.4	41 27	3712
565	77 35.4	41 26	
566	77 36.5	41 25	3709
567	77 37.5	41 24	
568	77 38.5*	41 24	3711
569	77 39.5	41 22	
570	77 40.6	41 21	3710
571	77 41.6	41 20	
572	77 42.6	41 19	3708
573	77 43.6	41 18	
574	77 44.6	41 17	3707
575	77 45.6	41 17	
576	77 46.6	41 16	3702
577	77 47.6	41 16	
578	77 48.6	41 16	3704
579	77 49.7	41 15	
580	77 50.7	41 15	3705
581	77 51.7	41 15	
582	77 52.7	41 15	3704
583	77 53.7	41 14	
584	77 54.7	41 13	3702
585	77 55.7	41 13	
586	77 56.7	41 12	3698
587	77 57.7	41 12	
588	77 58.6	41 11	3693
589	77 59.6	41 11	
590	78 00.6	41 10	3694

Station No.	Latitude	Longitude	Elevation
591	78°01′6S	41°10′E	m
592	78 02.6	41 09	3685
593	78 03.6*	41 08*	(3684)
594	78 04.6	41 06	3683
595	78 05.6	41 05	
596	78 06.6	41 04	3681
597	78 07.6	41 03	
598	78 08.6	41 02	3682
599	78 09.6	41 01	
600	78 10.6	41 01	3679
601	78 11.5	41 00	
602	78 12.5	40 59	3677
603	78 13.5	40 59	
604	78 14.5	40 58	3679
605	78 15.5	40 57	
606	78 16.5	40 56	3674
607	78 17.6	40 55	
608	78 18.6	40 55	3670
609	78 19.6	40 54	
610	78 20.6	40 53	3670
611	78 21.6	40 53	
612	78 22.6	40 53	3668
613	78 23.6	40 52	
614	78 24.7	40 51	3667
615	78 25.7	40 51	
616	78 26.7	40 50	3665
617	78 27.8	40 50	
618	78 28.8	40 49	3662
619	78 29.9	40 49	
620	78 30.9	40 48	3659
621	78 31.0	40 48	
622	78 33.0	40 48	3653
623	78 34.1	40 48	
624	78 35.1	40 47	3650
625	78 36.1	40 47	
626	78 37.1	40 46	3649
627	78 38.0	40 45	
628	78 39.0*	40 44*	3650
629	78 40.0	40 44	
630	78 41.0	40 44	3654

Station No.	Latitude	Longitude	Elevation
631	78°42′1S	40°43′E	m
632	78 43.1	40 42	3648
633	78 44.1	40 41	
634	78 45.2	40 40	3647
635	78 46.2	40 40	
636	78 47.2	40 40	3647
637	78 48.2	40 40	
638	78 49.2	40 39	3639
639	78 50.3	40 39	
640	78 51.3	40 39	3629
641	78 52.3	40 39	
642	78 53.4	40 39	3628
643	78 54.4	40 38	
644	78 55.4	40 38	3622
645	78 56.4	40 38	
646	78 57.4	40 38	3613
647	78 58.4	40 37	
648	78 59.5	40 37	3617
649	79 00.5	40 36	
650	79 01.5	40 35	3619
651	79 02.5	40 35	
652	79 03.5	40 34	3616
653	79 04.6	40 34	
654	79 05.6	40 33	3618
655	79 06.7	40 33	
656	79 07.7	40 32	3613
657	79 08.7	40 32	
658	79 09.7	40 32	3609
659	79 10.8	40 32	
660	79 11.8	40 31	3613
661	79 12.8	40 31	
662	79 13.9	40 31	3618
Plateau St. (663)	79 14.8	40 30	3624
664	79 16.7	40 30	3619
665	79 18.6	40 31	3615
666	79 20.5	40 31	3621
667	79 22.5	40 32	3616
668	79 24.4	40 32	3614
669	79 26.3	40 32	3609

Station No.	Latitude	Longitude	Elevation
670	79°28′2S	40°33′E	5599 m
671	79 30.1	40 33	3603
672	79 32.0	40 33	3609
673	79 33.9	40 34	3604
674	79 35.8	40 34	3592
675	79 37.8	40 34	3584
676	79 39.7	40 35	3584
677	79 41.6	40 35	3583
678	79 44.0	40 36	3582
679	79 45.4*	40 36	3581
680	79 47.4	40 36	3579
681	79 49.3	40 37	3576
682	79 51.3	40 37	3574
683	79 53.3	40 38	3574
684	79 55.2	40 38	3569
685	79 57.2	40 38	3570
686	79 59.1	40 39	3568
687	80 01.1*	40 39*	3563
688	80 03.1	40 39	3562
689	80 05.1	40 39	3557
690	80 07.1	40 39	3559
691	80 09.0	40 39	3554
692	80 11.0	40 38	3558
693	80 13.0	40 38	3561
694	80 15.0	40 38	3564
695	80 17.0	40 38	3571
696	80 19.0	40 38	3553
697	80 21.0	40 38	3553
698	80 23.0	40 38	3539
699	80 24.9	40 38	3545
700	80 26.9	40 38	3545
701	80 28.9	40 38	3544
702	80 30.9	40 38	3538
703	80 32.9	40 37	3535
704	80 34.9	40 37	3530
705	80 36.9	40 37	3532
706	80 38.9	40 37	3526
707	80 40.8	40 37	3518
708	80 42.8	40 37	3517
709	80 44.8	40 37	3518

Station No.	Latitude	Longitude	Elevation
710	80°46′8S	40°37′E	3515 m
711	80 48.8	40 37	3505
712	80 50.8	40 36	3497
713	80 52.8	40 36	3487
714	80 54.7	40 36	3490
715	80 56.7	40 36	3488
716	80 58.7	40 36	3486
717	81 00.7*	40 36*	3481
718	81 02.7	40 36	3471
719	81 04.7	40 36	3467
720	81 06.7	40 36	3466
721	81 08.7	40 36	3467
722	81 10.7	40 36	3466
723	81 12.8	40 36	3468
724	81 14.8	40 36	3467
725	81 16.8	40 36	3461
726	81 18.8	40 36	3457
727	81 20.8	40 36	3460
728	81 22.8*	40 36	3459
729	81 24.8	40 36	3457
730	81 26.9	40 36	3463
731	81 28.9	40 36	3449
732	81 31.0	40 36	3446
733	81 33.0	40 36	3440
734	81 35.1	40 37	3436
735	81 37.1	40 37	3432
736	81 39.1	40 37	3429
737	81 41.2	40 37	3420
738	81 43.2	40 37	3416
739	81 45.3	40 37	3417
740	81 47.3*	40 37	3413
741	81 49.1	40 37	3406
742	81 51.0	40 37	3407
743	81 52.8	40 37	3401
744	81 54.6	40 37	3391
745	81 56.4	40 37	3394
746	81 58.3	40 37	3402
747	82 00.1*	40 37*	3407
748	82 02.1	40 37	3404
749	82 04.1	40 37	3411

Station No.	Latitude	Longitude	Elevation
750	82°06′1S	40°36′E	3412 m
751	82 08.1	40 36	3402
752	82 10.1	40 36	3399
753	82 12.1	40 36	3402
754	82 14.0	40 36	3404
755	82 16.0	40 35	3407
756	82 18.0	40 35	3405
757	82 20.0	40 35	3404
758	82 22.0	40 35	3399
759	82 24.0*	40 35	3402
760	82 26.0	40 34	3397
761	82 28.0	40 34	3399
762	82 30.1	40 34	3392
763	82 32.1	40 34	3391
764	82 34.1	40 34	3384
765	82 36.1	40 33	3369
766	82 38.2	40 33	3371
767	82 40.2	40 33	3379
768	82 42.2	40 33	3373
769	82 44.2	40 33	3372
770	82 46.2*	40 32	3374
771	82 48.3	40 32	3370
772	82 50.3	40 32	3370
773	82 52.3	40 32	3372
774	82 54.3	40 32	3368
775	82 56.4	40 31	3368
776	82 58.4	40 31	3368
777	83 00.4*	40 31*	3362
778	83 02.5	40 31	3353
779	83 04.5	40 31	3362
780	83 06.6	40 32	3363
781	83 08.7	40 32	3361
782	83 10.7	40 32	3356
783	83 12.8	40 32	3353
784	83 14.9	40 32	3351
785	83 16.9	40 33	3349
786	83 19.0	40 33	3352
787	83 21.1	40 33	3348
788	83 23.1	40 33	3343
789	83 25.2*	40 33	3337

Station No.	Latitude	Longitude	Elevation
790	83°27′3S	40°34′E	3317 m
791	83 29.3	40 34	3313
792	83 31.4	40 34	3312
793	83 33.4	40 34	3307
794	83 35.5	40 34	3306
795	83 37.5	40 35	3300
796	83 39.6	40 35	3299
797	83 41.6	40 35	3299
798	83 43.7	40 35	3298
799	83 45.7	40 35	3292
800	83 47.8	40 36	3298
801	83 49.8*	40 36	3296
802	83 51.8	40 36	3290
803	83 53.9	40 36	3288
804	83 55.9	40 36	3294
805	83 57.9	40 37	3298
806	84 00.0	40 37	3298
807	84 02.0*	40 37*	3291
808	84 04.0	40 37	3291
809	84 06.1	40 37	3292
810	84 08.2	40 36	3288
811	84 10.2	40 36	3290
812	84 12.2	40 36	3290
813	84 14.3	40 36	3282
814	84 16.4	40 36	3276
815	84 18.4	40 35	3271
816	84 20.4	40 35	3271
817	84 22.5	40 35	3263
818	84 24.6	40 35	3260
819	84 26.6*	40 35	3257
820	84 28.6	40 34	3257
821	84 30.7	40 34	3253
822	84 32.8	40 34	3249
823	84 34.8	40 34	3248
824	84 36.8	40 34	3245
825	84 38.9	40 33	3249
826	84 41.0	40 33	3254
827	84 43.0	40 33	3257
828	84 45.0	40 33	3253
829	84 47.1	40 33	3248
830	84°49′2S	40°32′E	3237 m
831	84 51.2*	40 32	3234
832	84 53.2	40 32	3220
833	84 55.2	40 32	3207
834	84 57.2	40 32	3197
835	84 59.3	40 31	3191
836	85 01.3	40 31	3194
837	85 03.3*	40 31*	3194
838	85 05.3	40 30	3197
839	85 07.4	40 29	3195
840	85 09.4	40 28	3191
841	85 11.4	40 27	3187
842	85 13.4	40 26	3190
843	85 15.5	40 25	3189
844	85 17.5	40 24	3188
845	85 19.5	40 23	3188
846	85 21.5	40 22	3188
847	85 23.6	40 21	3186
848	85 25.6*	40 20	3184
849	85 27.7	40 19	3180
850	85 29.8	40 18	3169
851	85 31.9	40 17	3166
852	85 34.0	40 16	3163
853	85 36.1	40 15	3157
854	85 38.2	40 13	3155
855	85 40.4	40 12	3154
856	85 42.5	40 11	3154
857	85 44.6	40 10	3152
858	85 46.7	40 09	3146
859	85 48.8	40 08	3147
860	85 50.9*	40 07	3148
861	85 52.9*	40 06	3147
862	85 54.9	40 05	3142
863	85 56.9	40 04	3137
864	85 59.0	40 03	3135
865	86 01.0	40 02	3132
866	86 03.0	40 01	3122
867	86 05.0*	40 00*	3116
868	86 07.1	39 59	3107
869	86 09.2	39 58	3105

Station No.	Latitude	Longitude	Elevation
870	86°11′3S	39°58′E	3102 m
871	86 13.4	39 57	3109
872	86 15.5	39 56	3107
873	86 17.5	39 55	3103
874	86 19.6	39 55	3090
875	86 21.7	39 54	3080
876	86 23.8	39 53	3076
877	86 25.9	39 52	3079
878	86 28.0*	39 52	3079
879	86 30.1	39 52	3072
880	86 32.3	39 50	3065
881	86 34.4	39 49	3064
882	86 36.6	39 48	3058
883	86 38.7	39 48	3044
884	86 40.8	39 47	3033
885	86 43.0	39 46	3030
886	86 45.1	39 45	3028
887	86 47.2	39 45	3027
888	86 49.4	39 44	3016
889	86 51.5	39 43	3005
890	86 53.7	39 42	2995
891	86 55.8*	39 42	2994
892	86 57.9	39 41	2980
893	87 00.0	39 40	2981
894	87 02.1	39 39	2974
895	87 04.2	39 38	2955
896	87 06.3	39 38	2952
897	87 08.4*	39 37*	2945
898	87 10.4	39 40	2945
899	87 12.3	39 42	2946
900	87 14.3	39 45	2953
901	87 16.3	39 47	2946
902	87 18.3	39 50	2933
903	87 20.2	39 52	2933
904	87 22.2	39 55	2944
905	87 24.2	39 57	2939
906	87 26.2	40 00	2944
907	87 28.1	40 02	2945
908	87 30.1*	40 05	2942
909	87 32.1	40 07	2938
910	87°34′2S	40°10′E	2916 m
911	87 36.2	40 12	2909
912	87 38.2	40 15	2920
913	87 40.3	40 17	2932
914	87 42.3	40 20	2926
915	87 44.3	40 23	2910
916	87 46.4	40 25	2904
917	87 48.4	40 28	2901
918	87 50.4	40 30	2897
919	87 52.5	40 33	2899
920	87 54.5*	40 35	2913
921	87 56.5	40 38	2906
922	87 58.5	40 40	2894
923	88 00.5	40 43	2873
924	88 02.4	40 45	2866
925	88 04.4	40 48	2859
926	88 06.4	40 51	2855
927	88 08.4*	40 53*	2859
928	88 10.4	40 54	2859
929	88 12.5	40 54	2868
930	88 14.5	40 54	2857
931	88 16.5	40 55	2859
932	88 18.6	40 56	2867
933	88 20.6	40 56	2874
934	88 22.7	40 56	2863
935	88 24.7	40 57	2856
936	88 26.7	40 58	2841
937	88 28.8	40 58	2814
938	88 30.8*	40 58	2819
939	88 32.8	40 59	2815
940	88 34.8	41 00	2807
941	88 36.8	41 00	2818
942	88 38.8	41 00	2820
943	88 40.8	41 01	2827
944	88 42.8	41 02	2829
945	88 44.9	41 02	2832
946	88 46.9	41 02	2823
947	88 48.9	41 03	2807
948	88 50.9	41 04	2807
949	88 52.9	41 04	2810

Station No.	Latitude	Longitude	Elevation
950	88°54′9S*	41°04′E	2867 m
951	88 56.9	41 05	2791
952	88 58.9	41 06	2792
953	89 00.9	41 06	2792
954	89 02.8	41 06	2802
955	89 04.8	41 07	2811
956	89 06.8	41 08	2811
957	89 08.8*	41 08*	2816
958	89 10.8	41 12	2823
959	89 12.8	41 15	2832
960	89 14.8	41 19	2818
961	89 16.8	41 23	2818
962	89 18.8*	41 26	2823
963	89 20.8	41 30	2813
964	89 22.9	41 34	2810
965	89 24.9	41 37	2818
966	89 27.0	41 41	2823
967	89°29′0S	41°45′E	2831 m
968	89 31.1	41 48	2814
969	89 33.1	41 52	2813
970	89 35.2	41 56	2819
971	89 37.2	41 59	2826
972	89 39.3	42 03	2819
973	89 41.3	42 07	2809
974	89 43.4	42 10	2811
975	89 45.4*	42 14*	2801
976	89 47.4	42 15	2806
977	89 49.4	42 15	2803
978	89 51.4	42 15	2796
979	89 53.4	42 15	2799
980	89 55.4	42 15	2804
981	89 57.4	42 15	2807
South Pole (982)	89 59.9		2800

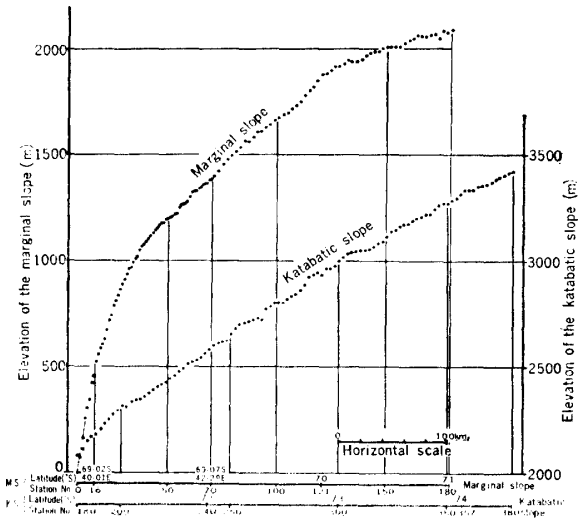

Fig. 1a. Elevation of the ice surfaces in the marginal slope and katabatic slope divisions.

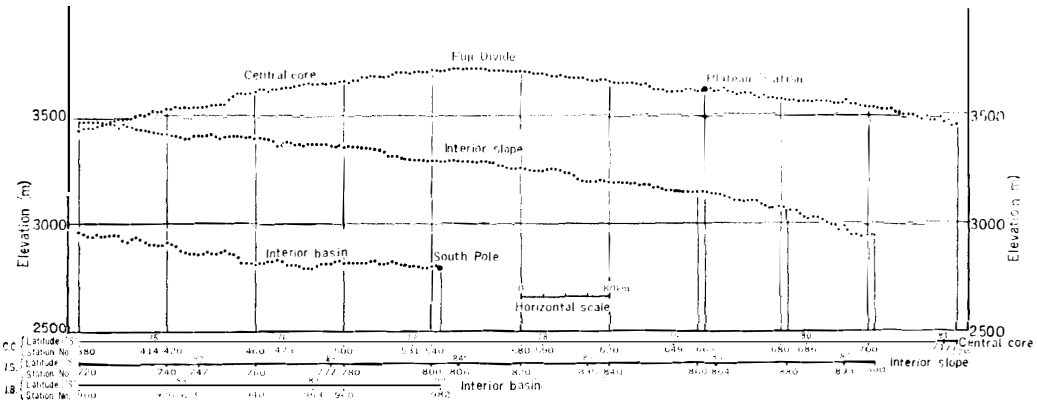

Fig. 1b. Elevation of the ice surfaces in the central core, interior slope and interior basin divisions.

4. Ice Surface Topography

The eastern part of the Queen Maud Land along the meridian of 40°E was covered almost completely by the surveying courses of the U.S.S.R., U.S.A., and Japanese traverse parties. Contour lines shown in Fig. 2 were drawn based on the elevation measured by these traverse parties and, in addition, with reference to topographic investigations, including observations on sastrugi, by the Japanese traverse. Ice surface profile along the Japanese traverse course from Syowa Station to the South Pole as a whole resembles closely that along the U.S.S.R. traverse course from Mirny to the South Pole. The highest point is located at the Fuji Divide (tentative) (77°26′S, St. 556). With the divide as the border, ice surface of the northern side and the southern side of the divide presents asymmetrical profile, as shown in Fig. 2. Ice surface topography of the surveyed area is divided into five areas as follows, seen from a broad view-point.

Topographic divisions	Position of boundary	Elevation (m)
Marginal slope	Prince Olav Coast (St. 0)	0
	17°S (St. 182)	2,113
Katabatic slope	74°25′S (St. 380)	3,423
Central core	81°S (St. 717)	3,481
Interior slope	87°S (St. 893)	2,981
Interior basin	90°S (St. 982)	2,800

The marginal slope is a fairly steep slope and is found in the edge of the Antarctic ice sheet (FUJIWARA, 1964). In the surface of the marginal slope,

there are clear domes and troughs which seem to be the reflection of the subglacial relief. Crevassed zones are also scattered there. The southern border of this division was formed from a subglacial valley which seems to extend from the Shirase Glacier to the Lambert Glacier.

The katabatic slope presents a stairs-like surface topography which consists of fairly steep slopes with relative height of 50–100 m and flats or shallow troughs. The mean gradient of the slope is about 1/250. In this area, there are many low slopes which extend east and west, but a few interminated rise in the shape of an independent dome, often seen in the marginal slope. Conditions of snow surface are characterized by katabatic wind blowing down along the stairs-like slope. That is, snow surface of ice rises presents a hard and glazed feature, and in the troughs in which drifting snow accumulates, sastrugi of various sizes are developed.

Ice sheet ascends continuously with fairly steep gradient to the latitude of 74°25′S, at which the surface elevation is about 3,400 m. Near this latitude,

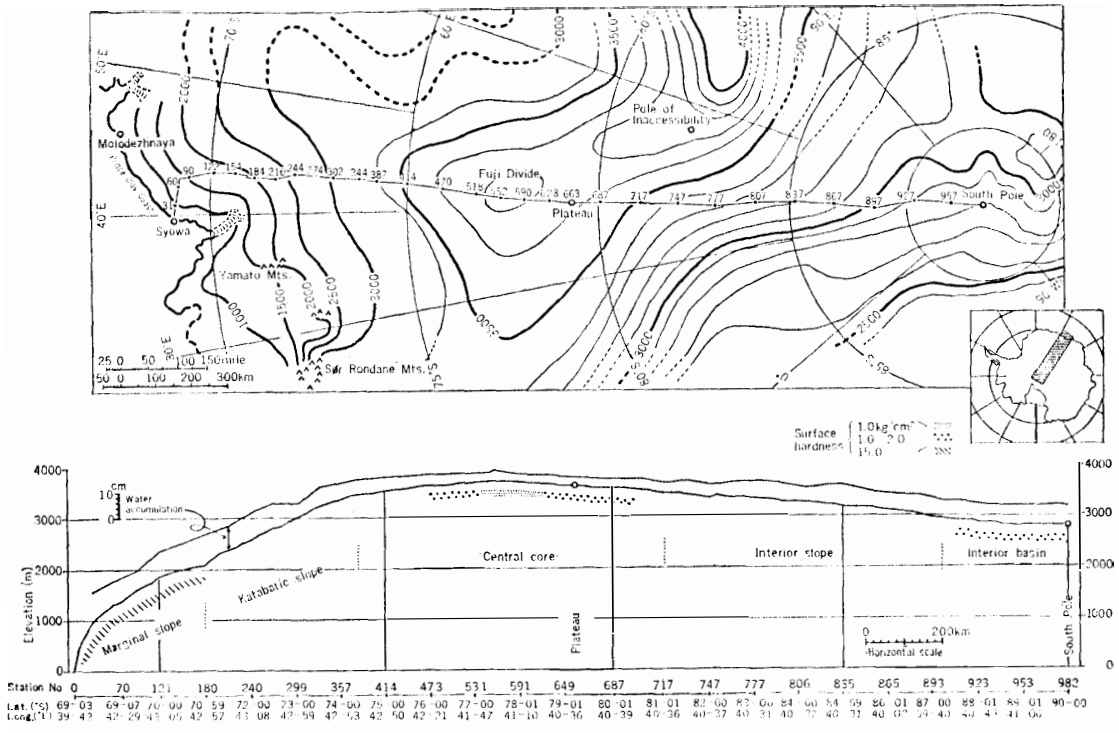

Fig. 2. Ice surface topography and mean annual water accumulation along the traverse route from Syowa Station to the South Pole. Upper: Topography from ice elevation data obtained by the JARE South Pole Traverse, the Soviet Vostok-Molodezhnaya and Molodezhnaya-Novolazarevskaya Traverses and the U.S.A. Queen Maud Land Traverses. Lower: Profile of ice surface and mean annual water accumulation measured from pit stratigraphy.

a gradient of the ice sheet slope suddenly becomes gentle, and thereafter an extremely gentle slope extends to the Fuji Divide, without a conspicuous relief. The mean gradient between 74°25'S and the Fuji Divide is less than 1/1000. The surface topography of the area between the Fuji Divide and 81°S resembles that of the area between the divide and 74°25'S. The area of broad ice plateau between 74°25'S and 81°S was named the central core. As shown in Fig. 2, the central core is the East Antarctic Ice Divide which extends from the Pole of Relative Inaccessibility to NNE. It is presumed by the U.S.S.R. party that under the ice of the central core, there is the Bernadsky Mountains whose elevation is in the range of 1,000–1,500 m, and its extension to the north continues through the Yamato Mountains to the far-off Riiser-Larsen Peninsula and the Gunnerus Bank (KAPITZA, 1967). However, the Japanese traverse party was not able to obtain data to substantiate the deduction made by the U.S.S.R. party. Along the U.S.S.R. traverse route from the Molodezhnaya to the Pole of Relative Inaccessibility, conspicuous subglacial mountains are also not found (KOGAN, 1968). Therefore, the inference on the continuation of subglacial mountains from the Bernadsky Mountains to the Gunnerus Bank requires a thorough examination and revision in the near future.

The interior slope, which extends from 81°S to 87°S, lies on the southwest slope of the East Antarctic Ice Divide. Actual gradient of the interior slope is fairly steep than that shown in profile of Fig. 1b, because the Japanese traverse party descended the slope obliquely. The mean gradient of the interior slope comes to about 1/460 according to the estimation on the basis of a contour map made out by the U.S. party (BEITZEL, 1967). In this area, there are low undulations which meet at right angle to the slope direction. That is, the undulations extend to the NW-SE direction near 82°S and to the NNW-SSE direction south of 83°S. Most of the wave height of undulations is within the range of 10–20 m, but some of them comes to 30–40 m. The wave length is just 5–10 km.

Roughly speaking, the interior basin which extends from 87°S to the South Pole, is bordered by the East Antarctic Ice Divide and the Trans-Antarctic Range, and belongs to a part of the Antarctic Basin. Ice surface of the interior basin presents conspicuous undulations with a relative height of 30–40 m, but a clear regularity on the form and direction of undulations, which is to be seen in the area of the interior slope, is not observed there. Such an undulation topography develops in the area between the South Pole and the Horlick Mountains, where relationships of surface topography to bed topography were fully investigated by ROBINSON (1966). The areal difference between the interior basin and the interior slope, concerning surface condition of snow such as microrelief form and snow hardness, is more clear than that concerning surface topography (see Figs. 3, 4, and 5 in "Preliminary Report of Glaciological Studies") (FUJIWARA *et al.*, 1971)

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