

VALUES OF GRAVITY ON
THE INLAND ICE IN NORTH GREENLAND

BY

C. B. B. BULL

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Introduction.

The scientific work of the British North Greenland Expedition (1952—1954) included the accurate determination of the altitude and the value of gravity at approximately three hundred points on the inland ice. These points lay between latitudes $76^{\circ}40'$ N. and $78^{\circ}10'$ N. on a line stretching from Dronning Louise Land in the east to the Nunatarssuaq region, at the head of Wolstenholme Fjord, on the west coast.

A list of the altitudes and positions of these points has already been published in this journal (1). The purpose of this paper is to record the values of gravity at these points, together with the values of the free-air anomaly (calculated from these gravity values, the altitudes and the theoretical values given by the International Gravity Formula¹) for the variation of gravity with latitude). Since the co-ordinates and altitudes of the stations have already been recorded, the stations are referred to by their station numbers only.

Gravity Measurements.

A full description of the methods employed in measuring gravity in North Greenland will be given elsewhere. A linkage was made in August 1952 between the existing gravity station at Reykjavik, Iceland, and Zackenberg, Young Sund, East Greenland ($74^{\circ}27.8'$ N., $20^{\circ}39.3'$ W.), by J. Martin of Expéditions Polaires Françaises (2). From Zackenberg five gravity linkages were made to the Expedition's Base on the northern side of Britannia Sø, in Dronning Louise Land, using a North American Gravimeter. During 1953 the survey was carried to station B 73. Gravimeter readings were taken at stations on the outward and return journeys. The difference between the two readings at each station permits the drift rate of the instrument to be determined. The standard error in the

¹) Theoretical value of gravity on the international ellipsoid, $\gamma_0 = 978.0490 (1 + 0.0052884 \sin^2 \varnothing - 0.0000059 \sin^2 2 \varnothing)$ cm/sec², where \varnothing is the latitude.

determination of values of gravity at these stations is about 1 milligal¹⁾ In the summer of 1954 the survey was continued to the edge of the inland ice in Nunatarssuaq. It was not possible to return along the same route to check these second year values, but the survey was terminated at a point which has been adequately linked with the gravity station at the former Thule (3 and 4). The difference between the value given below and that previously determined is 3 milligals. The accuracy of the previous measurement is not yet known. However, it is reasonable to assume, from the magnitude of this closure error, that the standard error of the values of station gravity given below for stations A 101 to A 172 is less than 5 milligals.

(The values of gravity given below are based on the value 982.2724 cm/sec² for Skolavarda, Reykjavik, which in turn is based on the value 980.9430 cm/sec² for Paris Observatory (Piliers de l'ancienne salle de pesanteur)).

The value of gravity at A 172 (Nuna Takeoff) determined by Barnes is 982.8274 cm/sec², based on the value 982.9401 cm/sec² at the former Thule (old Weather Bureau building, 76°33' N., 68°47' W.). (The value at the former Thule is based on the value 980.0996 cm/sec² at Carnegie Institute Geophysical Laboratory in Washington).

A detailed treatment has been given of the accuracy of the altitudes of these stations (5). The standard error of the absolute altitudes is 10 metres, though the height differences between adjacent stations are correct to the nearest metre. This standard error of 10 metres represents an error in the free-air correction of 3 milligals. Compounded with the estimated standard error in the values of station gravity, this produces a standard error of approximately 6 milligals in the free-air anomaly, though it must be emphasised that the differences between values at adjacent stations is probably correct to 1 milligal.

The latitudes of the gravity station have been determined with an accuracy of 0.1 minute, and no errors are introduced into the free-air anomaly from this source.

References.

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3. Woods Hole Oceanographic Institution. Publication reference No. 53—36, Appendix, p. 11, 1953.
4. BARNES, D. F., & ZAVADIL, R. J.: Gravity studies on the Greenland Ice Cap. U. S. Department of Army. 1954.
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¹⁾ 1 milligal = 0.001 cm/sec².

**Values of station gravity, γ_0 , free-air correction
and free-air anomaly.**

Station	Station gravity (cm/sec ²)	γ_0 (cm/sec ²)	Free-air correction (cm/sec ²)	Free-air anomaly (cm/sec ²)
A 80	982.579	982.969	0.325	— 0.065
B 79	.579	.969	.325	— .065
A 79	.558	.968	.356	— .055
B 78	.551	.968	.372	— .045
A 78	.548	.968	.376	— .044
B 77	.533	.967	.392	— .042
A 77	.529	.967	.395	— .043
B 76	.526	.967	.400	— .041
A 76	.525	.967	.410	— .032
B 75	.525	.967	.414	— .028
A 75	.538	.966	.418	— 0.010
B 74	.553	.966	.421	+ 0.007
A 74	.573	.966	.431	+ .038
B 0	.598	.966	.441	+ .074
A 1	.572	.966	.462	+ .069
B 1	.570	.966	.464	+ .068
A 2	.536	.966	.485	+ .055
B 2	.529	.966	.486	+ .049
A 3	.506	.966	.485	+ .025
B 3	.498	.967	.485	+ .016
A 4	.498	.967	.484	+ .014
B 4	.498	.968	.489	+ .020
A 5	.494	.968	.494	+ .021
B 5	.477	.969	.501	+ .009
A 6	.475	.969	.504	+ .009
B 6	.473	.970	.505	+ .008
A 7	.467	.970	.505	+ .004
B 7	.468	.970	.506	+ .004
A 8	.462	.970	.515	+ 0.006
B 8	.446	.970	.519	— 0.006
A 9	.445	.971	.520	— 0.005
B 9	.457	.971	.529	+ 0.015
A 10	.457	.972	.530	+ .015
B 10	.446	.972	.540	+ .014
A 11	.441	.973	.547	+ .015
B 11	.458	.975	.554	+ .038
A 12	.448	.975	.559	+ .032
B 12	.437	.975	.563	+ .025
A 13	.433	.975	.566	+ .024
B 13	.430	.976	.567	+ .022
A 14	.438	.977	.559	+ .021
B 14	.428	.976	.568	+ .019
A 15	.426	.977	.568	+ .017

Station	Station gravity (cm/sec ²)	γ_0 (cm/sec ²)	Free-air correction (cm/sec ²)	Free-air anomaly (cm/sec ²)
B 15	982.418	982.977	0.569	+ 0.009
A 16	.407	.977	.574	+ 0.003
B 16	.403	.977	.573	- 0.002
A 17	.402	.977	.572	- .004
B 17	.401	.978	.572	- .005
A 18	.400	.978	.575	- 0.003
B 18	.408	.978	.575	+ 0.005
A 19	.408	.978	.579	+ .009
B 19	.409	.978	.583	+ .014
A 20	.417	.978	.596	+ .035
B 20	.413	.978	.598	+ .033
A 21	.413	.978	.597	+ .032
B 21	.416	.979	.594	+ .032
A 22	.415	.979	.593	+ .029
B 22	.414	.979	.593	+ .028
A 23	.401	.979	.607	+ .029
B 23	.398	.980	.609	+ .027
A 24	.399	.980	.610	+ .029
B 24	.399	.981	.613	+ .031
A 25	.388	.981	.622	+ .029
B 25	.385	.981	.623	+ .026
A 26	.381	.981	.624	+ .023
B 26	.377	.982	.628	+ .023
A 27	.376	.982	.628	+ .023
B 27	.373	.982	.631	+ .022
A 28	.372	.983	.634	+ .023
B 28	.369	.983	.636	+ .022
A 29	.365	.983	.639	+ .021
B 29	.357	.983	.643	+ .017
A 30	.352	.983	.645	+ .014
B 30	.352	.984	.646	+ .014
A 31	.350	.984	.647	+ .013
B 31	.346	.985	.651	+ .013
A 32	.343	.985	.652	+ .010
B 32	.338	.985	.654	+ .007
A 33	.330	.986	.656	0.000
B 33	.328	.986	.657	- 0.001
A 34	.326	.987	.658	- .002
B 34	.326	.987	.656	- .006
A 35	.321	.988	.660	- .007
B 35	.314	.988	.665	- .010
A 36	.310	.988	.666	- .013
B 36	.306	.989	.665	- .018
A 37	.301	.989	.668	- .020
B 37	.297	.989	.669	- .024
A 38	.294	.990	.667	- .029

Station	Station gravity (cm/sec ²)	γ_0 (cm/sec ²)	Free-air correction (cm/sec ²)	Free-air anomaly (cm/sec ²)
B 38	982.293	982.990	0.670	— 0.028
A 39	.285	.991	.678	— .027
B 39	.281	.991	.680	— .031
A 40	.277	.992	.678	— .037
B 40	.274	.992	.680	— .038
A 41	.276	.992	.679	— .038
B 41	.278	.993	.683	— .031
A 42	.276	.993	.688	— .029
B 42	.276	.993	.690	— .027
A 43	.272	.994	.694	— .028
B 43	.271	.994	.695	— .028
A 44	.272	.995	.696	— .027
B 44	.270	.995	.698	— .027
A 45	.267	.996	.700	— .029
B 45	.266	.996	.700	— .030
A 46	.263	.997	.702	— .031
B 46	.262	.997	.704	— .031
A 47	.257	.997	.706	— .035
B 47	.253	.998	.706	— .039
A 48	.251	.999	.707	— .041
B 48	.250	.999	.710	— .039
A 49	.250	.999	.711	— .039
B 49	.248	982.999	.714	— .038
A 50	.246	983.000	.716	— .038
B 50	.245	983.000	.719	— .037
A 51	.240	982.999	.724	— .036
B 51	.237	983.000	.725	— .038
A 52	.234	982.999	.727	— .038
B 52	.234	.999	.730	— .036
A 53	.233	.999	.733	— .034
B 53	.231	.999	.735	— .034
A 54	.228	.999	.738	— .034
B 54	.227	.999	.740	— .032
A 55	.222	.999	.743	— .034
B 55	.219	.999	.745	— .035
A 56	.218	.999	.747	— .034
B 56	.219	.999	.748	— .032
A 57	.219	.999	.750	— .031
B 57	.217	.999	.752	— .030
A 58	.216	.999	.754	— .030
B 58	.215	.999	.755	— .029
A 59	.212	.999	.759	— .029
B 59	.210	.999	.759	— .030
A 60	.211	.999	.760	— .028
B 60	.211	.999	.762	— .026
A 61	.212	.999	.764	— .023

Station	Station gravity (cm/sec ²)	% (cm/sec ²)	Free-air correction (cm/sec ²)	Free-air anomaly (cm/sec ²)
B 61	982.211	982.999	0.766	— 0.022
A 62	.209	.999	.768	— .022
B 62	.207	.999	.770	— .021
A 63	.207	.998	.771	— .020
B 63	.206	.998	.772	— .020
A 64	.205	.998	.774	— .020
B 64	.204	.998	.775	— .019
A 65	.203	.998	.777	— .019
B 65	.203	.998	.778	— .018
A 66	.206	.998	.778	— .014
B 66	.207	.998	.779	— .013
A 67	.206	.998	.780	— .013
B 67	.205	.998	.781	— .013
A 68	.204	.998	.781	— .013
B 68	.202	.998	.781	— .015
A 69	.198	.998	.781	— .019
B 69	.197	.998	.781	— .020
A 70	.197	.998	.780	— .021
B 70	.200	.998	.780	— .018
A 71	.207	.998	.780	— .011
B 71	.209	.998	.779	— .010
A 72	.206	.998	.778	— .015
B 72	.202	.998	.777	— .019
A 73	.200	.998	.777	— .022
B 73	.198	.997	.776	— .023
A 101	.196	.997	.777	— .024
B 101	.194	.996	.777	— .025
A 102	.192	.995	.777	— .027
B 102	.191	.994	.776	— .027
A 103	.190	.993	.776	— .028
B 103	.193	.992	.776	— .024
A 104	.189	.991	.777	— .025
B 104	.184	.990	.777	— .030
A 105	.180	.989	.777	— .031
B 105	.180	.988	.777	— .031
A 106	.178	.987	.778	— .031
B 106	.178	.986	.779	— .030
A 107		.985	.780	
B 107		.984	.779	
A 108	.177	.983	.780	— .029
B 108	.175	.982	.780	— .028
A 109	.173	.982	.781	— .028
B 109	.173	.981	.781	— .027
A 110	.173	.980	.779	— .028
B 110	.168	.979	.782	— .029
A 111	.176	.978	.779	— .023

Station	Station gravity (cm/sec ²)	γ_0 (cm/sec ²)	Free-air correction (cm/sec ²)	Free-air anomaly (cm/sec ²)
B 111	982.178	982.977	0.780	— 0.019
A 112	.179	.976	.780	— .017
B 112	.176	.974	.781	— .017
A 113	.177	.973	.780	— .016
B 113	.180	.972	.778	— .014
A 114	.180	.971	.777	— .013
B 114	.181	.972	.776	— .011
A 115	.191	.972	.773	— .009
B 115	.198	.974	.770	— .005
A 116	.203	.975	.767	— .005
B 116	.205	.976	.765	— .006
A 117	.208	.978	.762	— .008
B 117	.210	.979	.759	— .010
A 118	.213	.981	.756	— .011
B 118	.218	.982	.753	— .011
A 119	.220	.984	.751	— .013
B 119	.224	.985	.748	— .013
A 120	.229	.986	.745	— .013
B 120	.234	.988	.741	— .012
A 121	.246	.989	.737	— 0.006
B 121	.256	.990	.734	+ 0.001
A 122	.267	.990	.731	+ .007
B 122	.274	.991	.726	+ .008
A 123	.278	.992	.722	+ .008
B 123	.280	.993	.718	+ .005
A 124	.286	.994	.715	+ .007
B 124	.296	.994	.711	+ .013
A 125	.304	.995	.708	+ .017
B 125	.316	.995	.704	+ .025
A 126	.321	.996	.701	+ .026
B 126	.322	.997	.698	+ .024
A 127	.328	.997	.694	+ .025
B 127	.325	.998	.692	+ .019
A 128	.327	.998	.689	+ .018
B 128	.329	.999	.683	+ .013
A 129	.330	982.999	.680	+ .010
B 129	.332	983.000	.676	+ .008
A 130	.337	.000	.673	+ .009
B 130	.348	.001	.669	+ .016
A 131	.350	.001	.666	+ .015
B 131	.353	.002	.662	+ .013
A 132	.359	.002	.658	+ .014
B 132	.368	.003	.655	+ .020
A 133	.376	.003	.652	+ .025
B 133	.381	.002	.651	+ .030
A 134	.383	.001	.650	+ .032

Station	Station gravity (cm/sec ²)	% (cm/sec ²)	Free-air correction (cm/sec ²)	Free-air anomaly (cm/sec ²)
B 134	982.379	983.001	0.649	+ 0.027
A 135	.375	.000	.649	+ .024
B 135	.376	982.999	.648	+ .025
A 136	.383	.998	.647	+ .032
B 136	.392	.998	.646	+ .041
A 137	.405	.997	.646	+ .054
B 137	.415	.996	.645	+ .063
A 138	.419	.996	.644	+ .068
B 138	.423	.995	.644	+ .072
A 139	.432	.995	.643	+ .080
B 139	.427	.994	.642	+ .075
A 140	.424	.993	.641	+ .072
B 140	.424	.992	.642	+ .073
A 141	.419	.991	.642	+ .070
B 141		.990	.642	
A 142	.415	.989	.641	+ .068
B 142	.411	.988	.640	+ .063
A 143	.399	.986	.637	+ .049
B 143	.388	.985	.635	+ .038
A 144	.387	.984	.633	+ .035
B 144	.382	.983	.630	+ .029
A 145	.389	.982	.626	+ .033
B 145	.396	.980	.620	+ .036
A 146	.397	.979	.615	+ .033
B 146	.395	.978	.610	+ .026
A 147	.393	.977	.604	+ .020
B 147	.398	.976	.601	+ .023
A 148	.409	.976	.595	+ .028
B 148	.428	.975	.586	+ .040
A 149	.439	.974	.578	+ 0.43
B 149	.446	.973	.572	+ .045
A 150	.452	.972	.564	+ .043
B 150	.458	.972	.559	+ .045
A 151	.466	.971	.550	+ .045
B 151	.472	.970	.546	+ .048
A 152	.480	.968	.540	+ .051
B 152	.484	.968	.538	+ .054
A 153	.495	.967	.529	+ .057
B 153	.501	.966	.524	+ .060
A 154		.965	.517	
B 154		.964	.510	
A 155		.963	.507	
B 155		.962	.502	
A 156	.532	.960	.494	+ .066
B 156	.533	.959	.487	+ .061
A 157	.533	.958	.484	+ .058

Station	Station gravity (cm/sec ²)	γ_0 (cm/sec ²)	Free-air correction (cm/sec ²)	Free-air anomaly (cm/sec ²)
B 157	982.541	982.957	0.478	+ 0.062
A 158	.542	.957	.476	+ .061
B 158	.545	.956	.475	+ .064
A 159	.550	.956	.473	+ .068
B 159	.562	.954	.467	+ .075
A 160	.570	.954	.465	+ .081
B 160	.575	.953	.460	+ .082
A 161	.573	.953	.457	+ .077
B 161	.577	.952	.449	+ .074
A 162	.585	.951	.446	+ .080
B 162	.588	.950	.446	+ .084
A 163	.595	.949	.441	+ .086
B 163		.948	.428	
A 164	.615	.948	.418	+ .085
B 164	.624	.947	.412	+ .088
A 165	.623	.948	.420	+ .095
B 165	.606	.948	.435	+ .093
A 166	.605	.948	.438	+ .092
B 166		.948	.437	
B 167	.641	.949	.411	+ .102
B 167	.658	.949	.384	+ .093
A 168	.678	.949	.376	+ .105
B 168	.674	.949	.359	+ .084
A 169	.678	.949	.356	+ .084
B 169	.705	.949	.336	+ .092
A 170	.728	.949	.321	+ .099
B 170	.757	.949	.306	+ .115
A 171		.949	.298	
B 171	.812	.950	.252	+ .114
A 172	.824			

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