The Opposition of Mars, 1980

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The aphelic opposition of Mars in 1980 was well observed by the BAA. Important changes on the surface of the planet in *Aetheria* and *Claritas-Daedalia* were recorded but most of the albedo features exhibited their usual seasonal forms. The shrinkage of the North Polar Cap followed the usual pattern, but observations were also made of the rare dark rift *Rima Tenuis* which divides the cap in two. Previous studies of the Martian NPC are discussed.

INTRODUCTION

In opposition to the Sun on 1980 February 25, Mars was in Leo, and some 101 million km from Earth. This was the third in the present series of aphelic oppositions, and the N hemisphere of the planet was tilted towards the Earth and Sun during the period of observation, with the latitude of the centre of the disk varying over the extreme range of +7° to +27°. Other physical data were as follows:

Diameter of Mars at opposition .... 13″·8
Latitude of centre of disk at opposition.................. +21°
Declination at opposition .... +13°
Heliocentric longitude (η) at opposition.................. 156°
Mars in aphelion .... 1980 Feb. 23 (η = 155°)
Summer Solstice of N hemisphere } 1980 Apr. 8 (η = 175°)
Winter Solstice of S hemisphere }

The Martian Date at opposition was June 1, and so the observations covered spring and summer in the Martian N hemisphere.

The following 40 observers or observing groups contributed useful observations:

Observer	*Location*	*Instrument(s)*
G. L. Adamoli	Verona, Italy	108mm OG
K. N. L. Bailey	Moulsford, Oxon.	216mm refl.
R. M. Baum	Chester	115mm OG
K. W. Blaxall	Colchester	216mm refl.
N. D. Bryant	Ilfracombe	254mm refl.
F. C. Butler	Brixton, London	221mm refl.
C. F. Capen	Lowell Observatory, Flagstaff, Arizona, USA	310mm and 610mm OGs
J. Coates	Burnley	300mm refl.
P. B. Doherty	Stoke-on-Trent	419mm refl.
J. Dragesco	Cotonou, Benin, W. Africa	203mm Mak-Cass.
C. Ebdon	Dagenham	254mm refl.
E. L. Ellis	St Albans	90mm OG
M. Foulkes	Cleethorpes	254mm refl.
	Hatfield, Herts.	215mm refl.
W. E. Fox	Newark, Notts.	254mm refl.
M. V. Gavin	Worcester Park, Surrey	215mm and 300mm refls
J. D. Greenwood	Morecambe	255mm refl.
I. Hancock	Whitstable	222mm refl.
A. W. Heath	Long Eaton, Notts.	300mm refl.
D. Hitchens	Stalmine, Lincs.	220mm refl.
A. J. Hollis	Northwich	135mm, 203mm and 300mm refls
G. F. Johnstone	Leamington Spa	245mm refl.
R. J. Livesey	Newton Mearns, Glasgow	216mm refl.
C. J. R. Lord	St Annes-on-Sea	150mm Mak-Cass. and 250mm refl.
R. A. Mackenzie	Dover	75mm OG and 90mm Mak-Cass.
R. J. McKim	Cambridge	200mm and 320mm OGs
	Colchester	216mm refl.
T. C. McLeish	Orpington	300mm Cass.
P. A. Moore	Lowell Observatory	310mm and 610mm OGs
	Selsey, Sussex	125mm OG, 320mm and 390mm refls
P. W. Parish	Gillingham	222mm refl.
C. Raeburn	Stock, Essex	150mm Mak-Cass.
A. J. Read	Yateley, Hants.	114mm refl.
K. A. Read	Canvey Island	150mm refl.
J. H. Robinson	Teignmouth, Devon	260mm refl.
J. H. Rogers	University College, Los Angeles, USA	320mm refl.
J. M. Saxton	Leeds	216mm refl.
South Downs AS	(various)	(various)
D. Stott	Itchen Stoke, Hants.	298mm refl.
K. M. Sturdy	Helmsley	216mm refl.
G. M. Tattersfield	Cambridge	320mm OG
R. de Terwangne	Antwerp, Belgium	203mm Cass.
P. Wade (Lancaster and Morecambe AS)	Morecambe	73mm OG

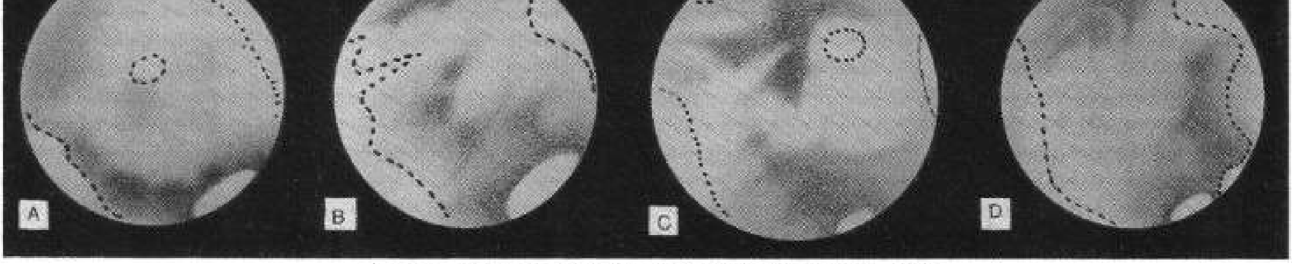

Figure 1. Drawings by R. M. Baum with 115mm OG, ×186.
(*a*) 1980 March 3d 19h 30m, ω = 85.
(*b*) 1980 February 23d 22h 20m, ω = 204.
(*c*) 1980 March 21d 19h 30m, ω = 286.
(*d*) 1980 March 13d 19h 35m, ω = 358.

A total of 641 drawings was received, nearly twice as many as for the previous apparition, together with many descriptive notes and reports. No photographs were submitted. Long series of observations were contributed by Adamoli, Blaxall, Butler, Coates, Heath, Hollis, Livesey, Moore, Rogers, Sturdy and Wade. Capen sent details of observations made by the ALPO, and also contributed some of his drawings taken with the telescopes of Lowell Observatory. Professor Dragesco sent a very useful series of drawings with his 203mm Celestron. Baron Terwangne also contributed a fine series of drawings and intensity estimates, including many colour filter observations. The Co-ordinator obtained a number of drawings with the telescopes of Cambridge University Observatories.

The observations cover the period 1979 August 22 (η = 68°) to 1980 June 23 (η = 209°), the extreme dates being due to Moore and Terwangne respectively. This report describes in turn the albedp features recorded, atmospheric activity, and the retreat of the north polar cap. That it is considerably longer than its immediate predecessors reflects upon the enthusiasm of the members of the new Terrestrial Planets Section.

SURFACE FEATURES

Study of the southern hemisphere features was hindered by the N tilt of the planet's axis, but considerable detail was seen in the N maria and deserts. For adequate discussion of the features observed during the present apparition, a return to the 'sectionalization' of the planet into three regions of longitude adopted in earlier reports and *Memoirs* has been necessary. The boundaries of Regions I, II and III are to be regarded as somewhat flexible. The nomenclature used follows that of Ebisawa's general map of the planet[1]; whilst the writer recommends the 1957 de Mottoni IAU map[2] for general use, it is not detailed enough for the present report.

The accompanying figures present a selection of drawings and charts to illustrate the features of the 1980 opposition of Mars.

Region 1: ω = 250-010°

Syrtis Major, which dominates this region of Mars, was prominent throughout the apparition and showed its normal seasonal form, being quite wide with a pointed NE corner, tailing off into the faint streak of *Nilosyrtis* (figures 7c, *Id, \2d).* The lighter patches of *Crocea* and *Oenotria* were occasionally seen. The following side of the *Syrtis* was well defined but *Deltoton Sinus* was invisible, as was also the case in 1977-78. To the south, *Libya* made an incursion into the E side of *Syrtis Major,* according to observations in good seeing by Baum, Capen, Dragesco, Fox, Heath, Parish and K. A. Read (figure lc). *Moeris Lacus* formed a small dark bulge in the E side of the *Syrtis,* but the connecting *Nepenthes-Thoth* 'canal' remained rather faint or

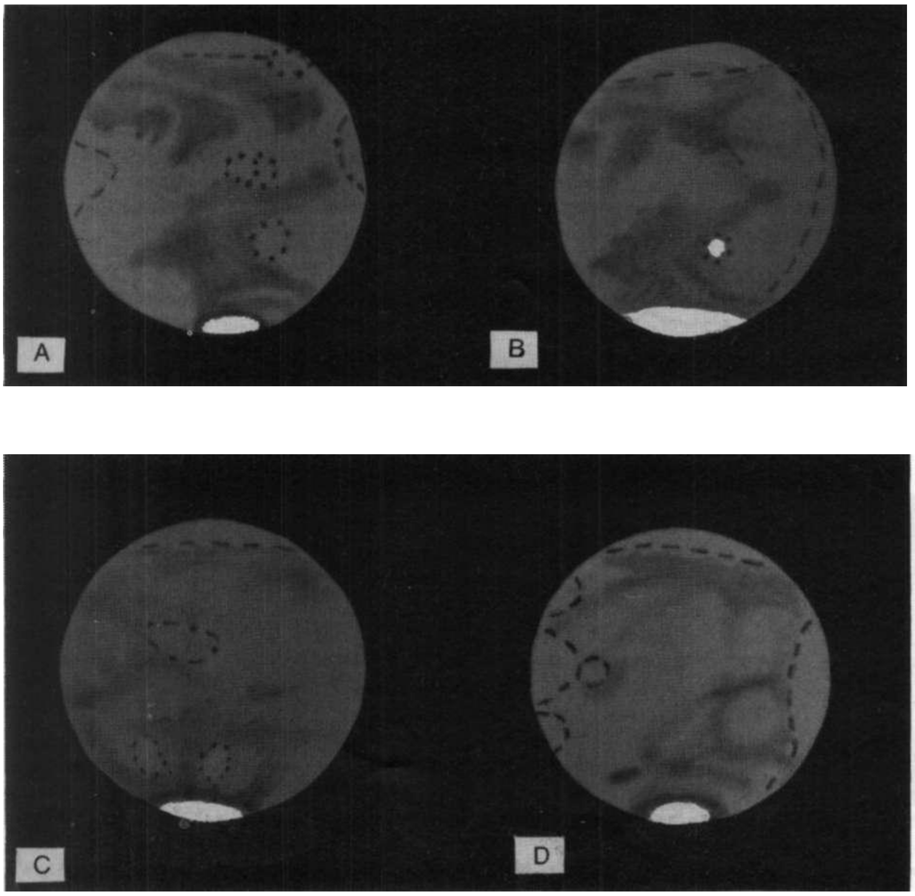

Figure 2. Drawings by C. F. Capen at Lowell Observatory.
(a) 1980 March 25d 04h 30m, ω = 31. 610mm OG, x810.
(b) 1979 Sept. 12d 13h 25m, ω = 44. 310mm OG, x390.
(c) 1980 February 11d 08h 30m, ω = 106. 610mm OG, X810.
(d) 1980 March 9d 04h 15m, ω = 167. 610mm OG, x810.

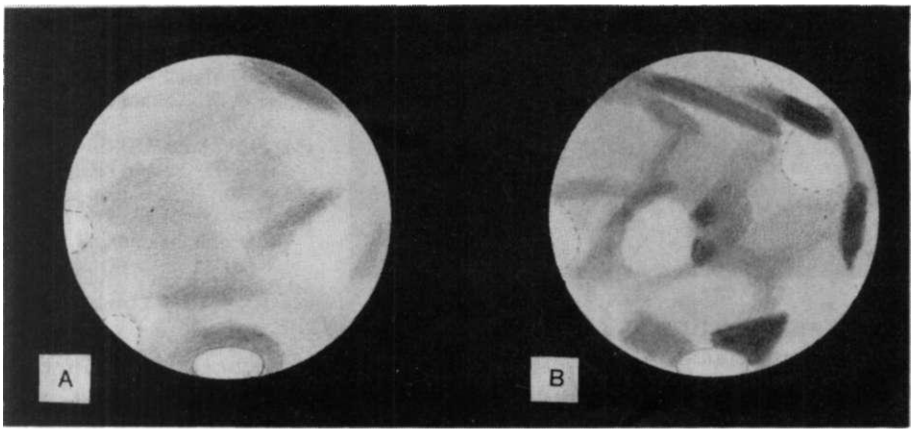

Figure 3. Drawings by P. B. Doherty with 419mm refl.
(a) 1980 February 23d 23h 40m, ω = 224, x248.
(b) 1980 February 15d 22h 43m, ω = 280, x372.

incomplete, thus continuing the pattern of recent apparitions[3]. *Nepenthes-Thoth* was invisible to most observers (figures lc, 3a, 3b, 6b, 7c, 7d, 12d*)*. The apparent colour of *Syrtis Major* was generally described as dark blue-grey or greenish-grey, by Baum, Doherty, Fox, Gavin, Greenwood and Lord, as was that of the lighter area of *Iapigia* farther south. The fainter streaks of *Astusapes* and *Astaboras* were occasionally delineated (figures *3b, Ad,* 12c, *Yld).*

To the north, *Boreosyrtis-Copais Palus* was a rather dark patch, especially early in the apparition, set amidst the dark shading of *Utopia. Casius, Nodus Alcyonius* and *Coloe Pons* were prominent, but *Nubis Lacus* was not seen. *Protonilus, Deuteronilus* and *Ismenius Lacus* were well seen, especially later in the apparition (figures *Ad,* 5c, *Sd, \2a,* 12c).

Mare Tyrrhenum was normal, and its colour was similar to that of *Syrtis Major;* its W end terminated in the very dark *Syrtis Minor,* which had also been prominent in 1978. *Amenthes* was recorded, and *Aethiopis* appeared slightly shaded to Doherty, who described it as reddish on February 15. However, this region was much less strongly shaded than it had been in 1960-63. *Hellespontus* was visible, at least in its northern parts, but *Yaonis Fretum* formed the more conspicuous darker border to the *Hellas* basin. *Mare Serpentis* was considered by Terwangne to be less dark than it had been in 1975-76 or 1977-78. *Sinus Sabaeus* was fairly dark, having a similar colour to *Syrtis Major,* but some observations showed its E end to be obscure, leaving a gap between it and *iapigia* (figure 8c); see also the "atmospheric activity' section. *Portus Sigeus* and the doubling of *Meridiani Sinus* were recorded (figures 1d, 2a, Ad, 8c, 12a-c). *Pandorae Fretum* was all but invisible, as it always is at this Martian season. Some of the classical 'canals', such as *Phison, Euphrates, Gehon* and *Hiddekel,* were occasionally noted as pale streaks crossing the equatorial deserts. *Gehon* is shown most clearly in the drawings of Capen and Dragesco (figures *Ad,* 12a, c, *d).* The *Arabia* desert was orange to Heath on February 10. The desert areas of *Ausonia, Noachis* and *Hellas* were foreshortened throughout the apparition. As these areas were invaded by the expanding S polar hood they brightened up considerably (see 'atmospheric activity' section). Prior to the expansion of the SPH, *Hellas* was rose coloured to Terwangne on February

Region II: ω = *010-130°*

Mare Acidalium was the dominant feature of this region, with darker edges and some internal detail apparent (figures la, 2a, 5a). Its colour was described as greenish or grey. *Niliacus Lacus* was well separated from the S part of *Mare Acidalium* by a lighter *Achillis Pons* (figure 2α, 5a). *Nilokeras* was wide and dark and *Lunae Lacus (Palus)* was conspicuous (figures *2b, Aa, 5a, 5b,* 10a). *Baltia* was lightly shaded with *Mare Boreum* rather darker. The very dark patch of *Hyperboreus Lacus* was seen to border the small summer NPC in March 1980 by Heath, Livesey, McKim and Sturdy. *Ceraunius* was a conspicuous wide streak, dividing *Tempe* from *Arcadia* (figures 2c, 4a, *5b).* When not cloud-covered, *Ascraeus Lacus (Mons)* appeared as a dark spot. The other *Tharsis* area volcanoes, such as

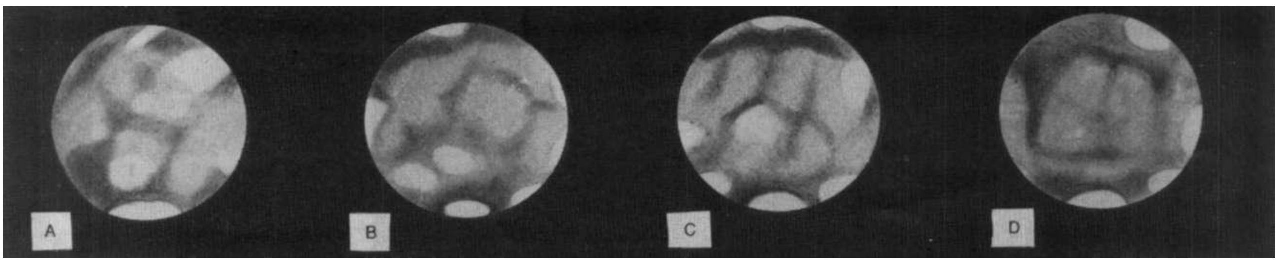

Figure 4. Drawings by J. Dragesco with 203mm Mak-Cass., x280, x330.
(a) 1980 February 4d 02h 05m, ω = 73.
(b) 1980 March 5d 23h 25m, ω = 126.
(c) 1980 February 25d 00h 03m, ω = 222.
(d) 1980 February 12d 23h 08m, ω = 312.

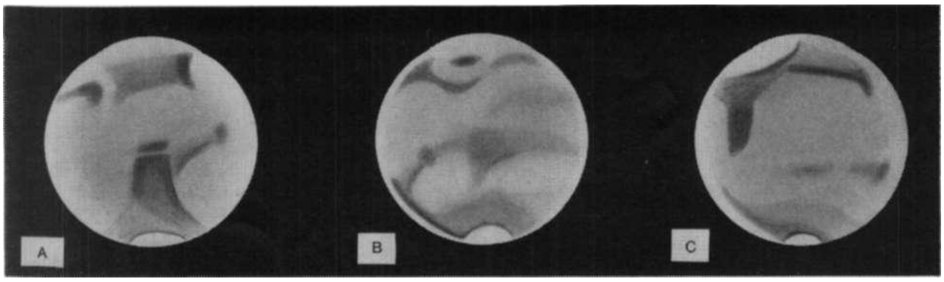

Figure 5. Drawings by R. J. McKim.
(a) 1980 March 9d 19h 15m, ω = 29. 320mm OG, x140, x320.
(b) 1980 March 10d 00h 05m, ω = 99. 200mm OG, x170, x320.
(c) 1980 March 20d 21h 15m, ω = 321. 200mm OG, x240, x320.

Pavonis Mons and *Olympus Mons,** were clearly seen trom time to time, together with associated topographic white clouds (figures 1*a, 2c, 2d, 6a, 7b,* 8b).

A band of shading running E-W separated *Tharsis* from *Tempe,* uniting *Ascraeus Lacus* and *Lunae Lacus. Chryse* was normal, but Sturdy considered *Xanthe* to be a little darker than usual. *Ganges* appeared as a conspicuous broad band of shading (figures *2b, 4a,* 8a). *Margaritifer Sinus* was dark and conspicuous, in contrast to the 1977-78 apparition. *Mare Erythraeum* was quite dark, and the lighter *Pyrrhae Regio* separated *Margaritifer Sinus* from the very dark *Aurorae Sinus. Oxia Palus* and *Juventae Fons* (figure *lb)* were recorded by only a few observers; the latter feature was very small. *Tithonius Lacus* was moderately shaded and *Solis Lacus* was a fairly dark spot, elongated E-W again after the marked secular changes of the 1970s[3,4]. *Solis Lacus* was a testing feature, lying so close to the S limb of Mars, and its visibility was further restricted by occasional white clouds over *Thaumasia.* Blaxall, Capen, Dragesco, Gavin, Hancock, Heath, McKim, Rogers, Stott and Terwangne occasionally observed this feature. The *Claritas-Daedalia* development was still visible, but it was smaller than in previous years[3,4], with a few observers representing it by a short band of shading between *Solis Lacus* and the E end of *Mare Sirenum.* Figures 2c, *4a, 4b, 5b, 7a* and 8a all show the appearance of the *Solis Lacus* region. *Araxes* was also seen, whilst *Argyre* behaved in an identical manner to the S deserts of Region I.

**Olympus Mons* is referred to by its modern name here, to indicate that it was observed as a darker spot on the Martian surface. The term *Nix Olympica* is used later in this Report to denote the white cloud covering this feature.

Region III: ω = *130-250°*

Mare Sirenum, Mare Cimmerium and the E end of *Mare Tyrrhenum* were normal. *Hesperia* was shaded, and some complex but elusive details were drawn in the *Amazonis* and *Arcadia* deserts. Lord described *Amazonis* as deep reddish-orange on February 17. In the early part of the apparition, when near the CM, *Elysium* appeared dull, but later on increasing atmospheric activity made the region sometimes appear quite bright on mid-disk. Heath described its colour as dull orange. The markings surrounding *Elysium* were sometimes obscure and faint, particularly before opposition, and *Cerberus* in particular. Later, *Cerberus, Trivium Charontis* and *Phlegra* were darker and clearer. *Propontis I* and *Euxinus Lacus* were dark. *Propontis* was described as light grey-green (Doherty) or blue-grey (Lord). The area between the W border of *Elysium* and the *Syrtis Major* underwent secular changes between 1978 and 1980. The normally bright desert area of *Aetheria* was crossed by a dusky streak running E-W from the W border of *Elysium.* Not many observers were able to see this feature, but Terwangne records it clearly as late as June. The W side of *Elysium* also appeared darker, with the 'canals' *Chaos* and *Hyblaeus* blended into a broad, dusky curved border. The ALPO reported that these changes began late in the 1978 apparition[5]. *Hephaestus* was fairly conspicuous, and *Morpheos Lacus* less obvious. All these features are shown on Rogers' drawing in figure *6b,* whilst the *Elysium* area is represented in figures *lb, 2d, 3a,* 4c, 6a, *6b, 7c. Eunostos I* was weak, but *Eunostos II* is shown on some drawings as a more prominent feature (figures 4c, 7c). *Cyclops, Aethiops,* and *Gomer Sinus* were recorded, as were *Euminides-Orcus, Laestrygon, Tartarus* and *Erebus* (appearing as broad streaks). *Panchaia* and *Scandia* were shaded.

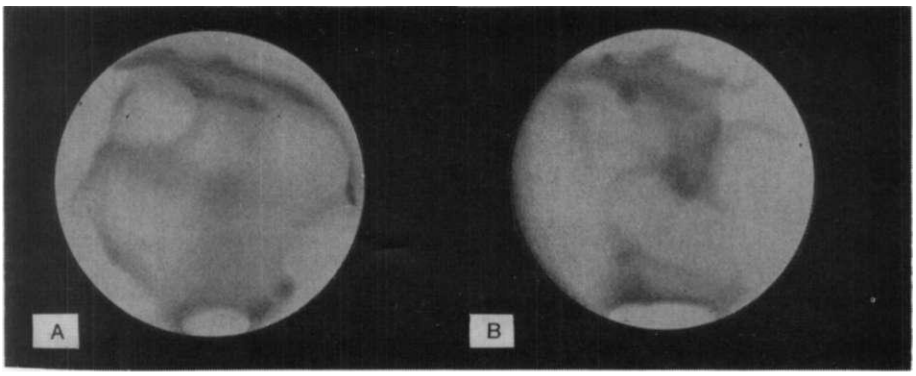

Figure 6. Drawings by J. H. Rogers with 300mm refl., x200.
(a) 1980 March 14d 08h 20m, ω = 185.
(b) 1980 March 5d 06h 30m, ω = 237.

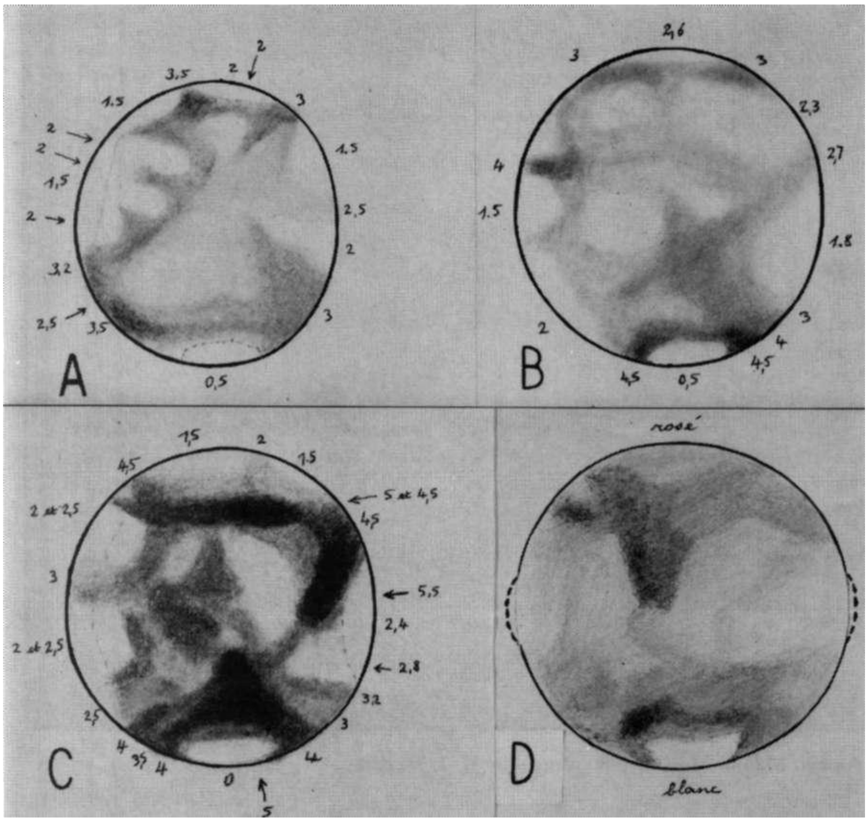

Figure 7. Drawings by R. de Terwangne with 203mm Cass.
(a) 1980 May 22d 20h 48m, ω = 93, x208, x251.
(b) 1980 April 5d 2()h 25m. ω = 167, x251.
(c) 1980 March 24d 19h 30m, ω = 267, x251, x291.
(d) 1980 February 1 Id 21h 15m, ω = 299, x182, x251.

Further colour notes for Region III were: Lord found *Memnonia* a pale russett pink on February 17, and Terwangne found *Electris* and *Eridania* on the S limb to be rose-coloured on February 20. Doherty likewise described *Ausonia* and *Eridania* as brilliant pink when near the preceding limb on February 23. *Hesperia, Mare Cimmerium* and *Mare Sirenum* had a similar apparent colour to *Mare Tyrrhenum* of Region I.

Apparitional Map

A careful study of the February and March drawings has resulted in the albedo map of figure 9. Relative intensity estimates (see next section) were a considerable aid in its compilation. The IAU map[2] and de Mottoni's chart for 1965[6] were useful in placing the main features, after which the finer details shown on the 1980 drawings were added. Some positional measurements on the best drawings with overlay graticules were needed to lay down some of the smaller features. The series of drawings by Baum, Capen, Doherty, Dragesco, Heath, Hollis, Lord, McKim, Rogers, Stott, Sturdy and Terwangne were used in the construction of the BAA chart. While details are inevitably represented in a different way by individual observers, the chart should give a balanced view of Mars at opposition in 1980.

Intensity Estimates

Of the 20 observers who made relative intensity estimates, only 12 were systematic enough for meaningful average intensities to be derived from their work. With Saturn, global features may always be estimated on the CM, but on Mars intensity estimates are spread over all parts of the disk, so features are subject to diminution in intensity by the Martian atmosphere to a variable extent. Thus more estimates are required to derive satisfactory average intensities for Martian than for Saturnian features.

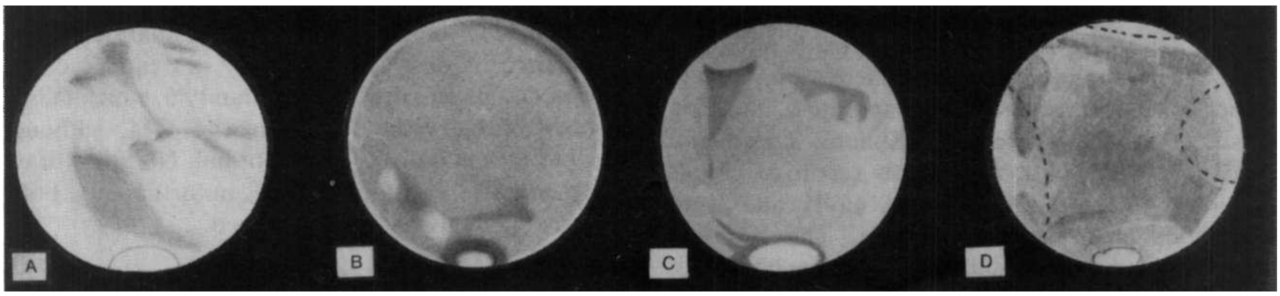

Figure 8.
(a) 1980 March 9d 21h 00m, ω = 54. 298mm refl., x317+W25 filter, D. Stott.
(b) 1980 March 3d 23h 50m, ω = 148. 300mm refl., x318, A. W. Heath.
(c) 1980 February l0d 22h 15m, ω = 317. 216mm refl., x230+W15 filter, K. W. Blaxall.
(d) 1980 March 13d 18h 30m, ω = 353. 200mm refl., x196, A. J. Hollis.

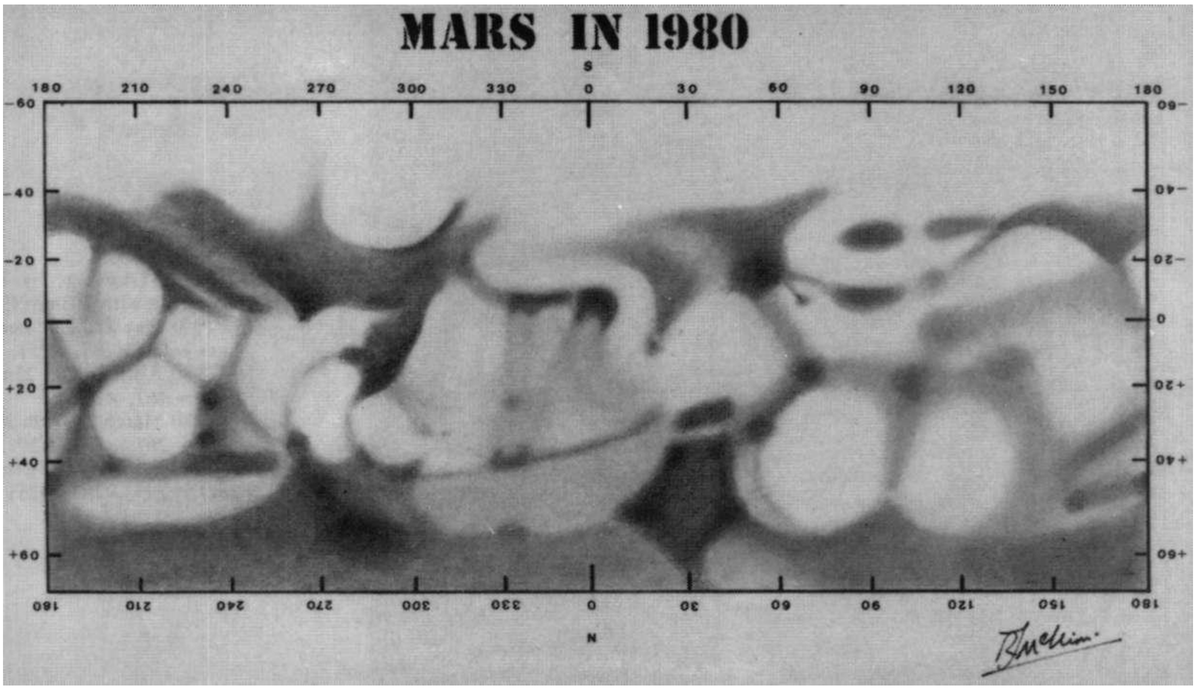

Figure 9. Albedo Map of Mars in 1980. drawn by R. J. McKim.

Table I presents the results of the Section's work in 1979-80. White light estimates only have been used, for colour filters affect the albedo feature intensities considerably. Heath found the W25 red filter made all the dark markings about one point darker on the usual scale, on which the normal intensity of the NPC is 0, most desert areas are about 2, and the black sky background is 10. Of the 1786 estimates contributed by the 12 selected observers, 1385 yielded useful averages for Table I. In general the derived values are typical of those features subject to seasonal change. The data were inadequate for any discussion of short-term intensity changes. A summary of the average intensity values for the features observed is presented in Table II.

THE MARTIAN ATMOSPHERE

In this section of the report we must deal with white and yellow clouds and the Martian Blue Clearing.

Martian Clouds

Most observers recorded white clouds and limb hazes during the apparition, with activity increasing throughout 1980 as the NPC evaporated, releasing volatiles into the Martian atmosphere. Those who used the W44A and W47 filters recorded clouds visible in integrated light more easily and were sometimes able to detect others. The seasonal growth of the S polar hood (SPH) was also observed, and is covered by this section.

Few observations for the period from 1979 August to November are available. The November observations (incomplete in longitudinal coverage) reveal a brighter S limb over *Ausonia* and show that *Chryse, Cydonia, Eden* and *Xanthe* brightened at the evening terminator. *Tempe, Tharsis* and *Thaumasia* were bright on the morning limb. The December drawings (again incomplete in longitudinal coverage) show that the SPH was noticed over *Argyre, Electris* and *Noachis,* whilst *Amazonis* and *Memnonia* were bright on the evening terminator. *Cebrenia, Elysium, Eridania, Hellas* and *Tempe* were bright on the morning limb.

Complete observations in 1980 January reveal an increasingly active atmosphere. The SPH was often recorded over *Argyre, Ausonia, Eridania* and *Noachis. Amazonis, Chryse, Electris, Hellas, Isidis Regio, Libya, Moab* and *Tempe* were often bright on the evening terminator, and *Aeria, Aetheria, Chryse, Hellas, Isidis Regio, Libya, Tempe, Tharsis, Thaumasia* and *Xanthe* were affected by early morning haze or cloud. On January 27 Hitchens found a small white afternoon cloud near *Aromatum Promontorium* and another just ρ the unseen *Mareotis Lacus.* Sturdy found a bright *yellow* area over *Tempe* on the Nf limb on January 2. Other evidence of dust storm activity in January comes from Dragesco's drawing of January 6, which fails to show *Margaritifer Sinus* on the CM, although adjacent features appeared normal. No other drawings are available for this date, unfortunately, but it seems the activity was short-lived.

The greatest number of observations was available in 1980 February and March, around the time of opposition. In February, the S limb was bright over the desert areas of *Argyre, Ausonia, Electris, Eridania, Noachis, Phaethontis* and *Thaumasia.*

Table I

Martian intensity estimates

Feature	Adamoli	Blaxall	Hancock	Heath	Hollis	Johnstone	Lord	Mackenzie	McKim	Stott	Sturdy	Terwangne
Achillis Pons	—	—	—	—	—	—	4.0	—	—	—	—	—
Acidalium, M.	6.2	3.9	5.5	5.4	5.6	5.7	7.5	6.2	5.6	8.0	7.7	4.6
Aeolis												2.3
Aeria	1.7	—	—	—	2.0	—	—	—	3.3	—	—	2.3
Aetheria	—	—	—	—	—	—	—	—	3.3	—	—	3 0
Aethiopis	2.0	—	2.0	2.0	2.0	—	2.0	—	—	—	—	2.8
Alcyonius Nodus	—	—	—	—	—	—	4.0	—	—	—	—	—
Amazonis	1.7	—	—	—	2.3	—	2.5	3.0	3 0	2 0	—	3.0
Amenthes	—											2.9
Arabia	1.9	—	—	—	2.0	—	3.0	2.7	3.3	2.5	—	2.2
Arcadia	1.8	—	2.2	—	2.0	—	—	—	3.0	—	—	3.0
Argyre (I)	1.9	—	—	—	—	—	2.0	2.0	2.0	—	—	—
Ascraeus Lacus	—	—	4.0	3.8	—	—	—	—	5.0	—	6.0	—
Astahoras	3.5	—	—	—	—	—	3.5	—	—	—	—	—
Astusapes	—	—	—	—	—	—	3.3	—	—	—	—	—
Aurorae Sinus	5.5	4.7	5.6	5.0	5.5	—	7.0	—	5.2	5.3	7.3	—
Ausonia	1.3	—	2.0	—	—	—	3.0	—	1.6	—	—	—
Baltia	—	—	—	—	—	—	3.8	—	—	—	—	3.7
Boreosyrtis	—	—	—	—	—	—	4.3	5.3	—	7.0	7.6	—
Boreum, M.	4.8	—	3.2	5.5	5.0	—	4.5	5.2	3.7	2.5	6.0	3.4
Candor							3.0					
Casius	—	4.4	—	—	5.0	—	3.8	—	4.9	—	—	4.2
Cecropia	5.4	—	5.0	4.5	—	—	4.3	4.0	3.5	—	5.7	—
Ceraunius	—	—	3.0	—	—	—	—	—	4.2	—	5.0	—
Cerberus	—	—	—	—	3.8	—	—	—	4.2	3.2	—	3.1
Chryse	1.5	—	—	—	1.8	—	2.5	—	3.0	—	—	2.2
Cimmerium, M.	5.9	5.0	5.5	5.9	5.3	—	—	4.3	4.9	—	7.5	4.3
Claritas												2.6
Claritas-Daedalia	—	—	—	—	—	—	—	—	4.2	—	—	—
Copais Palus												4 1
Cydonia	—	—	—	—	2.3	—	3.0	—	3.2	—	—	3.5
Deucalionis Regio												3.2
Deuteronilus	—	—	—	—	4.0	—	3.0	—	—	—	5.0	—
Diacria	—	—	—	3.2	—	—	—	—	—	—	—	3.6
Dioscuria							3.0					
Eden	1.8	—	—	—	2.2	—	—	—	3.2	—	—	—
Electris	1.3	—	—	—	—	—	—	—	1.4	—	—	—
Elysium	1.8	—	2.0	—	2.0	—	—	—	3.2	2.0	—	2.6
Eridania	1.4	—	2.0	—	—	—	—	—	1.4	—	—	—
Erythraeum, M.	6.0	—	—	—	4.8	—	6.0	—	4.8	—	—	3.5
Ganges	—	—	4.0	—	—	—	—	—	—	—	5.0	—
Hellas	0.7	1.2	—	—	1.0	—	—	2.2	1.2	—	—	1.3
Hephaestus	—	—	—	4.5	—	—	—	—	4.0	—	6.2	—
H esperi a	—	—	—	—	—	—	4.5	—	—	—	—	4.2
Hyblaeus									3.8			
Hyperboreus Lacus	—	—	—	6.0	—	—	4.5	—	6 0	—	9.2	—
lapigia	5.3	5 1	5.5	—	5.6	4.0	6.0	—	5.0	5.5	7.0	4.6
Indus					4.0							
Isidis Regio	—	—	—	—	—	—	3.0	—	—	—	—	2.5
Ismenius Lacus	—	—	—	—	4.0	—	3.8	—	4.0	—	—	—
Libya	—	—	—	—	—	—	3.0	—	4 0	—	—	—
Lunae Lacus	—	—	4.2	3.8	3.5	—	4.5	—	4.5	3.5	6 0	—
Margaritifer Sinus	—	4.5	—	5.0	4.7	—	5.0	—	5.5	—	—	—
Memnonia	—	—	—	—	2.0	—	—	—	—	—	—	2.3
Meridiani Sinus	6.2	4.5	—	5.3	5.3	—	—	—	6 0	—	8.0	4.0
Nepenthes-Thoth	—	—	—	—	3.5	—	4.5	—	—	—	4.0	—
Niliacus Lacus	—	4.5	—	—	—	—	6.5	—	6 0	—	—	3.5
Nilokeras	3.8	—	3.8	—	3.5	—	4.5	—	4.3	3.3	5.8	3.4
Nilosyrtis	—	3.5	—	—	—	—	4.5	—	—	—	—	—
Noachis	2.1	—	—	—	—	—	4.0	2.7	3.5	—	—	—
Ortygia	5.6	—	—	—	4.7	—	4.0	—	4.2	—	—	—
Panchaia	5.7	—	4.9	6 0	—	—	—	—	3.8	—	—	4.1

Table I *(continued)*

Feature	*Observer*: Adamoli	Blaxall	Hancock	Heath	Hollis	Johnstone	Lord	Mackenzie	McKim	Stott	Sturdy	Terwangne
Phlegra	—	—	3.3	—	—	—	—	—	3.8	—	5.3	3.3
Phoenicis Lacus												2.7
Propontis	—	—	—	—	4.9	—	3.5	—	4.5	—	—	—
Protonilus												3.4
Sabaeus Sinus	5.4	4.8	—	4.5	4.8	—	3.8	5.0	5.2	—	7.2	
Scandia	5.6	—	—	4.7	—	—	—	—	3.5	—	6.6	—
Serpentis, M.	—	—	—	—	—	—	4.5	—	—	—	—	4.0
Sirenum, M.	5.2	4.5	4.3	—	4.4	—	6.5	—	4.0	—	—	3.4
Sithonius Lacus	—	—	3.8	4.5	—	—	2.5	—	—	—		
Solis Lacus	—	4.5	5.7	5.2	—	—	—	—	6.0	—	—	2.8
Syrtis Major	6.5	5.2	6.5	6.4	5.3	5.5	6.5	6.5	6.0	7.5	8.7	5.1
Syrtis Minor	—	—	6.5	—	6.3	—	5.0	—	—	—	—	—
Tempe	1.8	—	2.3	—	2.2	—	2.0	2.0	3.0	—	—	2.5
Tharsis	1.6	—	2.0	—	2.7	—	—	—	3.0	2.0	—	2.5
Thaumasia	—	—	—	—	—	—	2.0	—	2.7	—	—	2.6
Tithonius Lacus									4.8	4.8		
Trinacria												4.1
Trivium Charontis	—	—	3.8	3.7	4.8	—	—	—	—	5.0	7.3	3.3
Tyrrhenum, M.	6.0	4.0	5.5	6.0	5.7	4.5	5.5	4.2	5.0	6.0	8.0	4.6
Utopia	6.2	4.2	5.2	5.8	6.0	—	4.0	4.3	4.4	—	5.7	3.9
Xanthe	—	—	2.0	—	—	—	3.0	—	3.0	—	—	2.4
Yaonis Fretum	—	—	—	—	—	—	4.5	—	5.5	—	9.0	
Zephyria	1.4	—	2.0	—	—	—	—	—	3.2	—	—	2.2
No. of useful estimates:	223	70	115	74	154	12	52	55	192	35	99	304
Period of observation	January 6.May 2	December 25.May 5	February 19—April 18	February 10—April 5	January 20.June 1	January 23.March 25	February 15.March 10	December 12-May 10	January 12-April 30	December 31—April 3	January 25-May 2	February 2 June 23

Table II

Apparitional average intensity estimates

Feature	*Average intensity*	*Standard deviation*	*Number of estimates*
Achillis Pons	4.0	(.)	1
Acidalium, M.	6.0	(1.2)	65
Aeolis	2.3	(.)	6
Aeria	2.3	(0.7)	27
Aetheria	3.2	(0.2)	14
Aethiopis	2.1	(0.3)	19
Alcyonius Nodus	4.0	(.)	1
Amazonis	2.5	(0.5)	33
Amenthes	2.9	(.)	6
Arabia	2.5	(0.5)	30
Arcadia	2.4	(0.6)	35
Argyre (I)	2.0	(0.1)	6
Ascraeus Lacus	4.7	(1.0)	9
Astaboras	3.5	(0.0)	2
Astusapes	3.3	(.)	1
Aurorae Sinus	5.7	(0.9)	34
Ausonia	2.0	(0.7)	11
Baltia	3.8	(0.1)	7
Boreosyrtis	6 0	(1.5)	17
Boreum, M.	4.4	(1 1)	41
Candor	3.0	(..)	1
Casius	4.5	(0.5)	30
Cecropia	4.6	(0.8)	19
Ceraunius	4.1	(1.0)	5
Cerberus	3.6	(0.5)	14
Chryse	2.2	(0.6)	16
Cimmerium, M.	5.4	(1 0)	42
Claritas	2.6	(—)	5
Claritas-Daedalia	4.2	(—)	2
Copais Palus	4 1	(—)	8

Table II *(concluded)*

Feature	*Average intensity*	*Standard deviation*	*Number oj estimates*
Cydonia	3.0	(0.5)	12
Deucalionis Regio	3.2	(.)	4
Deuteronilus	4.0	(1.0)	3
Diacria	3.4	(0.2)	11
Dioscuria	3.0	(.)	1
Eden	2.4	(0.7)	13
Electris	1.4	(0.1)	8
Elysium	2.3	(0.5)	28
Eridania	1.6	(0.3)	7
Erythraeum, M.	5 0	(1 0)	16
Ganges	4.5	(0.5)	6
Hellas	1.3	(0.5)	28
Hephaestus	4.9	(1.2)	5
Hesperia	4.4	(0.2)	6
Hyhlaeus	3.8	(.)	2
Hyperboreus Lacus	6.4	(2.0)	5
lapigia	5.4	(0.8)	33
Indus	4.0	(—)	1
Isidis Regio	2.8	(0.3)	6
Ismenius Lacus	3.9	(0 1)	4
Libya	3.5	(0.5)	2
Lunae Lacus	4.3		17
Margaritifer Sinus	4.9	(0.4)	9
Memnonia	2.2	(0.2)	13
Meridiani Sinus	5.6	(1.3)	24
Nepenthes.Thoth	4.0	(0.5)	5
Niliacus Lacus	5 1	(1.4)	10
Nilokeras	4.0	(0.8)	32
Nilosyrtis	4.0	(0.5)	2
Noachis	3 1	(0.8)	12
Ortygia	4.6	(0.7)	13
Panchaia	4.9	(1.0)	25
Phlegra	3.9	(0.9)	17
Phoenicis Lacus	2.7	(.)	7
Propontis	4.3	(0.7)	10
Protonilus	3.4	(.)	8
Sabaeus Sinus	5 1	(1.0)	30
Scandia	5 1	(1.3)	19
Serpentis, M.	4.2	(0.3)	7
Sirenum, M.	4.6	(1.0)	31
Sithonius Lacus	3.6	(1.0)	6
Solis Lacus	4.8	(1.3)	13
Syrtis Major	6.3	(1.0)	80
Syrtis Minor	5.9	(0.8)	6
Tempe	2.3	(0.4)	37
Tharsis	2.3	(0.5)	38
Thaumasia	2.4	(0.4)	8
Tithonius Lacus	4.8	(0.0)	5
Trinacria	4.1	(.)	6
Trivium Charontis	4.6	(1.4)	28
Tyrrhenum, M.	5.4	(1.1)	66
Utopia	5.0	(0.9)	53
Xanthe	2.6	(0.5)	17
Yaonis Fretum	6.3	(2.4)	4
Zephyria	2.2	(0.7)	19
		Total	1385

Hellas was very bright on the morning limb but lost its brilliance as the Martian day progressed. It was sometimes brightened again by evening haze, but generally appeared no brighter than the equatorial deserts (figures *3b, Ad, 7d,* 8c). *Libya* was bright on the morning limb and cloud or haze persisted sometimes till midday (figure 4c). The region sometimes appeared bright again on the evening limb. *Elysium* was bright on the morning limb. As soon as the region moved onto the disk it became dull but it brightened in the Martian afternoon. The following areas often brightened when near the ρ limb: *Aeria, Aetheria, Aethiopis, Amazonis, Arcadia, Cebrenia, Chryse, Deucalionis Regio, Eden, Hesperia, Memnonia, Neith Regio, Scandia, Tharsis, Utopia* and *Zephyria.* The following areas were often bright when entering the disk: *Aeolis, Aeria, Arabia, Arcadia, Baltia, Chryse, Daedalia, Dioscuria, Eden, Isidis Regio, Neith Regio, Noachis, Tempe* and *Tharsis.* Clouds visible near the CM were seen by Dragesco on February 4 *(Tempe, Tharsis;* figure 4a), by Hollis on February 17 *(Aetheria;* with W47 filter only) and February 27 (two *Tharsis* clouds, one being MJC *Olympica* and another N/ it), and by Gavin on February 23 (two small white patches N and S of *Nodus Gordii,* the S one being *Nix Olympica).* Terwangne saw *Nix Olympica* near the *ρ* limb on February 20.

Also in February, some evidence of obscuration of the E end of *Sinus Sabaeus* was found; Blaxall found the E end truncated on the 10th (figure 8c), and Coates found the entire feature difficult on the 16th. Others also show the E end of this feature to be obscure at other times. Dragesco failed to see *Margaritifer Sinus* on the CM on February 9, suggesting yellow cloud activity. However, this activity must have been short-lived for the feature was visible to others on the following night. Bailey reported a bright yellow patch over *Isidis Regio* on the/limb on February 22, and Parish found *Ausonia* and *Eridania* yellowish on February 19.

In 1980 March the northward expansion of the SPH became more noticeable. *Hellas* appeared particularly bright to Baum, Doherty, Dragesco, Gavin, Hollis, McKim, Moore, Saxton and Sturdy on March 20-22, this brilliance remaining throughout the entire Martian day. The region continued to be very bright for the rest of the period of observation (figures lc, 5c, *\2d).* Baum described *Hellas* as bluish-white on the 21st and brighter still the following night. Others soon confirmed that the region rivalled or exceeded the NPC in brilliance. Doherty remarked that he had never seen *Hellas* appear so bright. The other S deserts were more or less filled by the SPH and were more conspicuous than earlier in the apparition. The brightness of

Hellas throughout the day indicates either a perpetual cloud covering or possibly the formation of a frost covering on the basin floor.

Evening haze or cloud was reported over the following areas in March: *Aetheria, Aethiopis, Arcadia, Chryse, Cydonia, Eden, Elysium, Isidis Regio, Libya, Neith Regio, Nox Lux, Tempe, Tharsis* and *Xanthe.* Morning haze was observed at the terminator over: *Aeria, Amazonis, Baltia, Chryse, Cydonia, Elysium, Isidis Regio, Libya, Memnonia, Tempe, Tharsis* and *Xanthe.* The clouds over *Arcadia, Chryse, Tempe* and *Xanthe* were particularly brilliant in the Martian afternoon, sometimes forming on mid-disk and brightening as they neared the limb (figure *4b).* Small white clouds were reported in *Claritas,* while Heath observed one on March 3 lying between *Aurorae Sinus* and *Solis Lacus.* Other clouds on mid-disk were seen over *Aetheria, Baltia* and *Cydonia. Elysium* and *Libya* were often bright whether on the morning or evening side of the planet.

As in February, a number of small white afternoon clouds associated with the *Tharsis* ridge volcanoes were reported. Baum found one on the 3rd on the SW slopes of *Ascraeus Mons* (figure *la);* Heath also observed this cloud together with another near the position of *Maeotis Palus* (figure *8b).* Lord observed *Nix Olympica* on March 3, and Rogers saw it on the *ρ* limb on March 14 (figure 6a). Capen's drawing in figure *2d* shows a number of topographic white clouds. Other observations in March were as follows: Gavin saw a tiny white spot on the *ρ* limb on the 3rd and 4th, corresponding in position to *Aromatum Promontorium,* and Dragesco's drawings of March 22 and 24 show a brighter area encroaching upon the *Iapigia-Aeria* region which was not present on the 20th or 25th; unfortunately these observations lack confirmation. Finally, Sturdy found *Elysium* "very striking and yellow" approaching the CM on March 2, whilst Greenwood on March 13 observed a bright yellow area over *Chryse* on the *p* limb.

High cloud activity continued during 1980 April. The S deserts remained bright, covered by the SPH. Afternoon cloud activity predominated over morning cloud activity, as it had tended to in the previous month. However, as Mars receded from the Earth, the total number of observations began to decrease. The following areas brightened in the Martian afternoon or on the evening limb: *Amazonis, Chryse, Cydonia, Elysium, Libya, Memnonia, Nox Lux, Tharsis, Xanthe* and *Zephyria.* Cloud activity on the morning terminator was observed over: *Amazonis, Chryse, Elysium, Isidis Regio, Libya, Neith Regio, Tempe, Tharsis, Xanthe* and *Zephyria.* Further evidence of yellow cloud activity comes from Dragesco's series of drawings, taken under generally better conditions. On April 7 with the CM at long. 162° he found *Mare Sirenum* to be covered by yellow clouds. The Mare had appeared normal on April 6 to several observers, so the activity must have been short-lived once again.

Observations in May and June are less complete for many observers had ceased observing by this time. However, Terwangne in particular continued to make useful drawings. The SPH remained bright, but no S polar cap had formed by the end of June. Just a few notable cloud observations will be recorded here: Gavin saw a cloud over *Tempe* near the CM on May 21, while on May 22 Terwangne recorded a very large irregular white cloud formation on the ρ limb covering *Chryse, Xanthe* and *Aurorae Sinus* (figure *7a).*

In summary, white cloud activity was normal for the season, increasing during the period of observation. Yellow cloud activity was also noted, but no long-lived dust storms were detected. As in the 1977-78 apparition[3], the yellow cloud activity was much less important than the white cloud activity. The seasonal growth of the SPH was well seen but no SPC was recorded.

Blue Clearings

A systematic search for the temporary transparency of the Martian atmosphere in blue-violet light was made by Heath and Terwangne. Heath used the W47 filter (peak transmission 440nm) and Terwangne used a Zeiss blue glass filter (peak transmission 470nm, passband 400-520nm) transmitting more of the longer wavelengths. Most of Heath's observations (January 26-April 5) record only the NPC (and NPCB when visible) but a strong Blue Clearing of the *Mare Acidalium* region was seen on March 12 (figure 10), with the *Margaritifer Sinus* region also appearing in violet light. Heath also saw *Mare Acidalium* through the filter in less favourable seeing the following night. In some regions of Mars, where detail is vague in white light it is not surprising that the W47 filter reveals a blank disk in poor seeing, thus a number of Heath's observations of only a NPC being visible in violet light are not definitive. However, it is notable that he could not see *Syrtis Major* with the filter on February 10 with the CM long. 317°, or the *Syrtis* and the S maria on February 17. Similarly, *Mare Acidalium* was invisible in blue-violet light on March 7, 8 or 9, as was *Syrtis Major* on

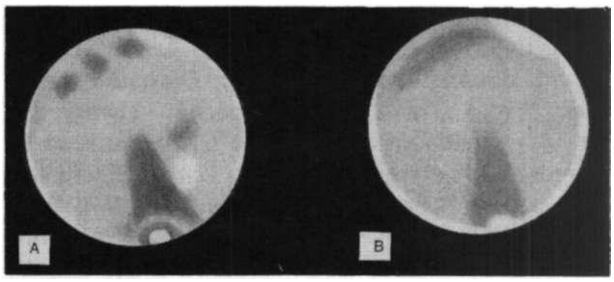

Figure 10. Two drawings by A. W. Heath, 300mm refl., x318, showing a Blue Clearing.
(a) 1980 March 12d 22h 25m, ω = 51. Integrated light.
(b) 1980 March 12d 22h 30m, ω = 51. With W47 blue-violet filter.

March 22, 25/29. Thus the Blue Clearing was only occasionally evident. More W47 filter notes by others are: Hollis, April 7, *Ceraunius* visible near ρ limb: Coates, March 21, 25, 29 and May 1, *Syrtis Major* invisible; Stott, March 9, *Mare Acidalium* invisible. Some vague shadings in blue-violet light were seen by Stott and McLeish on March 3 and April 9 respectively, with CM longs. 126° and 168°.

Terwangne's records (March 25-June 18) show that surface detail was more easily seen through the Zeiss filter with the wider passband, but, as with the W47 observations of other observers, the degree of transparency of the Martian atmosphere in violet light depended on both CM longitude and time. On March 25 *Syrtis Major* appeared almost as clearly as in white light through the Zeiss filter, which contrasts with the negative Blue Clearing recorded by Coates and Heath on the same night. But on June 4 and 8 *Syrtis Major* was invisible with the Zeiss filter. On June 5 there was a general Blue Clearing of the *Syrtis Major* area. Other notable observations were the visibility of the broad outlines of white light features through the filter on April 17 (CM long. 53°) and also on May 26 (CM long. 67°), *but excluding Mare Acidalium,* on the latter date. On other occasions only very slight evidence for Blue Clearing over parts of the disk was obtained by Terwangne, the features seen in violet light often differing from those in integrated light.

In conclusion, some slight evidence for the Blue Clearing was recorded in 1980, but it is notable that the phenomenon has been dismissed as spurious by some authorities. The ALPO reported a widespread Blue Clearing between February 3 and April 17[5].

NORTH POLAR CAP

Observing in the early morning of 1979 August 22, Moore recorded a large bright north polar *hood* with no sharp southern boundary. The observations to hand at this time are fragmentary, but by early November 1979 a sharply defined north polar *cap* had become visible, free from surrounding haze.

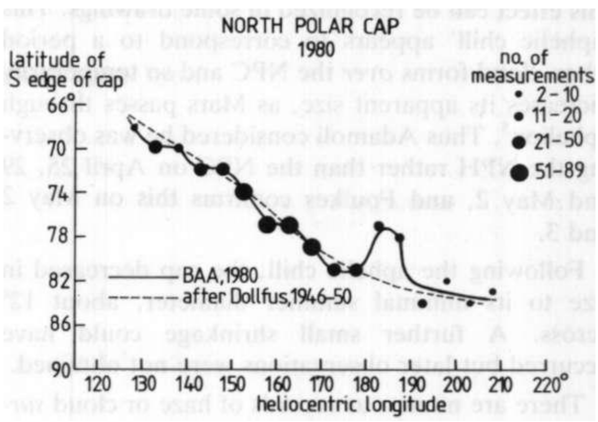

Figure 11. Curve to show the shrinkage of the NPC in 1979-80, by R. J. McKim.

The drawings reveal that a dark NPC band developed, becoming prominent by early December. The NPCB persisted until after opposition and was extremely conspicuous in December, January, February and early March. It had an apparent greenish-blue or grey-green tinge to Baum, Greenwood, Hollis, Lord and Raeburn. Some variation in NPCB intensity with longitude is indicated, whilst the collar appeared serrated to Gavin in February (figure 14a) and to Capen on various occasions. As time progressed, the edge of the cap retreated northwards at a slightly variable rate. The large number of drawings available enabled this shrinkage to be represented graphically. The latitude of the S edge of the cap on the CM of each drawing was measured, and the results combined over intervals of 5° in η (equivalent to about 12 terrestrial days). In all, 500 measurements from drawings in white light or with W15 or W25 filters were suitable for analysis, from 36 sources. Figure 11 illustrates the diminution of the cap as a function of time, and shows that the 1980 curve did not differ much from the average curve obtained by Dollfus for the 1946-50 period[7]. It will be seen that the cap occasionally remained static in size for short periods before continuing to shrink. Around η = 186° there was a small but significant increase in cap size, and

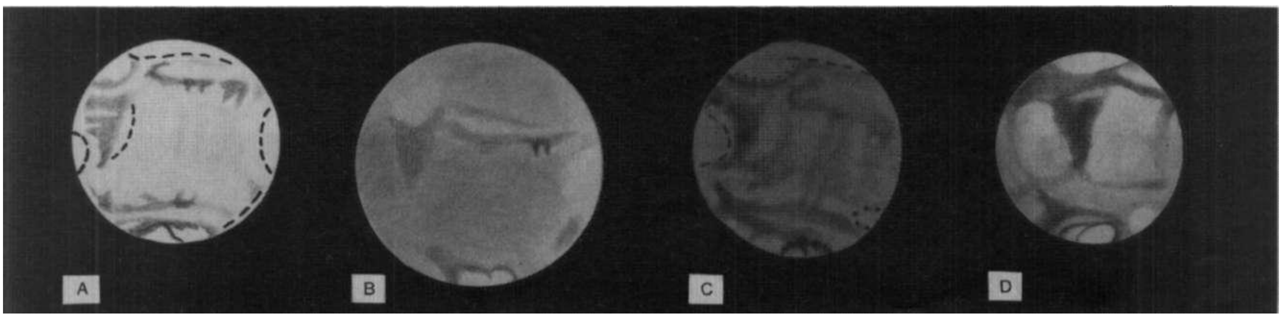

Figure 12. Drawings to show NPC details.
(a) 1980 February 23d 06h 00m, ω = 325. 610mm OG, x810. C. F. Capen.
(b) 1980 February 23d 06h 30m, ω = 332. 610mm OG, x810. P. A. Moore.
(c) 1980 April 4d 06h 40m, ω = 333. 610mm OG, x810, C. F. Capen.
(d) 1980 March 24d 22h 30m, ω = 304. 203mm Mak-Cass., x280, J. Dragesco.

this effect can be recognized in some drawings. This 'aphelic chill' appears to correspond to a period when cloud forms *over* the NPC and so temporarily increases its apparent size, as Mars passes through aphelion[5]. Thus Adamoli considered he was observing the NPH rather than the NPC on April 25, 29 and May 2, and Foulkes confirms this on May 2 and 3.

Following the aphelic chill, the cap decreased in size to its minimal summer diameter, about 12° across. A further small shrinkage could have occurred but later observations were not obtained.

There are numerous records of haze or cloud *surrounding* the polar cap, and these commence at the time when the NPCB had all but disappeared, in late 1980 March. Thus Baum recorded a tiny residual NPC surrounded by a bright summer polar haze on April 2, and Sturdy shows the same effect on March 28, 29 and 30. Coates made a number of similar observations from March 25 onwards, while Terwangne frequently draws the same aspect for the N polar region from March 25 until he observed the planet for the last time on June 23. The residual NPC was described as dull white by Doherty on June 6, and Terwangne's intensity estimates show that the cap generally became less bright as the apparition progressed.

Some evidence for haze over the cap prior to the aphelic chill is forthcoming. Observing the planet around opposition Lord remarked that observations with a W44A blue filter revealed considerable haze over the centre of the cap in February, which had disappeared by mid-March. The blue filter observations of Hollis and Robinson confirm the presence of haze over the NPC at this time.

A most interesting feature of the apparition was the reappearance, following years of invisibility, of the *Rima Tenuis* rift across the NPC. On 1980 February 11, with the CM long. 299°, Terwangne found an inflexion in the NPC outline following the CM (figure *Id).* Later observations reveal a rift in this position. Using the 610mm OG of Lowell Observatory on February 23, Patrick Moore gave the following description: "Cap not regular in outline; *Rima Tenuis* detected." Moore shows an indentation in the outline of the cap at $\omega \approx 325°$. Capen, observing with Moore, traced the indentation farther into the cap, the rift appearing to cut the cap in two. The closely comparable drawings made by these two observers are reproduced in figure 12 *(a, b).* On the following morning the observations were repeated. "Polar cap shows an indentation with *Rima Tenuis,* as before, and there is a distinct dark collar all round the cap", wrote Moore in his observing notes. Unfortunately, few other observations of this feature were received by the Section. Critical observation was hampered by the small disk size, and many UK observers experienced poor seeing conditions. However, Gavin's drawing of 1980 February 19 shows the rift partly crossing the cap, and Capen's drawings show that it was still visible later in the apparition (figures 12c, *\3b).* The end of the rift at long. 325° appears to have been the most conspicuous, and no BAA drawings showing the other end commencing are to hand, although it may have been visible to Gavin on February 19 and could correspond to a small notch at the edge of the NPC on a drawing by Dragesco on 1979 December 25 at long. 150°. According to the ALPO[5] the rift was first seen in 1979 December, and later in the apparition extended right across the cap. As Capen's February drawing in figure 12a shows, the course of the rift was not entirely straight, as one expects from the historical record. As far as the writer can ascertain, the rift was last reported in 1950*, so it would appear to have escaped detection at some aphelic oppositions.

The usual seasonal detachment of *Olympia* from the NPC was also recorded in 1980. The first indica-

**Rimu Tenuis* was discovered by Schiaparelli from Milan in 1888[8], and was reported by various observers at a few aphelic oppositions up to and including 1918, although the BAA Mars Section did not observe it at this time. It was apparently not recorded during the 1960s series of aphelic oppositions[5], and thus it appears that the 1980 observations are the first for many years. However, some additional sightings of the rift between 1918 and 1980 have been discovered by the writer. In 1950, C. F. M. du Martheray reported having seen the rift on February 19[9]. In 1933 some sightings of the more conspicuous end of the rift were made by the BAA Mars Section in February and March[10,11]; the observers were B. Burrell. F. M. Holborn, T. E.'R. Phillips and W. H. Steavenson. Holborn's drawing of March 24 shows *Rima Tenuis* cutting across the cap, and his sighting of a rift is noted in Waterfield's Interim Report[1]", but the other observers are credited here for the first time. E. M. Antoniadi also observed the rift from Meudon Observatory in the same year and published his drawings and a polar chart in *L'Astronomie*[12].

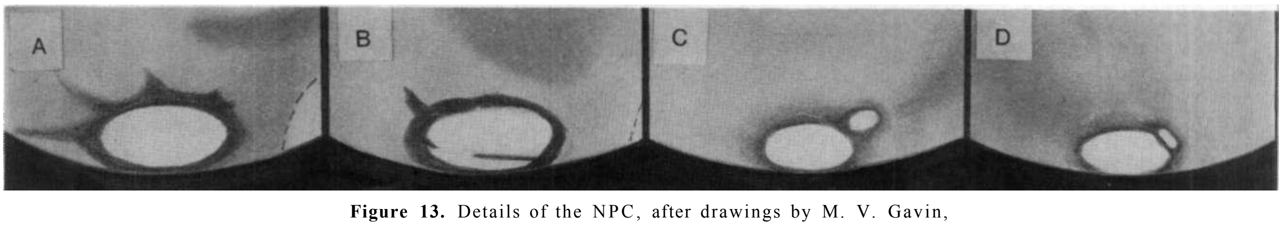

Figure 13. Details of the NPC, after drawings by M. V. Gavin,
(a) 1980 February 10d 23h 30m, ω = 335. 215mm refl., x215.
(b) 1980 February 19d 22h 45m, ω = 245. 300mm refl., x.300.
(c) 1980 March 3d 22h 45m, ω = 132. 215mm refl., x215.
(d) 1980 March 4d 23h 30m, ω = 135. 215mm refl., x215.

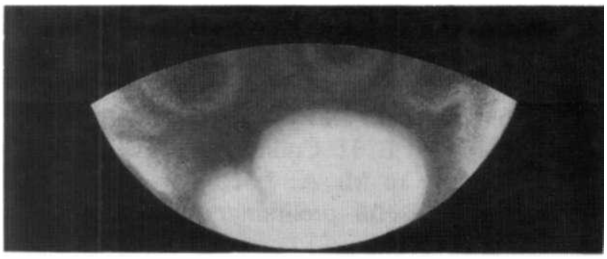

Figure 14. Drawing of the NPC showing the Rima Borealis rift, 1980 February 17d 23h 00m, ω = 266. 250mm refl., x270, C. J. R. Lord.

NORTH POLAR PROJECTION MAP 1980

from 262 measurements, η =151-170°

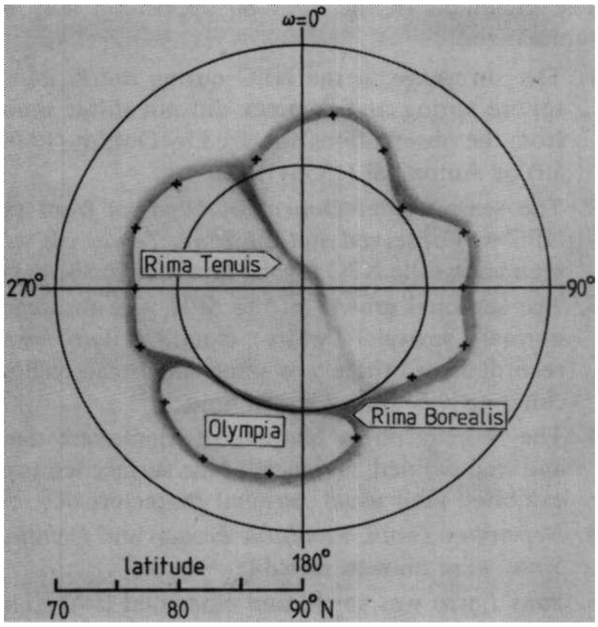

Figure 15. Map of the NPC at η = 151-170° on polar projection, by R. J. McKim. Crosses indicate the points used to define the boundary of the cap.

tion of the *Rima Borealis* rift, later to separate *Olympia* from the cap was noticed by Doherty, Hollis and Lord in the form of a notch at the edge of the NPC on February 15. In very good seeing on February 17, Lord could see the rift cutting farther into the cap (see figures *3b* and 14). *Olympia* was seen detached from the cap by Gavin on March 3 and 4, and by Dragesco on March 22, 24 and 25 (figures 12d, 13c, 13d). Further observations are not available. Thus *Olympia* was first seen detached on March 3 (η = 159°).

Reference to figure 11 shows that many drawings cover the period from η = 151° to η = 170° and that rather little change in the cap size took place over this period. The 262 measurements of the cap latitude over this period were used to derive the polar plot of figure 15, which defines the shape of the NPC over the period 1980 February 14-March 30. The sightings of *Olympia* and *Rima Tenuis* are also covered by this period about opposition (or aphelion). The measured latitudes were combined by CM longitude, being averaged over 20° or occasionally more, to define the cap boundary as a function of longitude. Interior details were added by more careful measurements on the drawings which showed them. The writer considers that the outline of the cap at this epoch is realistically delineated, but the interior details are not fully satisfactory due to the small number of observations of them. The polar plot reveals a number of small inflexions in the NPC outline. Thus the inflexion at ω — 50° is drawn by Baum on March 13, Hollis on March 8 and Terwangne on April 17.

A 'melting' curve was also drawn from measurements of the angle subtended by the NPC on each drawing, by taking the width of the cap at right angles to the CM. Though not illustrated here, this curve was in substantial agreement with that shown in figure 11. It is interesting to compare our results with those of the ALPO[5], with *Viking Orbiter* data[13], and also with measurements from previous oppositions. Firstly, our regression curve agrees very well with micrometer measurements published by the ALPO, with both sets of data showing the aphelic chill at the same heliocentric longitude. Secondly, the data are in satisfactory accord with *Viking Orbiter* data for 1979-80 as analyzed by James[13], but there is only a partial overlap in the heliocentric longitudes covered by *Viking* and the BAA. Figure 11 shows close accord between our work for 1980 and the measurements of Dollfus for 1946-50[7]. The cap was very slightly larger than predicted by Antoniadi's 'Permanent Table' (1856-1912)[x]. The cap was considerably smaller than in the 1962-67 epoch, according to the measurements of C. F. and V. W. Capen[5]. Dollfus[7], in reviewing past work on polar cap measurements, concluded that the large differences between the 'melting' curves in the literature for different epochs could be accounted for by systematic errors of measurement; the seasonal cycles of the polar caps were invariable. On the other hand, Capen and Parker[5] maintain that the irregular visibility of the *Rima Tenuis* and the variable regression curves from year to year reflect short-term changes in the Martian polar climate. The writer considers that the view expressed by Dollfus is more likely to be correct, and that it might be tested further using unpublished BAA records. The additional *Rima Tenuis* sightings reported in this paper along with the following remarks by Percival Lowell[14] concerning polar rifts are worthy of note: "Sometimes oppositions elapse between their several detections for they are not the least difficult of detail; but when they are caught, they prove to lie just where they did before".

CONCLUSIONS

The highlights of the 1979-80 opposition may be summarized:

1. The shrinkage of the NPC during the N hemisphere spring and summer did not differ much from the observations analyzed by Dollfus (1946-50) or Antoniadi (1856-1912).
2. The seasonal detachment of *Olympia* from the NPC was observed and the *Rima Tenuis* rift was seen across the NPC for the first time in 30 years.
3. The seasonal growth of the SPH was observed, normal seasonal white cloud activity was recorded, and there was some small-scale yellow cloud activity from time to time.
4. The N hemisphere features of Mars were dark and well-defined, and most of the surface features exhibited their usual seasonal characteristics.
5. *Nepenthes-Thoth, Pandorae Fretum* and *Deltoton Sinus* were faint or invisible.
6. *Solis Lacus* was small, and elongated E-W. The *Claritas-Daedalia* feature was smaller than in 1977-78.
7. An important development of the W border of *Elysium* was noted, and a new dark feature was seen across the *Aetheria* desert.

Mars Reports by the ALPO[5] and SAF[15] have already appeared for the 1980 apparition, while brief preliminary notes on the BAA observations appeared in the *Inner Planets Newsletter.*

In concluding this Report, the Co-ordinator extends his thanks to all who contributed, to Mr R. M. Baum and Mr E. H. Collinson for useful advice, and particularly to Mr A. J. Hollis for his initial collection and useful preliminary analyses of the observations.

REFERENCES

1 Ebisawa, S., Contr. Kwasan Obs. Kyoto, no. 89 (1960).
2 A reproduction of the IAU map (de Mottoni, 1957) may be found in J. Brit, astron. Assoc., 73, 28f (plate 1) (1963). See also McKim, R., ibid., 92, 170 (1982) for other sources of maps of the planet.
3 Collinson, E. H., ibid., 90, 560 (1980) and Dragesco, J., Bull. Soc. astron. France, 95, 3 (1981).
4 Collinson, E. H., J. Brit, astron. Assoc., 85, 336 (1975) and 88, 504 (1978).
5 Capen, C. F. and Parker, D. C, Strolling Astronomer, 29, 38 (1981) and 29, 51 (1981).
6 de Mottoni, G., Pubblicazioni Dell'Osservatorio Astronomico Di Milano-Merate, Nuova Serie. no. 22 (1970).
7 Dollfus, A., Icarus, 18, 142 (1973).
8 Antoniadi, E. M.. La Planete Mars, Paris, 1930.
9 du Martheray, C F. M., Orion, no. 28, 132-134 (July 1950).
10 Waterfield. R. L., J. Brit, astron. Assoc., 43, 234 and 240 (1933).
11 BAA Mars Section Archives, unpublished records.
12 Antoniadi, E. M., Bull. Soc. astron. France, 47, 345 (1933).
13 James, P. B., Icarus, 52, 565 (1982).
14 Lowell, P., Mars and Its Canals, 61, New York, 1906.
15 Dragesco, J., Bull. Soc. astron. France, 97, 141 (1983).