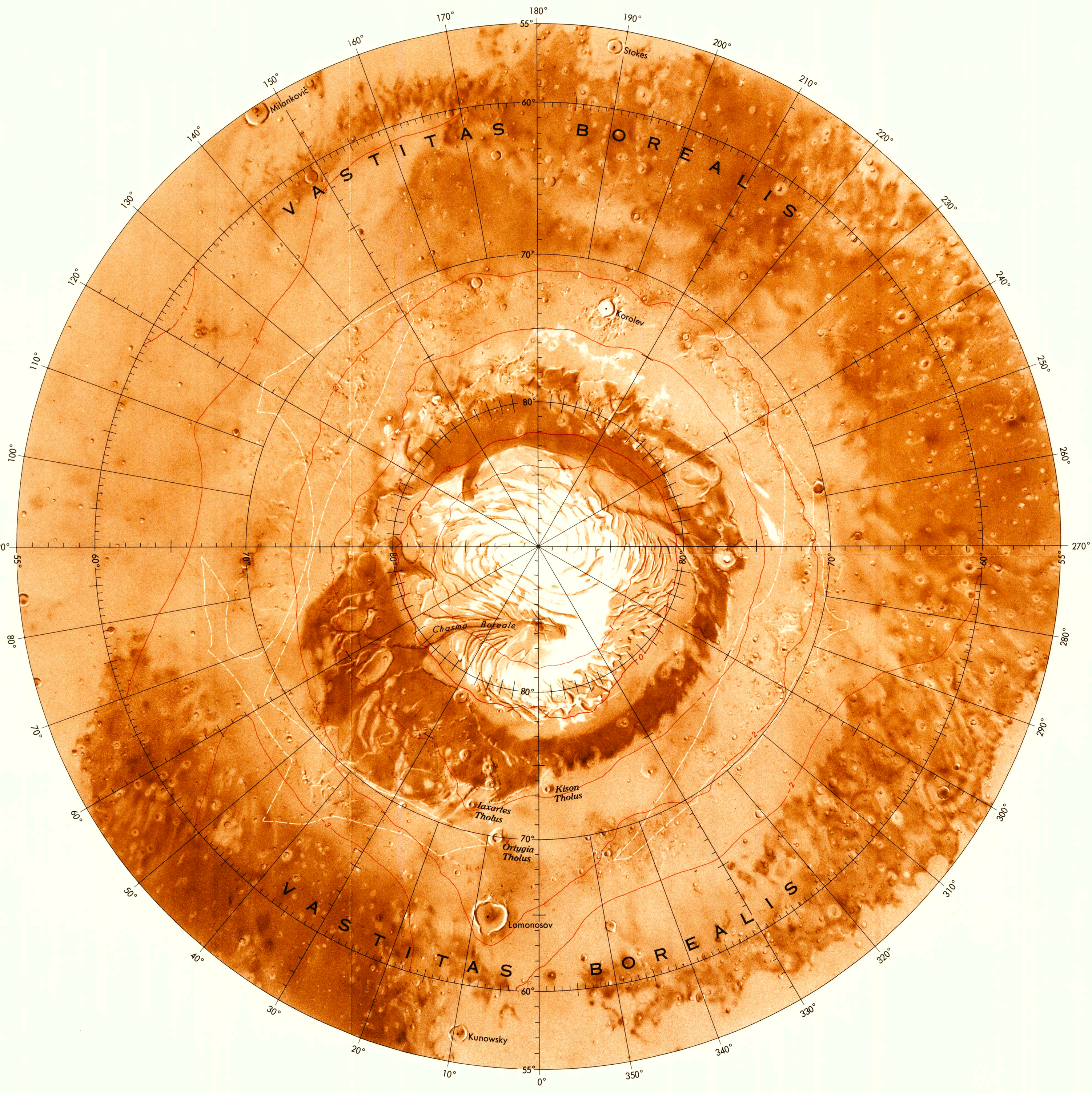
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared for the
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ATLAS OF MARS
1:25,000,000 TOPOGRAPHIC SERIES
M 25M 3 RMC, 1976
I-961



NORTH POLAR REGION

Polar cap as it appeared on August 4, 1972

NOTES ON BASE

This is one map in a series of topographic map sheets covering the entire surface of Mars at nominal scales of 1:25,000,000 and 1:5,000,000 (Batson, 1973). The major source of map data was the Mariner 9 television experiment (Masursky and others, 1970).

ADOPTED FIGURE

The figure of Mars used for the computation of the map projection is an oblate spheroid (flattening of 1/192) with an equatorial radius of 3393.4 km and a polar radius of 3375.7 km.

PROJECTION

The Mercator projection is used between the 65° parallels, and the polar stereographic projection is used for the polar regions north and south of the 55° parallels. The scale at the equator is 1:25,000,000 and 1:12,549,000 at the 60° parallels. Longitudes increase to the west in accordance with usage of the International Astronomical Union (IAU, 1971). Latitudes are areographic (de Vaucouleurs and others, 1973).

CONTROL

Planimetric control is provided by photogrammetric triangulation using Mariner 9 pictures (Davies, 1973; Davies and Arthur, 1973) and the radio-tracked position of the spacecraft. The first meridian passes through the crater Airy-O (latitude 5.19° S) within the crater Airy. No simple statement is possible for the precision, but local consistency is within 25 km.

MAPPING TECHNIQUE

A series of mosaics of rectified and scaled Mariner 9 pictures was assembled at 1:5,000,000. These mosaics were reduced to 1:25,000,000 and transformed where necessary to the projections of this sheet.

Shaded relief was copied from the mosaics and portrayed with uniform illumination with the sun to the west. Many Mariner 9 pictures besides those in the base mosaic were examined to improve the portrayal (Levinthal and others, 1973). The shading is not generalized and may be interpreted with photographic reliability (Inge, 1972).

Shaded relief analysis and representation were made by J. L. Inge.

ALBEDO MARKINGS

The albedo markings on this sheet were derived from Mariner 9 pictures specially processed by digital methods to remove the effect of variations in sun elevation within the area of each frame (Batson and Inge, 1976). Absolute albedo values could not be derived from Mariner 9 data. Regional variation in albedo values was controlled by reference to International Planetary Patrol Program data portrayed on a map by Inge and Capen (1974). Parts of the north polar region were not photographed by Mariner 9 in an ice- or frost-free state, so surface albedo could not be shown in those areas. They include the area of the ice-cap which is shown on the map at very nearly its minimum size, and the areas delineated by white dashed lines.

Airbrush portrayal of albedo markings was done by J. L. Inge.

CONTOURS

Since Mars has no seas and hence no sea level, the datum (The 0 km contour line) for altitudes is defined by a gravity field described by spherical harmonics of fourth order and fourth degree (Jordan and Lorell, 1973) combined with a 6.1 millibar atmospheric pressure surface derived from radio-occultation data (Kliore and others, 1973; Christensen, 1975). This datum is a triaxial ellipsoid with semi-major axes of A=3394.6 km, B=3393.3 km, and a semi-minor axis of C=3376.3 km. The semi-major axis A intersects the Martian surface at long 105°.

The contour lines (Wu, 1975) were compiled from Earth-based radar determinations (Downs and others, 1971; Pettengill and others, 1971) and measurements made by Mariner 9 instrumentation, including the ultraviolet spectrometer (Hord and others, 1974), infrared interferometer spectrometer (Conrath and others, 1973), and stereoscopic Mariner 9 television pictures (Wu and others, 1973).

Formal analysis of contour-line accuracy has not been made. The estimated vertical accuracy of each source of data indicates a probable error of 1-2 km.

COLOR

No attempt was made on the map to precisely duplicate the color of the Martian surface, although the color used does approximate it.

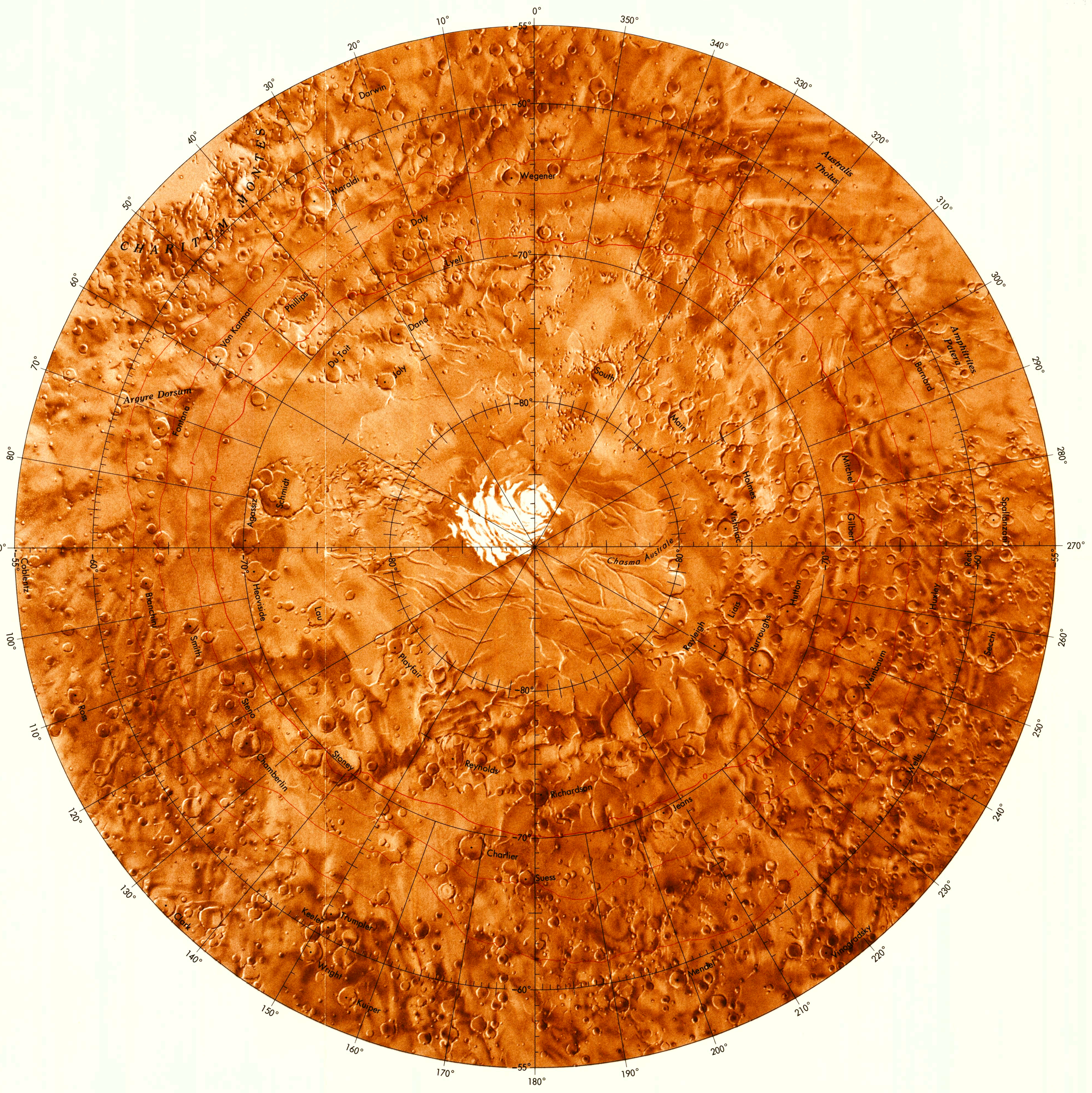
NOMENCLATURE

With minor modifications in spelling, all names on this sheet are approved by the International Astronomical Union. Cerberus, Margaritifer Sinus, Sinus Meridiani, and Sinus Sabaeus identify telescopically observed albedo features (IAU, 1960); all other names are for topographic features observed on Mariner 9 photography (IAU, 1974).

M 25M 3RMC: Abbreviation for Mars 1:25,000,000 series, 3rd edition, with shaded relief, R, markings, M, and contour lines, C.

REFERENCES

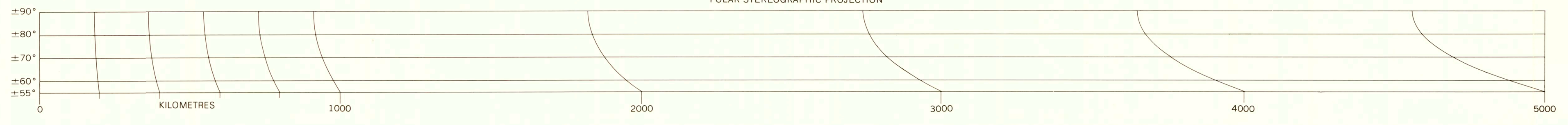
Batson, R. M., 1973, Cartographic products from the Mariner 9 mission: Jour. Geophys. Research, v. 78, no. 20, p. 4424-4435.
Batson, R. M., and Inge, J. L., 1976, Albedo boundaries on Mars in 1972: Results from Mariner 9 (in press).
Christensen, E. J., 1975, Martian topography derived from occultation, radar, spectral, and optical measurements: Jour. Geophys. Research, v. 80, no. 20, p. 2909-2913.
Conrath, B. J., Curran, R. K., Hanel, R. A., Kunde, V. G., Maguire, W. W., Pearl, J. C., Pirraglia, J., Welker, J., and Burke, T., 1973. Atmospheric and surface properties of Mars obtained by infrared spectroscopy on Mariner 9: Jour. Geophys. Research, v. 78, no. 20, p. 4267-4278.
Davies, M. E., 1973, Mariner 9: Primary control net: Photogramm. Eng., v. 39, no. 12, p. 1297-1302.
Davies, M. E., and Arthur, D. W. G., 1973, Martian surface coordinates: Jour. Geophys. Research, v. 78, no. 20, p. 4355-4394.
Downs, G. S., Goldstein, R. M., Green, R. R., and Morris, G. A., 1971, Mars radar observations, a preliminary report: Science, v. 174, no. 4016, p. 1324-1327.
Hord, C. W., Simmons, K. E., and McLaughlin, L. K., 1974, Mariner 9 ultraviolet spectrometer experiment: Pressure altitude measurements on Mars: Icarus, v. 21, no. 3, p. 292-302.
Inge, J. L., 1972, Principles of lunar illustration: Aeronaut. Chart and Inf. Center Ref. Pub., RP-72-1, 60 p.
Inge, J. L., and Capen, C. F., 1974, Mars—1973: (Map of albedo features, 1:25,000,000), Lowell Observatory, Flagstaff, Ariz.
International Astronomical Union, Commission 16, 1960, Physical study of planets, *in* Trans. 10th General Assembly, 1958: Internat. Astron. Union, v. X, p. 262.
——— 1974, Physical study of planets and satellites, *in* Proc. 15th General Assembly, 1973: Internat. Astron. Union Trans., v. XVB, p. 105-108.
Jordan, J. F., and Lorell, Jack, 1973, Mariner 9, an instrument of dynamical science: Presented at AAS/AIAA Astrodynamics Conf., Vail, Colo., July 16-18, 1973.
Kliore, A. J., Fjeldbo, Gunnar, Seidel, B. L., Sykes, M. J., Woiceshyn, P. M., 1973, S-band radio occultation measurements of the atmosphere and topography of Mars with Mariner 9: Extended mission coverage of polar and intermediate latitudes: Jour. Geophys. Research, v. 78, no. 20, p. 4331-4351.
Levinthal, E. C., Green, W. B., Cutts, J. A., Jahelka, E. D., Johansen, R. A., Sander, M. J., Seidman, J. B., Young, A. T., and Soderblom, L. A., 1973, Mariner 9—Image processing and products: Icarus, v. 18, no. 1, p. 75-101.
Masursky, Harold, Batson, R. M., Borgeson, W. T., Carr, M. H., McCauley, J. F., Milton, D. J., Wildey, R. L., Wilhelms, D. E., Murray, B. C., Horowitz, N. H., Leighton, R. B., Sharp, R. V., Thompson, T. W., Briggs, G. A., Chandeysson, P., Shipley, E. N., Sagan, Carl, Pollack, J. B., Lederberg, Joshua, Levinthal, E. C., Hartmann, W. K., McCord, T. B., Smith, B. A., Davies, M. E., de Vaucouleurs, G. D., and Leovy, C. B., 1970, Television experiment for Mariner Mars 1971: Icarus, v. 12, no. 1, p. 10-45.
Pettengill, G. H., Rogers, A. E. E., Shapiro, I. I., 1971, Martian craters and a scarp as seen by radar: Science, v. 174, no. 4016, p. 1321-1324.
de Vaucouleurs, G. D., Davies, M. E., Sturms, F. M., Jr., 1973, The Mariner 9 areographic coordinate system: Jour. Geophys. Research, v. 78, no. 20, p. 4395-4404.
Wu, S. S. C., Schafer, F. J., Nakata, G. M., Jordan, Raymond, and Blasius, K. R., 1973, Photogrammetric evaluation of Mariner 9 photography: Jour. Geophys. Research, v. 78, no. 20, p. 4405-4410.
Wu, S. S. C., 1975, Topographic mapping of Mars: U.S. Geol. Survey Interagency Rept. 63 (in press).

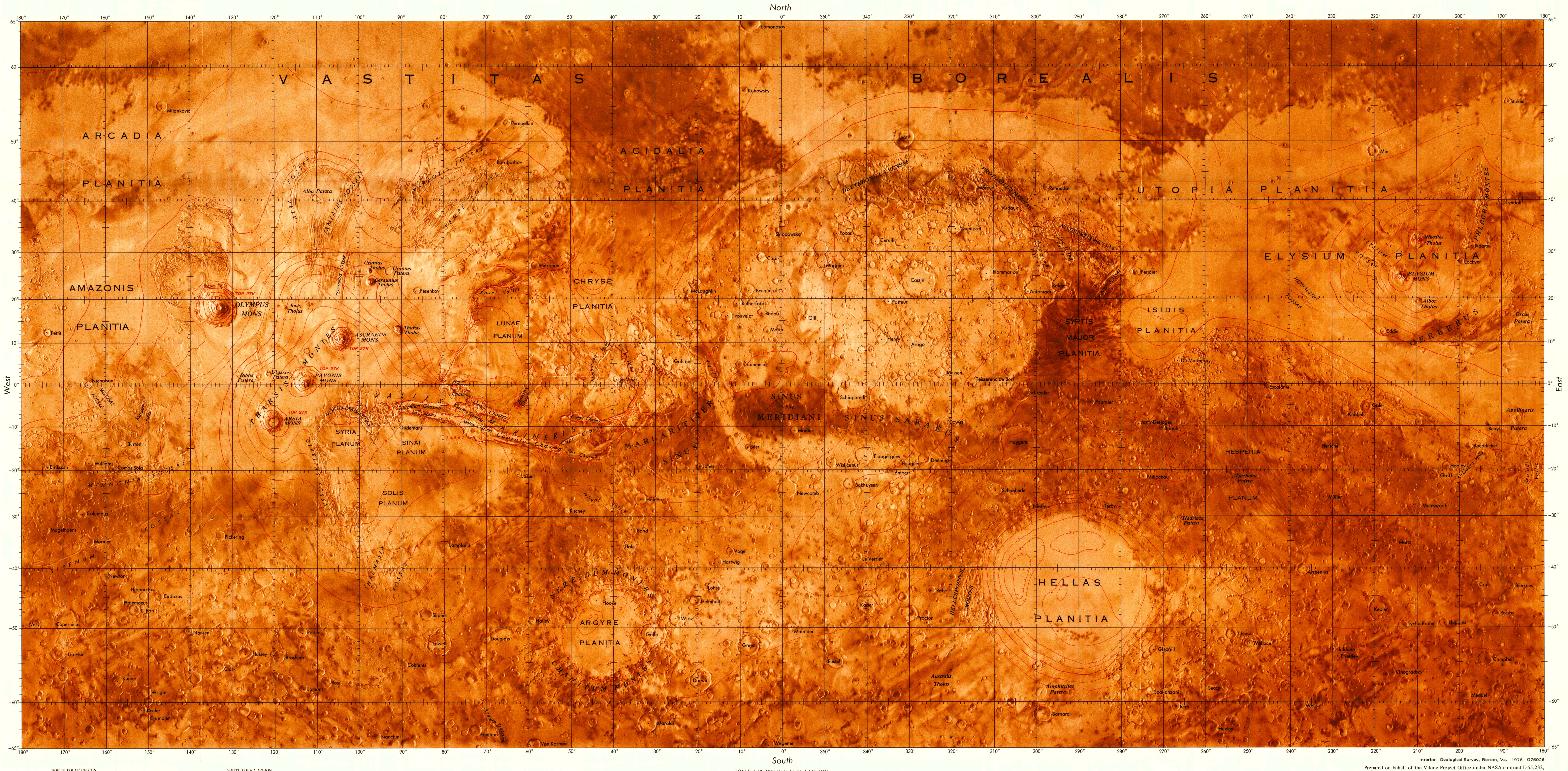


SOUTH POLAR REGION

Polar cap as it appeared on February 28, 1972

SCALE 1:12,549,000 AT 60° LATITUDE
POLAR STEREOGRAPHIC PROJECTION

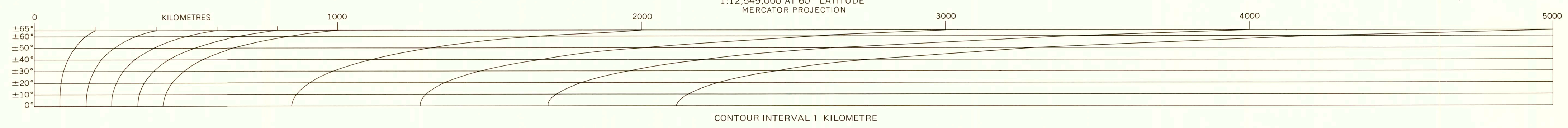




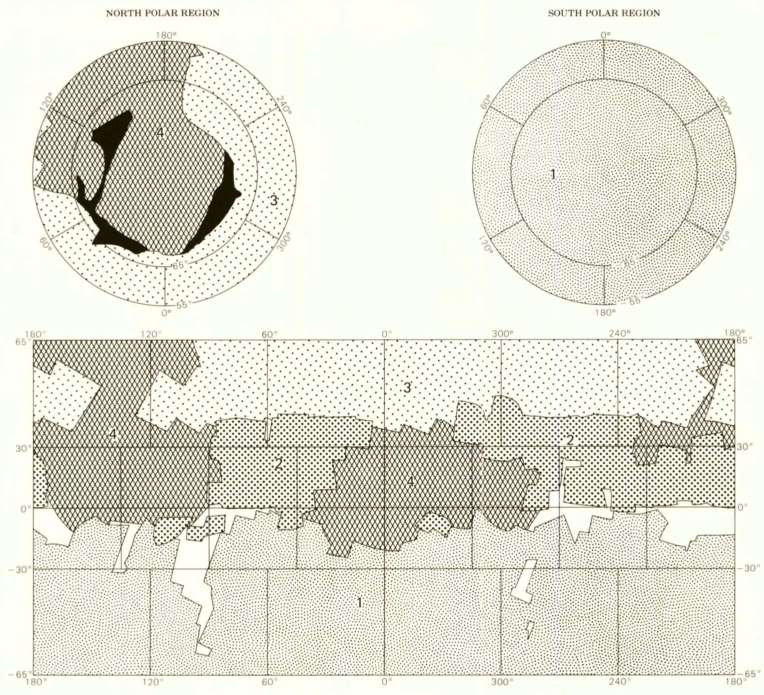
Interior—Geological Survey, Reston, Va.—1976—G76026

Prepared on behalf of the Viking Project Office under NASA contract L-55,232, the Jet Propulsion Laboratory, California Institute of Technology under contract WO-8122, and the Planetology Programs Office under NASA contract W-13,709.

SCALE 1:25,000,000 AT 0° LATITUDE
1:12,549,000 AT 60° LATITUDE
MERCATOR PROJECTION



CONTOUR INTERVAL 1 KILOMETRE



INDEX MAP SHOWING AREA OF USEFUL IMAGE COVERAGE

LIST OF PICTURES IN AREA 1
Jan. 2, 1972 through Jan. 25, 1972
(L_s=321 through 334)

DAS	Mo. Day	Lat.	Long.	Range (Km)
5130338	1·2	−71	273	2975
5130478	1·2	−70	247	2746
5164708	1·2	−71	129	5892
5164778	1·2	−57	124	5401
5164918	1·2	−34	122	5327
5200758	1·3	−57	299	5367
5236808	1·3	−54	115	5157
5236878	1·3	−40	120	5123
5236948	1·3	−23	120	5566
5272648	1·4	−67	256	5917
5272718	1·4	−54	267	5469
5272788	1·4	−43	271	5350
5272858	1·4	−32	272	5485
5272928	1·4	−16	272	6009
5344608	1·5	−67	250	5831
5380518	1·5	−64	64	5963
5380588	1·5	−52	73	5582
5380658	1·5	−40	76	5498
5380728	1·5	−28	77	5697
5381918	1·5	−63	104	3535
5381988	1·5	−64	102	3458
5416708	1·6	−28	253	5691
5452688	1·6	−34	68	5523
5452758	1·6	−20	69	5943
5453808	1·6	−76	82	3520
5453948	1·6	−71	44	3111
5488598	1·7	−46	244	5437
5488738	1·7	−19	245	5961
5524718	1·7	−36	59	5411
5524788	1·7	−24	59	5731
5560698	1·8	−35	236	5427
5560768	1·8	−23	236	5732
5596678	1·8	−35	52	5463
5596748	1·8	−23	52	5757
5632518	1·9	−68	219	5884
5668498	1·9	−67	40	5860
5668633	1·9	−46	44	5343
5668778	1·9	−24	44	5672
5704688	1·10	−35	221	5438
5704758	1·10	−22	220	5790
5707908	1·10	−11	97	2167
5740598	1·10	−56	35	5438
5740668	1·10	−45	36	5301
5740808	1·10	−25	35	5613
5776648	1·11	−46	213	5314
5776788	1·11	−24	212	5667
5812698	1·11	−35	26	5472
5813818	1·11	−30	347	4412
5848538	1·12	−68	192	5863
5848748	1·12	−36	200	5371
5848818	1·12	−24	200	5664
5884728	1·12	−40	15	5300
5920498	1·13	−74	206	5941
5920638	1·13	−52	190	5333
5920708	1·13	−40	191	5320
5920778	1·13	−25	191	5663
5956478	1·13	−73	22	5917
5956548	1·13	−65	3	5644
5956618	1·13	−52	7	5314
5956688	1·13	−40	8	5285
5956758	1·13	−26	8	5610
6029838	1·14	−86	320	3604
6100398	1·15	−64	353	5612
6100468	1·15	−51	354	5313
6100538	1·15	−40	353	5298
6101658	1·15	−72	257	3984
6136308	1·16	−73	179	5929
6136378	1·16	−65	168	5601
6136518	1·16	−40	168	5273
6136588	1·16	−25	167	5614
6172568	1·16	−27	342	5531
6244178	1·17	−75	339	5992
6244318	1·17	−50	336	5225
6244388	1·17	−39	335	5244
6244458	1·17	−24	334	5621
6280158	1·18	−61	157	5480
6280228	1·18	−49	154	5264
6280298	1·18	−38	152	5300
6280368	1·18	−24	150	5687
6316278	1·18	−39	327	5228
6316348	1·18	−24	325	5630
6388028	1·19	−62	323	5416
6398098	1·19	−49	320	5187
6424008	1·20	−49	137	5231
6460058	1·20	−39	310	5185
6460128	1·20	−25	308	5553
6495764	1·21	−73	145	5939
6531738	1·21	−74	317	5908
6531808	1·21	−61	308	5388
6532018	1·21	−24	300	5581
6748808	1·24	−73	219	3444
6820768	1·25	−63	253	3288

LIST OF PICTURES IN AREA 2
January 30, 1972 through March 16, 1972
(L_s=337 through 00)

DAS	Mo. Day	Lat.	Long.	Range (Km)
7147668	1·30	7	281	3005
7147808	1·30	23	281	2886
7219698	1·31	13	274	2888
7219768	1·31	21	274	2856
7255678	2·1	9	85	2933
7291238	2·1	5	268	2161
7291658	2·1	8	266	2936
7327638	2·2	8	77	2938
7327708	2·2	16	77	2847
7327778	2·2	24	77	2843
7363618	2·2	7	253	2946
7363688	2·2	16	253	2851
7363758	2·2	24	252	2844
7399598	2·3	7	68	2953
7399668	2·3	16	68	2859
7399738	2·3	23	68	2852
7435648	2·3	16	244	2868
7471558	2·4	8	59	2975
7471628	2·4	16	59	2881
7507468	2·4	5	326	2978
7507538	2·4	13	236	2858
7507608	2·4	21	236	2836
7543448	2·5	6	50	2962
7543518	2·5	16	51	2838
7543588	2·5	24	51	2833
7579428	2·7	8	226	2979
7579498	2·7	17	226	2861
7615338	2·6	5	42	2968
7615408	2·6	15	42	2834
7615478	2·6	23	42	2823
7651318	2·8	7	217	2972
7687298	2·9	15	30	2804
7687368	2·9	23	30	2799
7723208	2·9	7	204	2910
7723278	2·9	17	204	2832
7795098	2·10	9	195	2929
7795168	2·10	17	195	2846
7795238	2·10	24	195	2853
7866988	2·11	9	186	2937
7867058	2·11	16	186	2865
7867128	2·11	24	186	2866
7938878	2·12	8	177	2954
7938948	2·12	16	177	2873
7939018	2·12	24	177	2871
8191024	2·13	36	317	3201
8191164	2·13	43	313	3433
8263404	2·15	58	310	4044
8334874	2·15	30	304	3062
8335014	2·15	37	299	3248
8335154	2·15	43	294	3477
8406974	2·16	37	290	3184
8479004	2·17	37	281	3216
8550894	2·18	30	276	3056
8551034	2·18	37	271	3246
8622854	2·19	29	267	2980
8622994	2·19	37	262	3179
8658834	2·20	29	82	2950
8658974	2·20	37	78	3153
8694884	2·20	30	258	3049
8695024	2·20	36	253	3240
8730864	2·21	29	73	3034
8731004	2·21	37	68	3225
8766844	2·21	29	249	3027
8766984	2·21	37	244	3221
8801914	2·22	−11	122	3991
8838944	2·22	36	235	3233
8873804	2·23	19	72	2337
8874784	2·23	29	55	3062
8874924	2·23	36	50	3250
8875064	2·23	43	45	3481
8945694	2·24	21	62	2484
8946674	2·24	29	46	3004
8946814	2·24	37	41	3200
9018564	2·25	29	37	2980
9018704	2·25	37	32	3178
9090454	2·26	29	27	2974
9090594	2·26	37	23	3174
9162484	2·27	37	13	3182
9198324	2·27	29	193	3051
9231224	2·28	−83	90	3413
9266854	2·28	−48	297	3717
9375004	3·1	−80	87	3303
9448714	3·2	−7	338	2137
9736554	3·6	−9	330	1892
9953834	3·9	30	290	3237
10204924	3·12	−7	86	2334
10492624	3·16	−5	48	2327

LIST OF PICTURES IN AREA 3
June 8, 1972 through June 30, 1972
(L_s=40 through 50)

DAS	Mo. Day	Lat.	Long.	Range (Km)
8659394	2·20	59	78	4008
11445784	6·8	49	307	4525
11445644	6·8	49	324	4274
11446134	6·8	58	302	5091
11481974	6·9	78	76	5576
11482114	6·9	59	117	5109
11622560	6·11	48	279	4495
11622770	6·11	78	256	5398
11622910	6·11	61	277	5070
11658400	6·12	47	113	4204
11658540	6·12	48	96	4459
11658750	6·12	78	78	5329
11658890	6·12	61	95	5034
11799591	6·15	49	266	4422
11799731	6·15	49	250	4611
11800011	6·15	58	248	5077
11800151	6·15	68	232	5420
11835571	6·16	48	82	4400
11835711	6·16	48	67	4579
11835991	6·16	58	66	5043
11976589	6·18	50	238	4443
11976729	6·18	50	221	4641
11977009	6·18	59	219	5107
11977149	6·19	74	199	5600
12012569	6·19	50	53	4459
12012709	6·19	50	36	4653
12012989	6·19	59	35	5119
12013129	6·19	74	15	5613
12152467	6·22	49	208	4487
12152887	6·22	60	192	5103
12188377	6·23	46	25	4465
12188517	6·23	47	11	4578
12188797	6·23	58	11	5058
12188937	6·23	72	359	5438
12327986	6·25	49	180	4516
12328126	6·25	49	163	4622
12328406	6·25	59	156	5090
12363896	6·26	47	356	4465
12364036	6·26	47	340	4570
12364456	6·26	71	338	5433
12502275	6·29	67	137	5359
12538255	6·30	67	313	5352

LIST OF PICTURES IN AREA 4
July 9, 1972 through Oct. 16, 1972
(L_s=54 through 97)

DAS	Mo. Day	Lat.	Long.	Range (Km)
12874503	7·9	27	346	13789
12874573	7·9	71	351	13664
12909993	7·10	31	156	13214
12910063	7·10	49	189	13549
12994317	8·3	53	131	13619
12994387	8·3	23	108	13810
13317550	10·12	88	254	9403
13328750	10·12	8	4	17462
13350030	10·12	23	250	3651
13353320	10·12	89	88	9074
13353600	10·12	33	211	9798
13354300	10·12	34	133	10815
13360390	10·12	36	145	15488
13471203	10·16	7	311	16257
13496123	10·16	25	213	3307
13500533	10·16	22	114	3363
13505503	10·16	12	116	15228

Mapping camera coverage
(frames not processed for albedo discrimination)

Mariner 9 albedo data not available

U. S. GEOLOGICAL SURVEY
RESTON, VA.
SEP 27 1976
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TOPOGRAPHIC MAP OF MARS

M 25M 3 RMC

1976

Mars Topo. 1:25,000,000. 1976.
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