The opposition of Mars, 1982

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Report of the Terrestrial Planets Section *Director: R. M. Baum; Mars Coordinator: R. J. McKim*

The 1982 aphélie apparition of Mars was very well observed by the BAA. Of the surface features, *Nepenthes* remained faint, the *Aetheria* and *Claritas-Daedalia* shadings persisted, and there were some changes in the *Casius* and *Boreosyrtis* regions. White and yellow cloud activity was recorded, and the behaviour of the polar regions was well documented during spring and summer in the Martian northern hemisphere.

Introduction

Mars was closer to the Earth at opposition on 1982 March 31 than at any time since 1975. Situated in Virgo, Mars was for N hemisphere observers at a slightly lower altitude above the horizon than in 1980, but the disk diameter was larger. The N hemisphere of Mars was tilted towards the Earth and Sun for most of the period of observation, the apparition being the fourth in the present series of aphelic oppositions. Physical details of the opposition were as follows:

Diameter of Mars at opposition	14".7
Latitude of centre of disk at opposition	+22°
Declination at opposition	-1°
Heliocentric longitude (η) at opposition	190°
Mars in aphelion	1982 January 10 (η = 155°)
Summer Solstice of N hemisphere Winter Solstice of S hemisphere	1982 February 25 (η = 175°)

The Martian Date at opposition was July 8, and so most of the observations covered spring and summer in the Martian N hemisphere, as in 1980[1].

Forty-four observers provided material for this report (table 1).

A very large total of 1073 drawings and 52 photographs was received, in addition to which van der Jeugt, Wade, Wilkinson and the Coordinator prepared Mars maps from their work. Capen sent details of the observations made by the Association of Lunar and Planetary Observers (ALPO) in the USA, and Dragesco sent drawings by Hernandez, Néel, Osawa and Poyet, all contributors to the Commission des Surfaces Planétaires of the Société Astronomique de France (SAF). Dragesco also obtained a fine series of drawings and photographs with his 355 mm Celestron. The writer has sent copies of some of the BAA observations to Dragesco for his SAF Mars report. Aerts contributed a report of his observing group of the Vereniging voor Sterrenkunde. Photographs were obtained by Arbour, Mobberley, Viscardy and Young, while long series of observations were made by Adamoli, Coates, Doherty, Foulkes, Heath, Hollis, Sturdy, Terwangne, Wade and Wilkinson. Anton, Rogers and the writer made many drawings with the large refractors of Cambridge University Observatories.

The Coordinator observed Mars between 1981 September 27 and 1983 February 18 (η = 108 - 12°), but detailed coverage by the Section was only obtained from 1981 December through to 1982 June. Most observers concentrated on the opposition period from March to May, when conditions in the UK were very favourable. The severe N hemisphere winter of 1981-82 led to a shortage of early drawings. Preliminary accounts of the 1982 apparition were published in the *Inner Planets Newsletter*[2], the BAA *Circulars*[4] and in the *Journal*[*].

During the apparition, Dr Audouin Dollfus and his colleagues carried out a series of visual and photographic observations at the Pic du Midi observatory with the 1-metre and 2-metre telescopes[5-6]. Dr Dollfus has kindly permitted the reproduction of some of the photographs obtained; see figure 1. Phobos and Deimos were also photographed at Pic du Midi. Techniques for planetary photography are fully described in a recent book by Bourge, Dragesco and Dargery[8].

Figure 1 (opposite). Photographs of Mars in 1982, Kodak TP 2415 film throughout. (A)-(H) by **R.** W. Arbour (406 mm refl., f/35, 1/5 sec), J. Dragesco (355 mm Schmidt-Cass., f/80, *Vi* -2 sec.) and G. Viscardy (520 mm Newt-Cass., f/69, *V** -1 sec). (I)-(L) taken with the 1-metre and 2-metre reflectors at Pic du Midi observatory by A. Dollfus, S. Brunier and J-M. Le Bars (f/50,'/s sec.)

(A) April 2d 22h 30m, ω = 7, *Viscardy;*
(B) April 5d 00h 51m, ω = 24, *Dragesco;*
(C) March 21d 00h 39m, ω = 151, *Dragesco;*
(D) March 15d 01h 05m, ω = 214, *Viscardy;*
(E) March 10d 00h 32m, ω = 247, *Viscardy;*
(F) April 15d 23h 07m, ω = 262, *Dragesco;*
(G) April 15d 00h 02m, ω = 285, *Arbour;*
(H) April 13d 01h 13m, ω = 320, *Dragesco;*
(I) April 11d 21h 13m, ω = 270, (2-metre);
(J) April 8d 23h 15m, ω = 326, (1-metre);
(K) April 7d 23h 42m, ω = 341, (1-metre);
(L) April 4d 00h 09m, ω = 23, (1-metre);

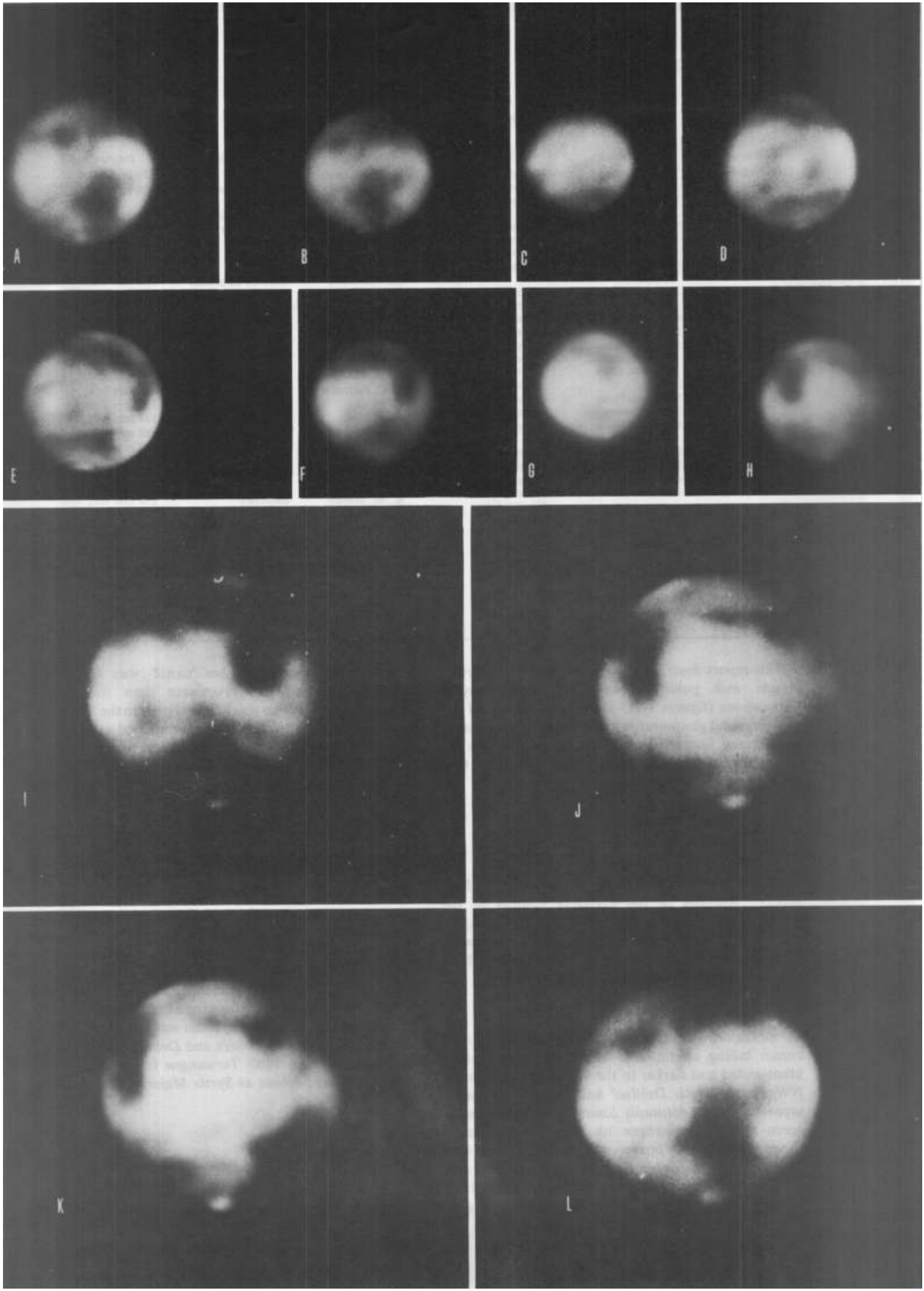
A
B
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Table 1
Observers of the 198 2 apparition

Observer	*Location*	*Instrument(s)*
G. L. Adamoli	Verona, Italy	108 mm OG and 200 mm refl.
L. Aerts	Heist-op-den-Berg, Belgium	150 mm OG
C. Anton	Cambridge	200 mm and 320 mm OGs
	Llandudno	254 mm refl.
R. W. Arbour	South Wonston, Hants.	406 mm refl.
I). Barbany	Barcelona, Spain	80 mm OG and 198 mm refl.
K. W. Blaxall	Colchester	216 mm refl.
N. D. Bryant	Ilfracombe	254 mm refl.
C. F. Capen	Lowell Observ-atory, Flagstaff, Arizona, USA	406 mm Cass., 310 mm and 610 mm OGs
J. Coates	Burnley	300 mm refl.
P. B. Doherty	Stoke-on-Trent	419 mm refl.
	Selsey, Sussex	125 mm OG
J. Dragesco	Cotonou, Benin, W. Africa	355 mm Schmidt-Cass.
E. L. Ellis	St Albans	90 mm OG
M. Falorni	Florence, Italy	203 mm refl.
M Foulkes	Cleethorpes	254 mm refl.
	Hatfield, Herts.	203 mm and 406 mm Cass.
W E. Fox	Newark, Notts.	254 mm refl.
M H. Gaiger	Kingston-upon-Thames	216 mm refl.
I. Hancock	Whitstable	222 mm refl.
Λ. W. Heath	Long Eaton, Notts.	300 mm refl.
C. Hernandez	Miami, Florida, USA	320 mm refl.
A. J. Hollis	Northwich	300 mm refl.
R. M. B. Lewis	Cardiff	279 mm refl.
R. J. Livesey	Newton Mearns, Glasgow	216 mm refl.
K. P. Marshall	Medellin, Colombia, S. America	203 mm refl.
R. J. McKim	Cambridge	200 mm and 320 mm OGs
	Colchester	216 mm refl.
M. Mobberly	Bury St Edmunds	356 mm Cass.
P. A. Moore	Selsey, Sussex	125 mm OG, 320 mm and 390 mm refls.
R. Neél	Vénissieux, France	308 mm refl.
T. Osawa	Fukuoka, Japan	200 mm and 320 mm refls.
P. W. Parish	Gillingham	222 mm refl.
R. A. Paterson	Thame, Oxon.	320 mm refl.
S. C. Pattinson	S. Croydon, Surrey	215 mm refl.
P. Poyet	Nice, France	307 mm Cass.
A. J. Read	Yateley, Hants.	114 mm refl.
J. H. Robinson	Teignmouth, Devon	260 mm refl.
J. H. Rogers	Cambridge	200 mm and 320 mm OGs
J. M. Saxton	Leeds	216 mm refl.
D. Stott	Winchester	298 mm refl.
K. M. Sturdy	Helmsley	216 mm refl.
R. de Terwangne	Antwerp, Belgium	203 mm Cass.
A. van der Jeugt	Gent and Lokeren, Belgium	125 mm OG and 150 mm Mak-Cass.
G. Viscardy	St Martin-de-Peille, France	520 mm Newt-Cass.
P. Wade	Morecambe	308 mm refl.
A. W. Wilkinson	Worcester	229 mm refl.
A. Young	Hemingford Abbots, Cambs.	610 mm refl.

This report describes the surface features, Martian clouds and polar regions. The accompanying illustrations (figures 1-11) present a selection of the drawings and photographs received, a general chart of the surface features, and diagrams to illustrate the seasonal behaviour and shape of the North Polar Cap (NPC).

Surface Features

These are discussed in the same manner as for the 1980 report[1]. Records of the apparent colours of the markings were made by Doherty in March and April, with occasional notes by others. In the following descriptions the nomenclature of Ebisawa[7] has been adopted. E and W are used areographically.

Region I: ω = 250-010°

Syrtis Major, wide and dark, with a pointed NE (IAU) corner tailing off into the ***Nilosyrtis.*** It was rather blunt-ended and darker to the N, with a bulge in the NW corner which Dollfus[5] and Osawa show as a separate patch ***(Astusapis Sinus).*** The ***Syrtis*** had a green tint to Terwangne on March 6; Hancock thought it to be grey brown on April 12; but otherwise no observer remarked upon its colour. ***Astusapes*** and ***Astaboras*** were pale streaks emanating from the N end of the ***Syrtis. Libya*** made a small incursion into the SE part of ***Syrtis Major*** as in 1980. ***Moeris Lacus*** was small, and the ***Nepenthes*** 'canal' was faint or incomplete, and less prominent than ***Nilosyrtis.*** However, ***Nepenthes*** was a little darker to the N, more so than in 1980, and its N end terminated at a small, very dark round spot: ***Nubis Lacus. Nubis Lacus*** was not seen in 1980; the writer considered that a similar though less prominent feature further N in that apparition was better regarded as ***Nodus Alcyonius**.*** Other areas N of the ***Syrtis Major*** also appeared to have altered since the last opposition. ***Nubis Lacus*** appeared a little SE of the tip of ***Casius,*** while ***Boreosyrtis-Coloe Palus*** appeared as a moderately dark E-W elongated condensation on the ***Nilosyrtis*** streak. At the previous apparition ***Boreosyrtis*** was connected to dusky N shadings (***Umbra)*** and thence to the darker ***Utopia*** region, but in 1982 ***Umbra*** had brightened to leave a gap between ***Boreosyrtis*** and ***Utopia. Utopia*** was shaded, appearing grey to Terwangne, with ***Casius*** forming a rather darker S end to this feature. ***Nodus Alcyonius*** was not seen. To the S and SW, ***lapigia*** was dark and ***Deltoton Sinus*** faint or invisible as in 1980. Terwangne found ***lapigia*** to have the same colour as ***Syrtis Major.***

*Measurements of the 1982 drawings and photographs place *Nubis Lacus* at +29°N, long. 265°, corresponding with the feature marked *Thoth* on the 1957 de Mottoni IAU Mars map (+30, 255). Ebisawa's map places *Nubis Lacus* at +22, 258 and *Nodus Alcyonius* at +33, 258.

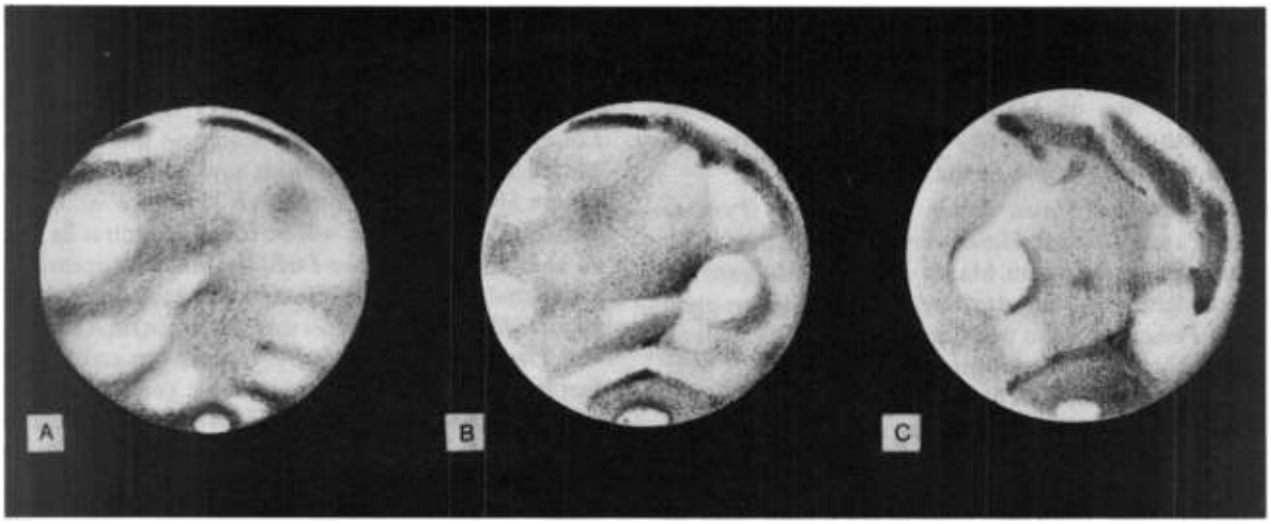

Figure 2. Drawings by **P. B.** Doherty with 419 mm refl., x 248, x 372.

(A) 1982 April 24d 20h 15m, ω = 142;
(B) 1982 April 19d 20h 00m, ω = 182;
(C) 1982 April 15d 21h 45m, ω = 243.

The accompanying illustrations show these features of the ***Syrtis*** region well: ***Nubis Lacus*** appears clearly in Viscardy's photograph (figure le) and is also evident on figure s 2c, 5d, 6b, 7b, 7c and in the Pic du Midi photos. Rogers' drawings in figure s 7b and 7c (made under superb seeing conditions) show the peculiar curve in the S tip of ***Casius, Nepenthes*** incomplete, the S end of ***Nilosyrtis,*** and also ***Boreosyrtis*** as an isolated patch. Figures 3f , 5f , 6b and 8b also illustrate this region. To the N, ***Copais Palus*** was dark, and the ***Cecropia*** and ***Ortygia*** regions to the W were usually dusky.

The ***Protonilus-lsmenius Lacus-Deuteronilus*** complex was dark and well seen, as a continuation of the ***Nilosyrtis-Boreosyrtis*** region. The complex darkened in the Martian N summer. ***Siloe Pons*** was also clearly visible as a dusky spot. The deserts to the N and S, ***Aeria, Arabia, Moab, Cydonia,*** etc., were described variously as ruddy or pink by Doherty. To the S of Region I, ***Sinus Sabaeus*** appeared as in 1980, as a dark strip with the E end (E of ***Portus Sigeus)*** noticeably faint and incomplete throughout the apparition. Doherty found it to have a blue-grey tint; the fading of the E end must be a permanent change rather than being due to veiling by cloud. Figures 5e and 6b show this aspect clearly, as do the Pic du Midi photos (figure 1). ***Mare Serpentis*** was weakly shaded, ***Hellespontus*** dusky but too fa r S to be well seen, and ***Yaonis Fretum*** formed a darker W border to the ***Hellas*** basin. ***Pandorae Fretum*** was darker than in 1980, particularly after opposition, though it was always less intense than ***Sinus Sabaeus.*** Numerous streaky half - tone feature s appeared in the equatorial deserts of Region I (see figur e 4). ***Euphrates, Gehon, Hiddekel*** and ***Oxus II*** were particularly noticeable as broad, dusky, curved streaks. ***Edom Prom,*** was noted as an occasionally lighter patch; Doherty foun d this crater to be bright pink on April 18. ***Deucalionis Regio*** was light, as were the deserts to the S ***(Ausonia, Hellas*** and ***Noachis).*** The W end of ***Mare Tyrrhenum, Syrtis Minor, Sinus Gomer {Cyclopia*** on the IAU map), ***Mare Hadriacum*** and ***Hesperia*** were all well-marked; the whole region had a green tint to Terwangne on March 6, while Doherty foun d ***Mare Tyrrhenum*** and ***Mare Hadriacum*** blue-grey in colour. Some observers show ***Amenthes*** as a dusky streak.

Region II: ω = 010-130°

Mare Acidalium, dominating this region, was dark throughout the apparition, particularly in its N parts. Its interior appeared slightly lighter than its edges. Anton, Heath and Terwangne foun d it to be grey and Osawa foun d it blackish-grey. ***Achillis Pons*** and ***Niliacus Lacus*** were well seen to the S as in 1980. The darker edges of ***Mare Acidalium*** continued E and W as the dusky streaks of ***Calirrhoe*** and ***Tanais. Nilokeras,*** wide and dark, appeared double to some observers, with Adamoli detecting a greenish tint on March 21. ***Achillis Fons*** and ***Idaeus Fons*** were dark condensations on ***Nilokeras. Lunae Lacus*** was well-marked, and intensity estimates by Heath and McKim suggest that it darkened in late March, remaining dark for the rest of the apparition. Heath foun d ***Lunae Lacus*** brown on May 3 and 4, contrasting with the greyness of ***Mare Acidalium.*** The aforementione d features are well seen in figures 3a-c, 5a, b and f, 9a, b and j and in some photographs. ***Hyperboreus Lacus,*** north of ***Mare Acidalium,*** is described in the NPR section.

Ceraunius was visible in its S half , but McKim thought it better seen in 1980. ***Ascraeus Lacus (Ascraeus Mons)*** was large and quite dark, especially after opposition. Other volcano sites in the ***Tharsis*** region were also observed and can be recognised from the general map (figur e 4); see also figure s 2a, 2b, 3d, 5b, 9c and 9d which also show white afternoon clouds associated with these surface features. Elusive details

in the ***Amazonis*** desert were also charted, high cloud activity rendering identification often difficult. ***Chryse*** was yellowish to Heath on March 31, while ***Tempe*** was orange to him on March 23 and yellowish-pink or yellowish-white to Doherty in late March. Both these areas were very bright at the limb.

Margaritifer Sinus, Mare Erythraeum, Pyrrhae Regio and ***Aurorae Sinus*** were normal, as in 1980. Doherty, observing on March 30 found ***Margaritifer Sinus*** light grey, but ***Aurorae Sinus*** was green-grey. ***Oxia Palus*** was quite well seen, appearing as a streak rather than a spot. ***Juventae Fons*** and ***Baetis*** were difficult, but were seen by Capen, Doherty, Hollis and Poyet. Doherty found ***Juventae Fons*** very small on March 30. The ***Solis Lacus-Thaumasia-Tithonius Lacus*** area was similar to 1980, but was even more foreshortened, lying very close to the S limb. Also, as in 1978 and 1980, white clouds from ***Thaumasia*** interfered with the visibility of details. ***Solis Lacus*** was small, uniform in intensity, elongated E-W, and connected to ***Mare Erythraeum*** by the ***Nectar*** streak according to Capen and Dragesco. ***Tithonius Lacus*** was resolved into two lobes by Dragesco on March 26 (figure 3c). As in 1980, a small remnant of the ***Claritas-Daedalia*** secular darkening was seen, between ***Solis Lacus*** and the E end of ***Mare Sirenum,*** but only Dragesco, McKim, Rogers and Terwangne show it unambiguously on the drawings available. For example, Dragesco shows it clearly on the f limb on March 26 (figure 3c), McKim saw it well on June 6 (figure 5b) and Rogers on March 25 (figure 7e). Other drawings of the region will be found in figures 2a, 3b, 9c and 9d. The ***Claritas-Daedalia*** feature appeared a little smaller than in 1980, and pointed to the south (figures 5b and 7e). ***Araxes*** was seen from time to time, and ***Phoenicus Lacus*** nearby. ***Ganges*** was an obvious feature, and was sometimes double (or had darker edges) to Capen (figure 9b) and Dragesco (figure 3b). ***Indus*** and ***Jamuna*** were faint streaks across the ***Chryse*** desert. ***Argyre*** often appeared bright on the S limb.

Region III: ω = 130-250°

Elysium often appeared as a bright region, surrounded by dusky shadings. Its colour was described as reddish or pinkish by Terwangne on April 15 and May 24, and as yellowish by Doherty and Rogers in April. Its brightness was not always uniform ; for example,

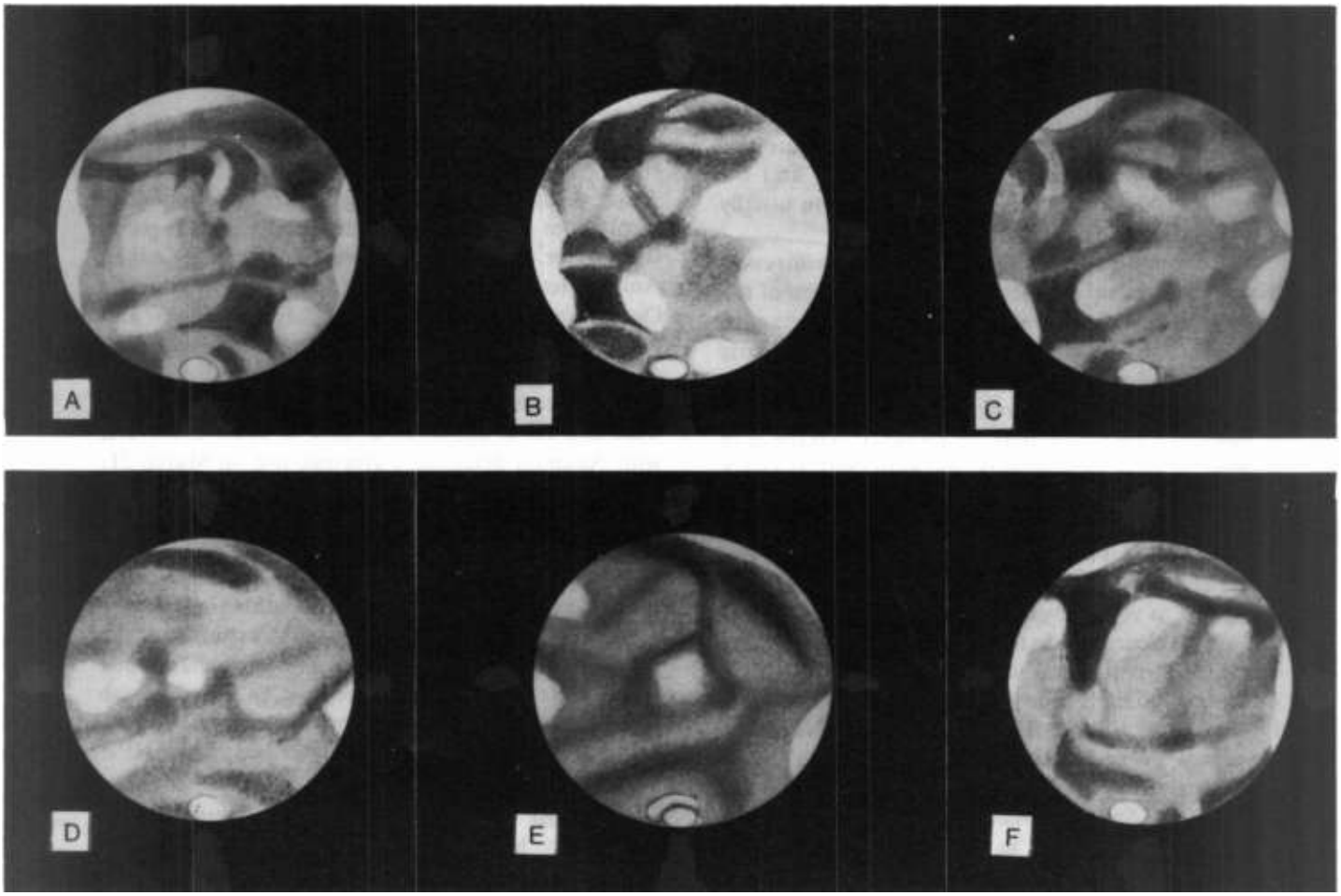

Figure 3. Drawings by J. Dragesco with 355 mm Schmidt-Cass., χ 490.

(A) 1982 April 5d OOh 10m, ω = 14;
(B) 1982 May Id 19h 51m, ω = 74;
(C) 1982 March 26d 23h 01m, ω = 76;
(D) 1982 March 21d OOh 07m, ω = 144;
(E) 1982 April 19d 22h 05m, ω = 210;
(F) 1982 March 7d 03h 01m, ω = 310;

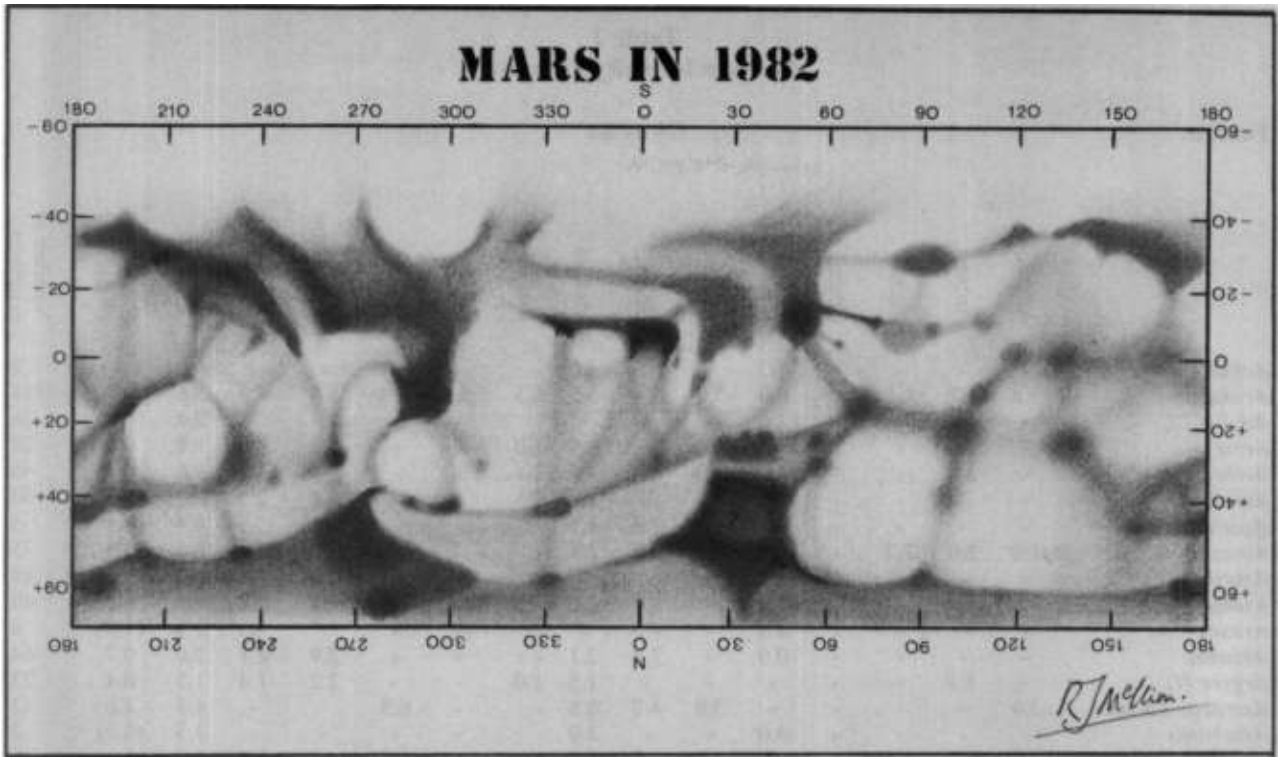

Figure 4. Albedo map of Mars in 1982, *R. J. McKim.*

Doherty found the p portion brilliant yellow-white and the rest ochre on April 20. The feature s ***Cerberus, Trivium Charontis, Phlegra, Styx, Propontis I*** and ***Propontis II*** were dark and conspicuous, and better seen than at opposition in 1980. ***Cebrenia*** was ofte n bright on the N border of ***Elysium,*** appearing pinkish to Doherty. The curved dusky W border of ***Elysium*** and ***Morpheos Lacus*** were also obvious. The ***Aetheria*** darkening, discussed in our last report[1] was very dusky and extensive, appearing grey to Doherty. This shading affected a wide area; see figures 2b, 5d, 7a, 7b, 8a and 8b, whilst figure s 2c, 3e, 5c, 6a and 9e also represent the ***Elysium*** area. The Pic du Midi photographs and those of figure ld-f also show ***Elysium*** and the ***Aetheria*** darkening. The shading was most intense at the W border of ***Elysium.*** A number of streaks were seen around ***Elysium,*** such as ***Eunostos I, Chaos*** and ***Hyblaeus. Cyclops*** and ***Cerberus II*** were a pair of diverging streaks going S fro m the tip of ***Cerberus (I)*** and terminating at ***Sinus Gomer*** (figur e 8a). ***Sithonius Lacus*** was a small dark spot, and ***Stymphalius Lacus*** was also seen to the N of ***Elysium. Herculis Pons*** appeared dusky early on, but later appeared as a bright region separating ***Propontis*** /fro m ***Propontis II***due to atmospheric activity in this region. ***Euxinus Lacus*** appeared to the E of ***Propontis I.*** In excellent seeing in April Doherty saw ***Thoana Palus*** (though not ***Nodus Laocoontis)*** as a dusky spot E of and rather fainte r than ***Nubis Lacus.*** The S deserts ***Phaethontis, Electris, Eridania*** and ***Ausonia*** were ofte n bright on the S limb. ***Eridania*** was described as being bright pink-white by Doherty on April 14. ***Mare Sirenum, Mare Cimmerium*** and the E end of ***Mare Tyrrhenum*** were normal, with some internal detail seen. Doherty found ***Mare Sirenum*** a dark blue-grey and ***Mare Cimmerium*** grey-green on April 19. The desert areas of ***Aeolis, Aethiopis*** and ***Zephyria*** were essentially featureless , and were described as reddish or pinkish by Doherty and Terwangne.

Apparitional Map

Visual and photographic observations made around the time of opposition by Capen, Doherty, Dragesco, Heath, Hollis, McKim, Osawa, Rogers, Sturdy, Terwangne, Viscardy and Wilkinson were used to construct the BAA 1982 apparitional map of figure 4. Coordinates of the main feature s were taken fro m Ebisawa's general chart, modifie d where necessary by supplementary measurements on the drawings and photographs using overlay graticules. The Pic du Midi photographs were extremely usefu l fo r positional measurements (covering the ***Elysium-Syrtis Major-Mare Acidalium*** regions). A greater amount of fin e detail is noticeable on the 1982 chart, reflectin g the increased opposition disk diameter fro m 1980.

Intensity Estimates

The white light intensity data submitted by 13 observers were suitable fo r analysis. Of the 3817 estimates submitted by these observers, 3308 were usefully incorporated into table 2. The average intensities for features given in the table are normal for N spring and summer, except where secular changes have occurred. Short-term variations are referred to in the text. As in 1980, the average intensities were useful in drawing up the apparitional map.

Table 2
Martian Intensity Estimates

Feature	*Observer*															
	Adamoli	Anton	Blaxall	Coates	Doherty	Heath	Hollis	McKim	Rogers	Stott	Sturdy	Terwangne	Wade	Average intensity	Standard deviation	Number of estimates
A chillis Pons	–	–	–		–	–		4.0	–	–	–	–	–	4.0	(-)	2
Acidalium, M.	5.8	4.7	4.5	6.0	6.0	5.7	5.4	5.5	6.5	5.5	7.9	5.0	4.5	5.6	0.9	118
Aeolis	-	-	-	-	2.6	-	-	-	-	-	-	2.3	-	2.4	(0.2)	26
Aeria	-	2.0	-	-	1.5	-	-	1.9	1.0	-	-	2.1	2.0	1.8	0.4	28
Aetheria	-	3.8	-	-	4.7	3.0	-	4.6	3.1	-	-	3.1	3.2	3.6	0.7	46
Aethiopis	-	-	-	-	2.6	1.2	-	2.0	1.5	-	-	2.8	2.7	2.1	0.7	50
Agathodaemon	-	-	-	-	-	-	4.4	4.5	-	-	-	-	-	4.4	(0.1)	6
Amazonis	1.2	2.0	2.2	-	1.8	-	2.2	2.1	-	-	-	3.0	2.1	2.1	0.5	75
Amethes	-	-	-	-	3.8	-	-	-	-	-	-	2.7	-	3.2	(0.6)	18
Arabia	1.8	2.0	-	-	2.0	-	2.4	2.0	1.5	2.0	-	2.2	2.2	2.0	0.3	40
A raxes	-	-	-	-	2.5	-	4.5	-	-	-	-	-	-	3.5	(1.0)	6
Arcadia	-	-	-	-	0.9	-	2.1	2.1	-	-	-	2.9	2.1	2.0	0.7	64
Argyre (I)	-	1.3	-	-	-	-	-	1.5	1.0	-	-	2.2	1.4	1.5	0.4	23
Ascraeus Lacus	3.0	-	-	-	-	3.0	4.2	4.8	-	-	6.5	-	-	4.3	1.6	12
Astaboras	-	-	-	-	4.0	-	-	3.0	-	-	-	-	-	3.5	(0.5)	2
Aurorae Sinus	5.5	-	4.5	-	-	-	4.3	5.2	-	-	8.9	4.2	5.5	5.4	1.6	36
Ausonia	1.1	1.5	1.5	-	0.3	-	-	1.4	1.5	-	-	1.9	1.6	1.4	0.5	39
Ballia	-	-	3.5	-	-	-	-	3.7	-	-	-	4.4	-	3.9	0.5	27
Boreosyrtis	-	-	-	-	-	-	4.8	-	3.5	-	-	4.5	-	4.3	0.7	33
Boreum, M.	4.5	-	-	-	5.0	6.0	4.7	3.6	-	6.5	-	4.5	3.9	4.8	1.0	60
Callirrhoe	-	-	-	-	-	-	7.0	5.4	-	-	-	-	-	6.2	(0.8)	5
Candor	-	-	-	-	-	-	-	-	-	-	-	2.3	-	2.3	(-)	17
Casius	-	-	-	-	4.4	4.0	-	4.6	6.0	-	-	3.8	3.7	4.4	0.8	35
Cebrenia	-	-	-	-	2.0	-	1.8	2.4	1.5	-	-	3.4	1.9	2.2	0.7	50
Cecropia	4.3	3.5	-	-	-	5.0	-	3.4	2.5	4.7	-	4.2	4.0	4.0	0.8	32
Ceraunius	-	-	-	-	-	-	3.2	3.7	-	-	5.0	3.0	-	3.7	0.9	35
Cerberus	-	-	3.5	-	3.7	-	4.0	4.8	-	-	-	3.4	3.2	3.8	0.6	40
Chaos-Hyblaeus	-	-	3.8	-	-	-	3.5	4.4	-	-	-	-	-	3.9	0.5	7
Chryse	1.8	-	2.5	-	-	-	2.3	2.0	0.5	-	-	2.2	1.8	1.9	0.7	41
Cimmerium, M.	5.8	4.1	4.5	6.3	6.0	5.0	4.5	5.2	5.5	6.0	8.2	4.5	4.6	5.4	1.1	93
Claritas	-	-	-	-	-	-	-	-	-	-	-	2.9	-	2.9	(-)	18
Copais Palus	-	-	-	-	5.1	-	-	5.0	-	-	-	-	-	5.0	(0.1)	4
Cydonia	3.0	3.0	-	-	2.0	-	1.7	2.0	-	-	-	3.2	2.6	2.5	0.6	39
Deucalionis Regio	-	-	-	-	1.0	-	3.0	1.9	-	-	-	3.8	2.5	2.4	1.1	18
Deuteronilus	4.0	4.0	-	-	4.5	-	4.6	4.5	-	-		–	–	4.3	0.3	8
Diacria	-	-	-	-	2.0	-	-	3.0	-	-	-	3.6		2.9	0.8	33
Dioscuria	3.2	-	-	-	2.0	-	-	2.0	-	-	-	3.3	2.0	2.5	0.7	24
Eden	1.5	2.1	2.5	-	-	-	1.8	2.0	1.5	2.0	-	-	2.6	2.0	0.4	39
Electris	1.5	0.8	2.0	-	0.5	-	1.9	1.4	-	-	-		2.0	1.4	0.6	16
Elysium	1.4	2.3	1.8	2.0	1.2	1.5	2.2	1.2	0.5	2.0	-	2.4	1.4	1.6	0.6	79
Eridania	1.8	1.0	2.0	-	0.5	-	2.0	1.7	-	-	-		1.4	1.5	0.6	33
Erythraeum, M.	5.1	4.0	3.5	-	-	3.0	4.6	4.3	4.2	-	7.0	4.1	4.1	4.4	1.1	71
Eunostos (I)	-	-	-	-	3.2	-	3.8	-	-	-	-	-	-	3.5	**(0.3)**	3
Ganges	-	-	-	-	-	-	-	3.8	-	-	5.0	-	2.8	3.9	**1.1**	5
Gehon	-	3.5	-	-	-	-	-	3.0	-	-	-	-	-	3.2	(0.2)	2
Corner Sinus	-	-	-	-	-	-	6.0	5.5	-		-	4.1	–	5.2	1.0	21
Hadriacum, M.	-	-	-	-	6.7	-	-	6.0	-	-	-	4.3	-	5.7	1.2	11
Hellas	0.6	0.3	1.2	1.4	0.5	0.3	0.3	0.4	0.8	1.2	0.1	1.2	1.0	0.7	0.4	62
Hellespontus	-	-	-	-	-	-	-	-	-	-	-	3.7	-	3.7	**(-)**	5
Hesperia	-	-	-	-	3.7	2.5	-	2.0	3.5	-	-	4.1	3.0	3.1	0.8	24
Hyperboreus Lacus	-	6.0	-	-	-	6.0	4.0	6.6	-	-	9.2	-	-	6.4	1.9	13
lapigia	6.2	-	-	-	6.0	-	5.4	5.1	6.5	-	-	4.8	4.6	5.5	0.7	51
Isidis Regio	1.7	-	2.5	-	2.8	-	2.8	2.0	1.6	-	-	2.3	2.0	2.2	0.5	38
Ismenius Lacus	4.5	-	3.0	-	3.5	-	4.3	5.5	-	-		3.4	3.0	3.9	0.9	22
Libya	-	-	-	-	1.5	0.8	2.3	1.7	1.2	2.0	-	2.8	1.8	1.8	0.6	42
Lunae Lacus	-	5.0	-	-	-	3.7	4.7	5.2	-	-	-	3.9	3.8	4.4	0.7	42
Margaritifer Sinus	-	4.5	-	4.0	-	4.8	4.5	5.3	-	5.0	-	3.9	3.2	4.4	0.7	32
Memnonia	2.0	-	-	-	1.4	-	2.0	2.0	-			2.4	2.0	2.0	0.3	35
Meridiani Sinus	5.6	4.5	4.0	6.0	6.0	5.2	5.3	5.9	7.0	7.0	9.0	4.5	5.0	5.8	1.3	51
Moab	-	-	-	-	2.0	-	-	-	-	-	-	2.2	-	2.1	(0.1)	9

Feature	*Observer*															
	Adamoli	Anton	Blaxall	Coates	Doherty	Heath	Hollis	McKim	Rogers	Stott	Sturdy	Terwangne	Wade	Average intensity	Standard deviation	Number of estimates
Moeris Lacus			–	–	3.8	–	–	–	–	–	–	3.0	–	3.4	(0.4)	12
Neith Regio	1.7	-	2.5	-	2.8	1.0	2.8	2.0	1.6	-	-	2.7	2.2	2.1	0.6	44
Nepenthes	-	-	-	-	3.1	-	3.8	-	-	-	-	-	-	3.4	(0.4)	7
Niliacus Lacus	6.0	-	-	-	6.0	-	4.9	5.2	-	5.0	7.8	4.7	3.3	5.4	1.3	39
Nilokeras	5.2	3.2	-	-	-	3.0	4.5	4.6	-	-	6.8	4.3	3.3	4.4	1.3	72
Nilosyrtis	-	-	-	-	-	-	-	-	-	-	-	3.6	-	3.6	(-)	21
Noachis	1.7	-	-	-	0.5	-	2.9	1.0	-	-	-	3.0	1.9	1.8	1.0	36
Nodus Gordii	-	-	-	-	3.8	-	-	3.9	-	-	-	-	-	3.8	(0.1)	3
Nuhis Lacus	4.5	4.0	-	-	5.3	-	4.0	4.5	5.0	-	-	3.9	-	4.4	0.5	29
Olympus Mons	-	-	-	-	-	-	-	4.2	-	-	-	-	-	4.2	(-)	2
Ortygia	-	-	-	-	-	-	-	3.4	-	-	-	3.4	-	3.4	(0.0)	23
Panchata	4.5	5.0	-	-	4.1	4.2	-	3.9	4.5	-	6.3	4.3	3.9	4.5	0.8	70
Pandorae Fretum	-	-	-	-	2.5	-	5.2	3.0	-	-	-	3.8	-	3.6	1.2	12
Phaethontis	1.2	-	-	-	-	-	-	0.5	-	-	-	-	-	0.8	(0.4)	5
Phlegra	-	3.8	3.7	-	4.5	-	-	4.2	-	-	-	3.7	3.3	3.9	0.4	51
Phoenicus Lacus	-	-	-	-	3.2	-	-	-	-	-	-	-	-	3.2	(-)	1
Propontis I	-	4.8	4.5	-	6.2	-	3.8	4.6	3.0	-	-	4.0	3.5	4.3	1.0	54
Propontis II	-	-	-	-	7.0	-	4.3	5.2	3.5	-	-	-	-	5.0	1.5	20
Protonilus	4.0	-	-	-	-	-	-	3.2	-	-	-	-	-	3.6	(0.4)	3
Sabaeus Sinus	4.7	3.8	4.0	-	4.8	6.0	5.0	4.5	-	5.0	6.5	4.0	3.8	4.7	0.9	56
Scandia	3.5	-	-	-	3.8	4.0	-	3.5	-	-	-	3.1	4.1	3.7	0.4	49
Serpentis, M.	-	-	-	-	4.0	-	-	-	-	-	-	4.0	-	4.0	(0.0)	10
Sirenum, M.	5.1	-	-	-	6.7	3.0	4.4	4.8	-	-	-	4.1	3.9	4.6	1.2	67
Sithonius Lacus	-	-	-	-	4.8	-	-	-	-	-	6.8	-	-	5.8	(1.0)	4
Solis Lacus	-	5.0	-	-	5.5	-	4.6	4.7	-	-	-	3.3	-	4.6	0.8	34
Styx	-	-	-	-	2.9	-	-	4.0	-	-	-	-	-	3.4	(0.6)	2
Syrtis Major	6.4	5.6	4.5	6.9	7.3	6.5	5.7	5.8	7.2	7.0	8.2	5.4	6.0	6.3	1.0	96
Syrtis Minor	-	-	-	-	-	-	6.8	6.0	-	-	-	-	-	6.4	(0.4)	6
Tanais	-	-	-	-	-	-	-	6.0	-	-	-	4.6	-	5.3	(0.7)	26
Tempe	1.7	-	-	-	0.8	0.5	2.0	1.4	-	-	-	2.7	1.4	1.5	0.7	80
Tharsis	1.7	2.0	2.5	-	1.2	-	2.1	2.0	-	2.2	-	2.6	2.9	2.1	0.5	69
Thaumasia	-	-	-	-	-	-	-	2.1	-	-	-	3.1	-	2.6	(0.5)	22
Thimiamata	-	-	-	-	-	1.0	-	-	-	-	-	2.5	-	1.8	(0.8)	9
Tithonius Lacus	-	-	-	-	3.4	-	-	4.3	-	-	-	3.4	-	3.7	0.5	27
Trinacria	-	-	-	-	5.8	-	-	-	-	-	-	4.5	-	5.2	(0.6)	12
Trivium Charontis	-	4.2	-	-	4.7	3.0	4.1	4.9	3.5	-	6.1	3.6	3.5	4.2	0.9	47
Tyrrhenum, M.	6.5	4.5	3.7	6.0	6.6	5.7	5.1	6.0	6.2	6.0	8.7	4.6	4.7	5.7	1.3	81
Utopia	5.1	4.1	3.5	3.3	3.0	4.8	-	4.4	5.0	4.0	6.6	4.0	3.9	4.3	1.0	97
Xanthe	1.5	2.0	-	-	-	-	-	2.0	-	-	-	2.5	1.7	1.9	0.4	36
Yaonis Fretum	-	-	-	-	-	-	4.0	5.0	-	-	9.0	-	-	6.0	2.6	4
Zephyria	1.8	-	-	-	2.8	-	2.5	2.1	1.5	-	-	2.3	1.8	2.1	0.4	54
No. of useful estimates:	188	88	50	35	146	82	325	456	47	26	118	1254	493	Total		3308

Period of Observation	December 27 - July 4	November 5- July 17	January 31 - June 4	January 27 - May 16	April 8 - June 1	March 23 - May 25	October 21 - July 20	November 19 - June 20	January 24 - May 25	March 25 - May 10	February 14 - May 29	January 16 - July 4	March 4 - June 14

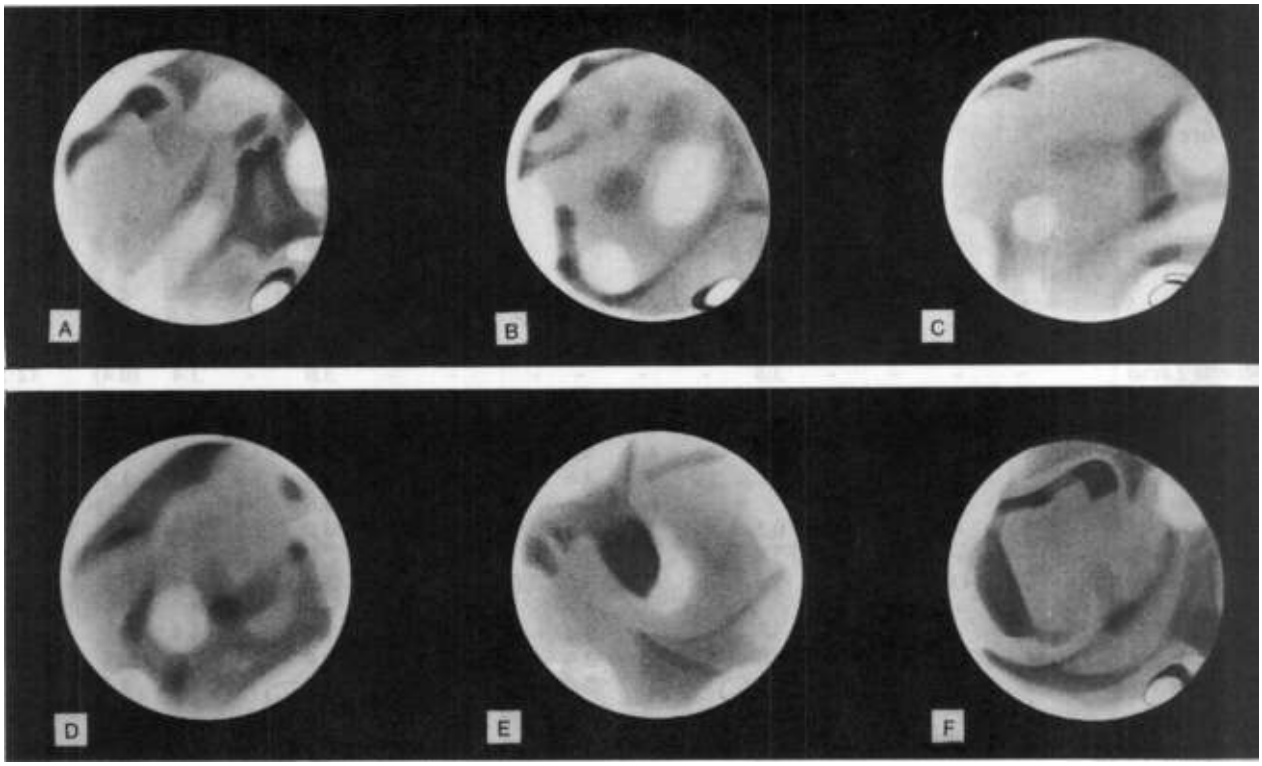

Figure 5. Drawings by R. J. McKim .

(A) 1982 May 9d 20h 10m, ω = 6, 320 mm OG, x 320;
(B) 1982 June 6d 20h 35m, ω = 112, 320 mm OG, x 320;
(C) 1982 April 21d 20h 20m, ω = 169, 320 mm OG, x 320;
(D) 1982 April 14d 20h 00m, ω = 226, 216 mm refl., x 232;
(E) 1982 April 8d 20h 45m, ω = 290, 216 mm refl., x 232;
(F) 1982 May 13d 20h 38m, ω = 336, 320 mm OG, x 230, x 320.

The Martian atmosphere

This section of the report covers white cloud activity (including the behaviour of the S polar hood), yellow cloud activity and the Martian blue clearing. An idea of the Section's coverage of the planet from 1981 October to 1982 July is given by the following figures which show the number of days per month in which observations were available: October: 3 (observed)/31 (possible); November: 7/30; December: 13/31; January: 15/31; February: 27/28; March: 31/31; April: 30/30; May: 30/31; June: 24/30; July: 11/31.

White clouds and the S polar hood (SPH)

The size, brightness and location of brighter areas on the planet are the criteria for deciding if these are white clouds or frost patches on the surface . Filter observations also help. Some distinction between clouds and frost patches has been attempted in the following account.

1981 October

No Martian clouds were observed on the tiny disk of the planet, far from opposition. The SPH was not detected as no observer shows any of the S deserts to be brighter than the equatorial regions.

1981 November

On November 5 Capen saw a "thin afternoon haze" over the ***Tharsis*** region and a morning frost patch on ***Aethiopis;*** the SPH was seen over ***Phaethontis, Electris*** and ***Eridania. Elysium*** was no brighter than the equatorial deserts. Dragesco recorded morning haze or cloud over ***Tempe*** and ***Thaumasia,*** with ***Noachis*** bright on the Sp limb on November 9. Anton, Dragesco and McKim found ***Hellas*** not to be especially bright on November 18-19 near the central meridian (CM). On November 22 Capen found ***Noachis*** to be dull on the CM, with ***Tempe*** again bright on the morning limb and a frost patch in ***Xanthe.***

1981 December

Morning haze or cloud was observed over ***Aeria, Chryse, Mare Sirenum, Margaritifer Sinus, Scandia, Tempe, Tharsis, Thaumasia, Xanthe*** and ***Zephyria.*** Evening hazes were seen over ***Aeria, Chryse, Elysium, Libya, Meroe, Tempe*** and ***Xanthe.*** Brighter areas near the CM were occasionally seen in ***Arcadia, Chryse*** and ***Libya. Hellas*** was found to be bright in the extreme S, but it was not yet a conspicuous feature . Although there were also some brightenings in ***Ausonia, Noachis*** and ***Thaumasia*** near the CM, the SPH was still not prominent; the observations were still incomplete in longitudinal coverage.

1982 January

The SPH was seen over parts of ***Phaethontis, Electris, Eridania, Ausonia, Hellas, Noachis*** and ***Argyre.*** It seemed most conspicuous in ***Noachis, Argyre,*** and in the S part of ***Hellas.*** Morning hazes were observed over ***Amazonis, Chryse, Cfaritas, Cydonia, Eden,***

Isidis Regio, Libya, Neith Regio, Tempe, Thaumasia, Utopia and *Xartthe.* Evening hazes were sighted over *Arabia, Chryse, Cydonia, Eden, Libya, Meroe, Syrtis Major* (Dragesco, January 27), *Tempe* and *Xanthe.* Dragesco found part of *Elysium* bright near the CM on January 2, and other light areas near the CM were seen during this month in *Aeria, Arcadia, Cydonia* and *Dioscuria.*

1982 February

Observations were now very complete, and cloud activity continued to increase as the NPC was still diminishing in size. The SPH moved northwards, with the S deserts appearing more extensive and brighter: there were also some brightenings in *Thaumasia. Hellas* now seemed more filled by the SPH and was conspicuous. The S deserts, although invaded by the SPH, remained separated from each other by dusky shadings. *Elysium* often brightened in the Martian afternoon, but was dull on the CM. Up to mid-month *Elysium* was not particularly bright on the morning limb but on February 16 and on subsequent occasions both Capen and Hernandez show it to be very bright and partly frost-covered. They also observed morning frost in the *Herculis Pons* region. *Libya* was bright in the morning, sometimes bright near the CM, and brighter again in the evenings. In February the first sightings of the bright, circular afternoon clouds over the Martian volcanoes in the *Tharsis* region were made by Aerts, Capen, Dragesco, Hernandez, Hollis and McKim. On February 11, Hollis found a cloud NW of *Ascraeus Lacus (Ascraeus Mons)* near the CM, and on February 13 he saw two clouds E of the same feature (figure 9c). *Nix Olympica,* the bright cloud which forms over *Olympus Mons,* was very brilliant when seen near the sunset terminator on a number of occasions. The clouds formed in similar but not identical positions on subsequent days, and were better seen with the W44A and W47 blue filters. They were not seen on the morning side of the disk.

Other hazes or clouds were observed. Bright areas on the morning limb were *Aeria, Aethiopis, Arabia, Arcadia, Chryse, Isidis Regio, Memnonia, Neith Regio, Ortygia, Panchàia, Tempe, Thaumasia, Xanthe* and *Zephyria.* Bright areas on the evening terminator were *Chryse, Claritas, Cydonia, Eden, Tempe, Tharsis, Xanthe* and *Zephyria.* Areas which occasionally contained bright patches near the CM were *Arcadia, Diacria, Tempe* and *Thaumasia.*

1982 March

Cloud activity remained high as Mars reached opposition. The SPH was bright, covering all the S deserts; *Hellas* was large and conspicuous. These regions retained separate identities and varied in brightness. The afternoon clouds in the *Tharsis* region were well seen. For example, on March 21 Dragesco sketched and photographed three such clouds (figures 1c, 3d); the two (or three?) southernmost ones were near *Pavonis Lacus (Pavonis Mons)-Ascraeus Lacus (Ascraeus Mons)* and *Olympus Mons,* while the more northerly one was located near *Alba.* These were the most frequently covered sites. Other topographic clouds were seen to be associated with *Nodus Gordii* and *Arsia Silva (Arsia Mons).*

Some observations of equatorial cloud bands were made. Capen on March 9 (CML 32°, figure 9b) shows a strip of haze reaching almost across the entire disk, while Hernandez observed the same effect on March 12 (CML *circa* 350°). This phenomenon is best seen in violet light.

Elysium was bright on the morning limb, but lost its brightness as it moved onto the disk. It began to brighten again in the Martian afternoon, becoming very bright near the sunset terminator. *Libya* was brightest at the limb or terminator, but was occasionally bright on mid-disk. Areas sometimes bright on the morning limb were *Aeria, Aethiopis, Arabia, Arcadia, Cebrenia, Chryse, Cydonia, Eden, Isidis Regio, Mare Erythraeum, Mare Sirenum, Meroe, Neith Regio, Tempe, Tharsis, Thaumasia, Xanthe* and *Zephyria.* Areas sometimes brightening towards the sunset terminator were *Aeolis, Aeria, Aetheria, Arcadia, Baltia, Chryse, Cydonia, Eden, Meroe, Ortygia, Tempe* and *Xanthe.* Lighter areas near the CM were observed in *Aeria, Arcadia, Cydonia, Edom* (March 6 and 7, Dragesco, figure 3f), *Nox Lux* and *Ophir* (March 26, Dragesco, figure 3c), *Tempe, Thaumasia* and *Thymiamata.* Various small white clouds around *Solis Lacus* were seen by Rogers on March 25 (figure 7e). Small bright frost patches were seen in *Cydonia (Nix Cydonia)* and *Tempe (Nix Tanaica,* figure 9b).

1982 April

Cloud activity remained high, and was similar to March. The SPH remained bright and extensive, although it displayed some variability. The brightened S deserts tended to merge together, and were more foreshortened due to the changing angle of presentation. A few small, bright patches within the SPH were sometimes noted. The topographic clouds were again well seen; see figures 2b, 3e, 5c, 6a, 7a, 8a and 9e. Capen observed cloud banding on various occasions as in the previous month.

Elysium was bright throughout the Martian day, and *Libya* behaved similarly. Areas often bright on the morning terminator were *Aeria, Cebrenia, Chryse, Cydonia, Eden, Isidis Regio, Meroe, Neith Regio, Tempe, Tharsis, Thymiamata, Xanthe* and *Zephyria.* Areas which brightened at the evening limb were *Aeria, Aetheria, Aethiopis, Amazonh, Arcadia, Chryse, Cydonia, Diacria, Isidis Regio, Neith Regio, Ophir, Tempe, Tharsis, Xanthe* and *Zephyria.* Brighter areas on mid-disk were occasionally visible in *Aeria, Aetheria, Arcadia, Cebrenia, Cydonia, Deucalionis Regio, Diacria, Dioscuria, Edom, Neith Regio, Ortygia,* parts of *Sinus Sabaeus, Tempe, Thaumasia* and *Thymiamata.* On April 14 Doherty found a small bright cloud or temporary frost patch in the N part of *Utopia* near the CM. Frost patches were also seen in *Cydonia, Tempe* and *Xanthe.*

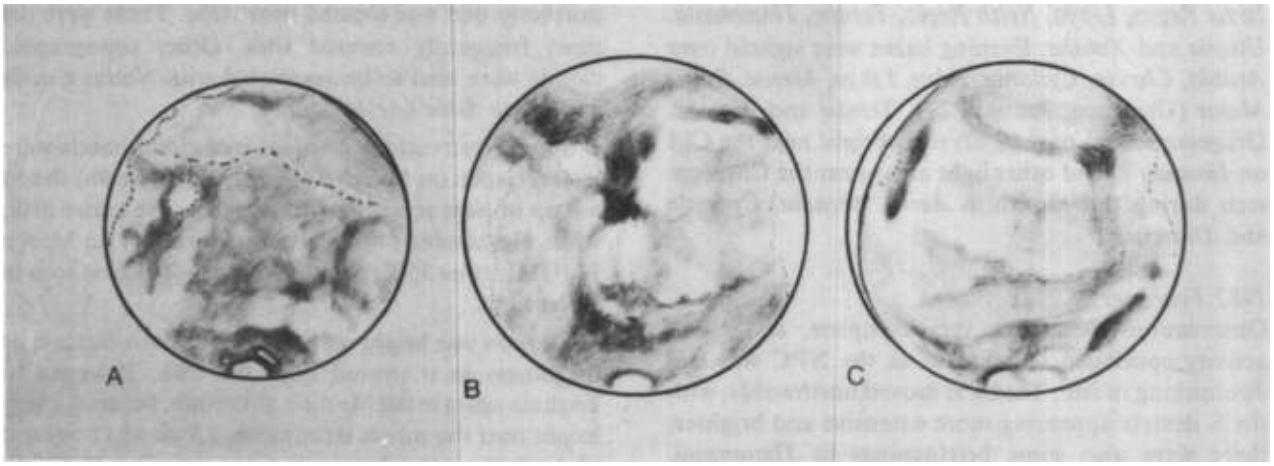

Figure 6. Drawings by T. Osawa.

(A) 1982 April 14d 16h 00m, ω = 168, 320 mm refl., x 391;
(B) 1982 March31d 16h 15m, ω = 293, 320 mm refl., x 391;
(C) 1982 February 17d 17h 30m, ω = 324, 200 mm refl., x 335;

1982 May

In May, the SPH remained extensive, and ***Hellas*** was extremely conspicuous (figure 9h). Again, there were some brighter patches within the SPH. Generally, the boundaries of the deserts along the S limb remained merged together. The tilt of the Martian axis reached a maximum of +25°.7 by the end of May, making observations of these regions difficult . Topographic clouds were less easily seen this month as the sunset terminator moved further beyond the sunset limb; as these clouds are best seen at the sunset terminator they were now somewhat less conspicuous. (This does not necessarily mean they were less frequent, simply that they could no longer be seen to maximum advantage).

Nix Olympica and a few other bright spots were seen several times, but by the end of the month the evening clouds over this region of the planet tended to be larger and less brilliant. ***Elysium*** was generally bright from midday onwards, and always appeared bright on the ϱ limb, but it was not so bright in the morning and appeared to be less conspicuous than earlier in the apparition. ***Libya*** was often bright throughout the Martian day. Towards the end of the month, the morning cloud over ***Libya*** was observed to merge with morning cloud covering the ***Syrtis Major*** as this feature rotated onto the visible disk. These diurnal clouds then shrank during the Martian day, and by local noon only the brightness in ***Libya*** remained. The drawings of Dragesco, McKim, Terwangne and Wilkinson illustrate this effect clearly from May 22 onwards. Sometimes, only the S half of the ***Syrtis*** would be covered by cloud on the morning terminator. Dragesco described one such cloud as yellow on May 22, so dust storm activity may also have been involved.

Other bright areas were as follows : sunrise terminator: ***Aeria, Amazonis, Baltia, Chryse, Mare Boreum, Tempe, Tharsis, Thaumasia, Xanthe*** and ***Zephyria.*** One morning cloud over ***Zephyria*** was very brilliant to Wilkinson on May 1 (figure 9d). To Dragesco, the clouds over ***Baltia*** (figures 5a, 5f) were blue-white; they were more likely to have been morning frost patches near the summer NPC remnant. Sunset limb: ***Aeria, Aeolis, Aetheria, Amazonis, Arcadia*** (very brilliant to Doherty, May 31), ***Cebrenia,***

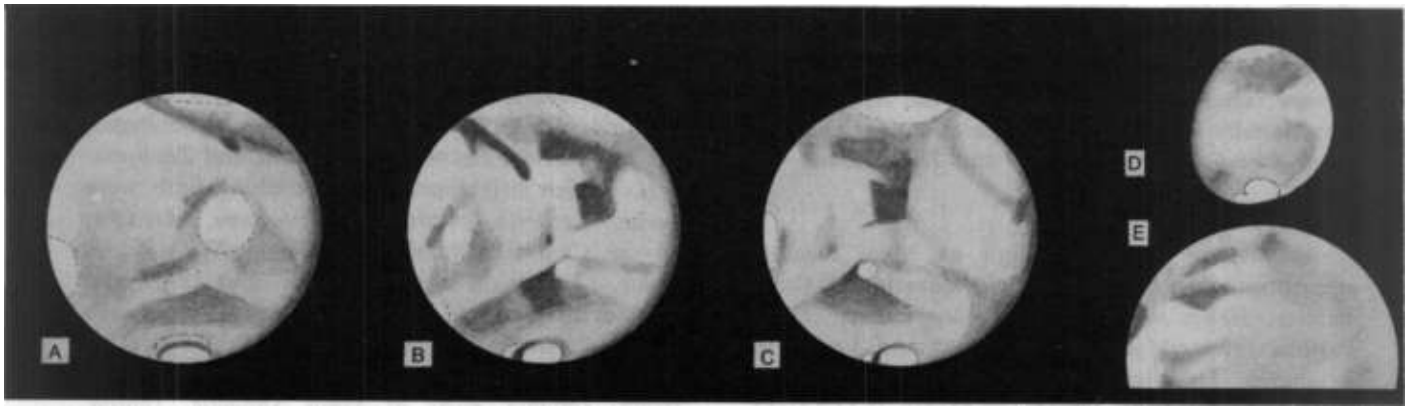

Figure 7. Drawings by J. H. Rogers with 320 mm OG, x 320, x 460.

(A) 1982 April 16d 19h 40m, ω = 204;
(B) 1982 April 15d 23h 15m, ω = 265;
(C) 1982 April 16d 1lh 35m, ω = 299;
(D) 1982 January 24d 02h 56m, ω = 334;
(E) 1982 March 25d 23h 45m, ω = 95.

Chryse, Cydonia, Diacria, Eden, Isidis Regio, Memnonia, Neith Regio, Tempe, Tharsis, Xanthe and *Zephyria.* Clouds near the CM were seen in *Aeria, Cebrenia, Edom, Tempe, Tharsis* and *Thymiamata.* Frost patches were again seen in *Tempe,* including *Nix Tanaica.*

1982 June

Cloud activity appeared to decline in June, but observation was becoming more difficul t as the disk diameter of the planet decreased. The SPH was still a bright region along the S limb, including *Thaumasia.* Its brightness and extent were subject to variation; by the end of the month there was no sign of any SPC. The northward tilt of the planet's axis remained high, but fel l slightly to +25°.2 at the end of the month. 5 Capen saw only an extensive SPH, indicating the SPC was not free from overlying haze at all longitudes (CML 359°). Osawa's next fe w observations were: August 17, CML 353°: SPC yellowish-white, not bright; ill-defined. September 7, CML 141°: SPC with a dusky collar, but observable only in good seeing. Using high powers on his 320 mm reflecto r Osawa observed Mars until 1983 January 31 by which time the S hemisphere of the planet was well presented to the Earth and Sun, and the SPC had decreased in size. The SPC varied in size, brightness and visibility during the period of observations; it was probably best seen in late November and December. Anton also detected the SPC during one late observation on 1982 November 13.

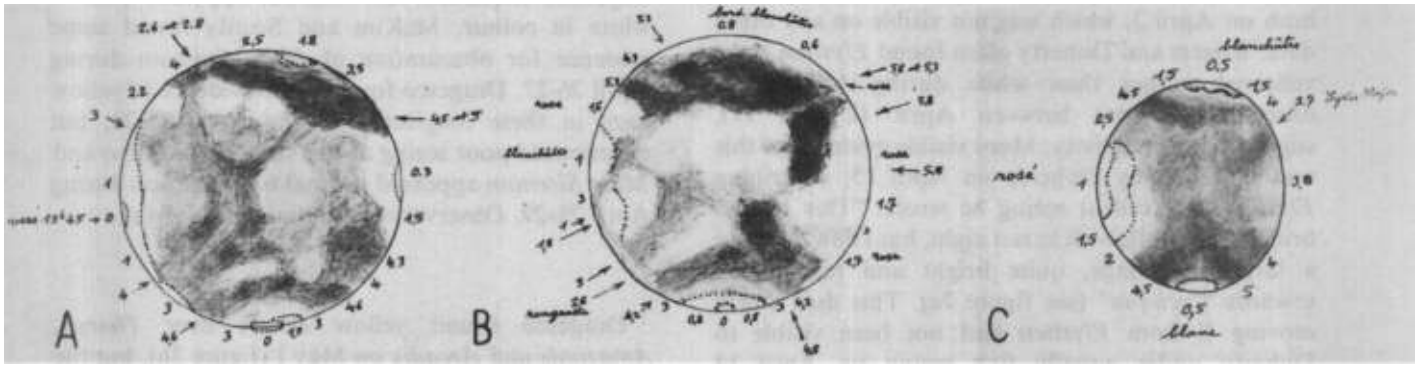

Figure 8. Drawings by R. de Terwangne with 203 mm Cass., x 251, x 300.

(A) 1982 April 16d 19h 40m, ω = 203;
(B) 1982 April 10d 20h 00m, ω = 261;
(C) 1982 June 27d 20h 30m, ω = 271.

Some topographic clouds were seen, but as in May they were largely replaced by large, less brilliant clouds over the same regions. *Elysium* was dull, except on the evening limb. *Libya* was occasionally brighter than the other equatorial deserts but was never particularly bright. Other bright areas were occasionally seen as follows: sunrise terminator: *Arcadia, Chryse, Memnonia, Tempe, Tharsis* and *Xanthe.* Sunset limb: *Aeria, Aethiopis, Arabia, Arcadia, Amazonis, Chryse, Cydonia, Eden, Tempe, Tharsis* and *Xanthe.* Near the CM: *Arcadia, Ophir, Tempe* and *Thaumasia.* Observations still covered all longitudes, but more thinly than before.

1982 July onwards

Observations were now incomplete in longitudinal coverage and do not warrant detailed treatment. However, the observations satisfactoril y document the appearance of the south polar *cap* fro m beneath the polar *hood.* The SPH was observed again during July, and *Elysium* no longer appeared bright, exceptât the evening limb. The tilt of Mars' axis decreased further, and the SPC began to be visible during August. Probably the firs t sighting was by Osawa on August 4 (CML 124°, η = 252°); he described it as yellowish-white, intensity 1-1.5. However, on August

Yellow clouds

No accurate charts could be drawn to show the motions of the dust storms detected because of the difficulty of exactly determining their boundaries. Nonetheless, some informatio n about their movements has been obtained.

1981 November

The ALPO reported that a yellow dust storm began in the W part of *Hellas* on or about November 19-20, spreading NW to affec t *Syrtis Major* and the N hemisphere, lasting till November 29d. BAA observations of November 18-19 show these features quite normal, with *Hellas* no brighter than the equatorial deserts, so the storm must have begun afte r the 19th. On November 22 Capen shows the S part of *Mare Acidalium* invisible, presumably hidden by yellow cloud.

1982 February and March

The ALPO reported that a dust storm began over *Elysium* and moved southwards over *Aeolis* towards Mare Cimmerium fro m February 26 to about March 10. They also reported a bright yellow cloud starting within *Chryse* fro m March 10-17, which had moved across *Xanthe* into *Tempe* by March 22d. We do not have adequate observations of these regions at these

times to confir m the storms. However, obscurations around the ***Solis Lacus*** region were noted during March. On March 13 Osawa foun d the region obscured (probably dust having spread fro m ***Chryse),*** but it was normal on the 20th. When the region became visible fro m the UK later, McKim thought ***Solis Lacus*** rather faint on March 22. Dragesco shows ***Mare Sirenum*** fainte r than normal on March 26. Finally, on March 25 Osawa foun d a dust cloud over ***Noachis*** with a khaki tint, while on March 18 and 25 Rogers foun d that a bright cloud trailing ***Olympus Mons*** was yellow in colour, although it became whiter and brighter as it moved towards the ϱ limb.

1982 April onwards

Dragesco foun d a yellow cloud over ***Aeria*** on the ϱ limb on April 3, which was not visible on any other date. Rogers and Doherty often foun d ***Elysium*** to be yellowish rather than white during April (their observations were between April 12 and 21), suggesting dust activity. More visible evidence of this was obtained by Doherty on April 15; describing ***Elysium*** in excellent seeing he wrote: "This was as brilliant and yellowish as last night, but I now detected a large appendage, quite bright and reaching S towards ***Cyclopia***" (see figur e 2c). This dust storm moving S fro m ***Elysium*** had not been visible to Doherty under equally fin e seeing on April 14 (McKim's drawing of that night in figure 5d also shows ***Elysium*** normal). Osawa foun d some yellow cloud activity in the S hemisphere on April 14 (CML 168°, figure 6a) but ***Elysium*** was normal on the f terminator. Observing later on the evening of April 15 Rogers does not confir m the S extension of the ***Elysium*** storm (figures 7b, 7c) but the region was then nearing the ϱ limb. However, Terwangne's drawing of April 15 (CML 210°) possibly confirm s Doherty. No-one reported the S extension of the storm on April 16, but Doherty shows ***Aeolis-Aethiopis*** as a bright region again on April 20 near the CM. This storm seems to have behaved in the same manner as that reported by the ALPO in February-March.

More yellow cloud activity was noticed on April 24. On this date, Osawa foun d ***Aurorae Sinus*** to be obscure, and later the same day Doherty, Dragesco and Terwangne recorded yellow clouds in other regions. At 20h 15m (CML 142°) Doherty (figure 2a) recorded that: "A brilliant elongated spot was seen near Mars' centre. I am certain this was a yellow cloud in the ***Olympus Mons*** area". ***Arcadia*** was bright, adjacent to the spot, while ***Tharsis*** and ***Xanthe*** on the evening limb were bright pinkish-white. Observing at the same time, Terwangne confirme d a cloud area from ***Arcadia*** to the disk centre but did not notice any particular colour. He foun d the cloud over ***Xanthe-Tharsis*** to be yellowish-white, suggesting further dust activity. Observations by others later on this date show that ***Nix Olympica*** was seen as usual as a bright ***white*** spot at the evening limb. It seems likely that a dust storm was in progress in the ***Olympus Mons*** area, but the storm did not reach a very high altitude. In the Martian afternoon , higher level water-ice clouds still formed on the slopes of the volcano, hiding the yellow cloud activity below. (Compare the observations of Rogers in March.) At 22h 30m (CML 172°) Dragesco shows ***Nix Olympica*** on the ϱ limb, with a ***yellow*** cloud to the north, in ***Arcadia.*** Capen's drawings (CML ***circa*** 260°) in the USA show that there was no dust storm activity being observed in the opposite hemisphere of Mars at this time. On April 25 Doherty foun d the planet identical to April 24 at the same CML, except that the brilliant area around ***Olympus Mons*** was less noticeable. On April 27 (CML 120°) McKim foun d ***Solis Lacus*** difficul t to see under good conditions of seeing, and a cloud over ***Xanthe*** on the ϱ limb, with a fingerlike extension into ***Tharsis,*** appeared yellow-white in colour. McKim and Sturdy foun d some evidence fo r obscuration of ***Mare Sirenum*** during April 26-27. Dragesco foun d some evidence of yellow haze in these longitudes during April 25-29, but experienced poor seeing at this time. ***Solis Lacus*** and ***Mare Sirenum*** appeared normal to Wilkinson during April 28-29. Observations continued into May.

Dragesco foun d yellow clouds over ***Tharsis, Amazonis*** and ***Arcadia*** on May 1 (figur e 3b), but the ***Solis Lacus*** region was normal. Poyet foun d ***Solis Lacus*** partly obscured by cloud on May 2, but it was again dark to Wilkinson the next day, and to McKim on May 4. These regions were carried progressively towards the morning terminator by the illusory 'reverse rotation' of Mars on successive nights fo r observers in the longitude of the UK. Thus the dust storm regions became progressively harder to observe. On May 5 Dragesco foun d a dust storm on the morning terminator to cover ***Thaumasia, Tharsis*** and ***Arcadia.*** On May 8 Osawa (CML 262°) foun d the opposite fac e of Mars normal. On May 9 Dragesco recovered the dust storm on the morning terminator over ***Chryse, Xanthe*** and ***Tempe.*** McKim confirme d an intensely bright cloud over ***Tempe*** but did not notice any colour. On May 10 Dragesco foun d the storm encroaching upon ***Niliacus Lacus.*** The next evening he saw the storm covering ***Xanthe, Nilokeras*** and ***Tempe.*** On May 12 the longitudes of the planet around ***Elysium*** appeared normal to Osawa fro m Japan. To Dragesco on the same date (CML 339°) the dust storm now covered ***Chryse, Xanthe, Margaritifer Sinus*** and the S part of ***Mare Acidalium,*** which he confirmed on May 13. McKim foun d ***Margaritifer Sinus*** fain t on May 13 also, with cloud over ***Chryse.*** Under a CML of 325° on May 13 and 14 Wilkinson thought the whole disk less contrasty than usual; the impression was of a general yellow veil. On May 15 Marshall foun d ***Mare Acidalium*** and ***Nilokeras*** readily visible (CML 70°), showing that the dust storm (if still present) had not obscured these feature s now invisible fro m the longitude of the UK. Both Marshall and Capen made similar observations on May 17 and

20. On May 17 Osawa (CML 178°) shows the S maria to be very faint, and he drew only vague mottlings to the S on May 21 (CML 134°). On May 22 Dragesco found a yellow cloud over ***Aethiopis-Libya,*** obscuring ***Syrtis Major*** which should have been visible near the morning terminator (CML 229°). As reported in the section of this report dealing with white clouds this phenomenon was well observed; it is unlikely that the activity was solely due to ***white*** clouds in these regions. McKim found the ***Syrtis*** fainter than usual near the CM on May 23, after its S portion had been covered by cloud on the morning terminator.

By late May, observations were becoming more difficult, but some observers still detected obscurations, particularly of the S maria. In excellent seeing on May 31 Doherty (CML 180°) did not detect any S maria with a 125 mm OG, **x** 300. However, Adamoli and Terwangne could still detect ***Mare Sirenum*** and ***Mare Cimmerium*** with larger instruments. Dragesco thought ***Mare Sirenum*** covered by dust on June 2, under poor seeing conditions, which Parish confirmed in very good conditions. These two observers also could not detect ***Mare Sirenum*** on June 4; however, such obscurations were temporary for the ***Mare*** was visible to others on June 1 and 3. The ***So/is Lacus*** region was well seen by various observers in early June. The E border of ***Elysium (Phlegra-Styx)*** seems to have been obscured in late May and early June, according to Anton, Dragesco, Hancock and Wilkinson. For example, between May 28 and June 1 they show ***Trivium Charontis-Cerberus*** readily visible but ***Phlegra-Styx*** invisible. On June 18 Terwangne may have observed a dust storm over ***Aeria*** and ***Arabia*** on the evening limb (CML 360°). On June 27 (figure 8c) and 28 Terwangne found ***Syrtis Major*** very faint at the morning terminator. This was similar to the phenomenon seen in May (see the section on white clouds) except that no bright cloud was seen on the f terminator to cover the Syrtis region. Dust storm activity seems the most likely explanation of these observations. After June, there are no systematic dust storm records available.

To conclude, yellow cloud activity has been higher than usual for this Martian season. Although N summer dust storms are not unknown they are usually much less conspicuous. However, the yellow cloud activity was much less frequent than white cloud activity this apparition, and the dust storms only affected certain areas. Yellow clouds were more obvious at the limb and terminator. It is unfortunate that our observations did not allow a fully complete picture of this activity to be built up. Yet more intensive coverage of the planet is needed to document these elusive phenomena.

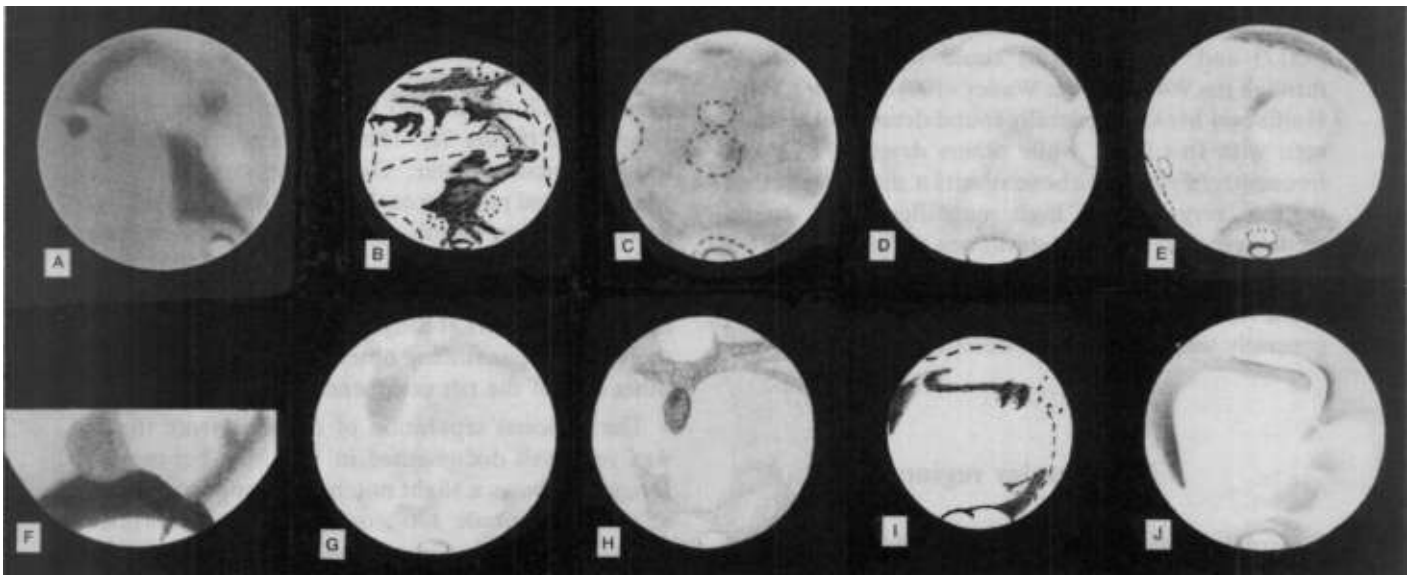

Figure 9. Miscellaneous drawings of Mars.

(A) 1982 March 31d 22h 00m, ω = 16,300 mm refl., x 190,x 318, *A. W. Heath.*
(B) 1982 March 9d 10h 00m, ω = 32, 310 mm and 610 mm OGs, x 250, x 810, *C. F. Capen.*
(C) 1982 February 13d 23h 35m, ω = 90, 300 mm refl., x 255, *A. J. Hollis.*
(D) 1982 May 1d 23h 20m, ω = 125, 229 mm refl., x 220, *A. W. Wilkinson.*
(E) 1982 April 19d 20h45m, ω = 193,216 mm refl., x 380, *K. M. Sturdy.*
(F) 1982 February 2d 06h 00m, ω =294,150mmOG,x225, x 280, *after a drawing by L . Aerts.*
(G) 1982 April 10d 23h58m, ω= 319,222 mm refl., x 170, *P. W. Parish.*
(H) 1982 May 16d 21h 11m, ω = 319, 308 mm refl.,x 310, *P. Wade.*
(I) 1981 December 30d 11 h 02m, ω = 328, 406 mm Cass., x 260, x 542, C . *F. Capen.*
(J) 1982 April 5d 22h 20m, ω = 339,205 mm refl., X 240, *M. Falorni.*

Blue clearings

More blue-filter drawings were made in 1982 than in 1980. Terwangne used his Zeiss blue filter for most of his work, obtaining similar results to those for 1980'. Anton, Blaxall, Capen, Coates, Heath, Hernandez, Hollis, McKim, Stott, Wade and Young together made over one hundred observations using the recommended W47 filter with apertures of 216 mm or greater. In brief, a moderate to strong blue clearing (BC) was detected over all parts of the disk for long periods of time during the opposition months, from February to May. The BC was ***not*** clearly defined around CML 100°, however. This may simply reflect the difficulty of observing these longitudes in white light, although Hollis did record a partial clearing at CML 90° on April 23. Few very late or very early observations are available, but a few ***selected*** ones are given below:

1981 November: Capen, 5d, CML 160°, and 22d, CML 350°, no BC. Anton and McKim, 19d, CML 285°, general BC, order 2.

1981 December: Capen, 30d, CML 328°, BC in N, not to the S.

1982 June: Hollis, 13d, CML 54°, BC seen.

The ability of different observers to detect this phenomenon varied considerably. For example, on April 12, CML 266-302°, Blaxall (power X230), Stott (x317) and Young (x320) could see ***Syrtis Major*** through the W47 filter but Wade (x 100) could not. Both Hollis and McKim generally found details quite easily seen with this filter, while others detected BCs less frequently. From the above results a moderate rather than a very low or high magnification is to be recommended. Also, observations should be carried out ***only*** when the image is adequately bright.

On the whole, then, the albedo features were generally well seen in blue-violet light in 1982.

North polar region

The sublimation of the north polar cap (NPC) showed the usual pattern, with the cap dwindling in size as the apparition progressed, and some internal rifts appearing in addition to detached outlying portions of the cap which were left behind as the main mass retreated. Later observations cover the behaviour of the static summer polar cap and record its eventual disappearance beneath the hazes forming the north polar hood (NPH). In the 1980 apparition[1] our observations did not continue far enough into the Martian year to record the formation of the NPH.

Early morning observations by Dragesco, Hollis and Saxton in 1981 October revealed a large NPC with a darker border. The cap was symmetrical and

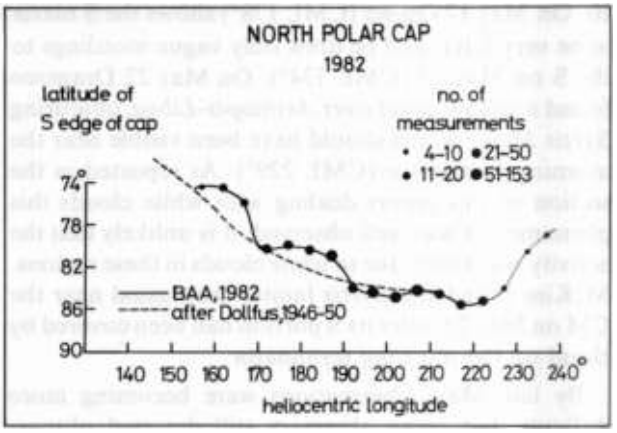

Figure 10. Curve showing the shrinkage of the NPC in 1982.

featureless. The dark border to the cap was well seen from November to mid-February. The ***Rima Tenuis*** rift was again seen in the NPC during 1981-82 as shown in figures 6c, 7d, 9f and 9i. Thus Capen shows the rift cutting into the cap on 1981 December 30 (figure 9i), with other ALPO observers sighting it at the same time[9,10]. Rogers observed the rift on the morning of 1982 January 24 with the 320 mm Northumberland refractor at Cambridge (figure 7d), and McKim suspected it with the same instrument on March 4, but the UK observations were not satisfactory; the rift was best seen early in the apparition and conditions in this country then were very poor. Osawa had a good view of the rift on February 17 (figure 6c) and Aerts recorded it on February 2 (figure 9f). The rift was apparently much less conspicuous later; Osawa shows it faintly on March 31 and possibly on June 5. Osawa drew a bright patch preceding the rift on March 31, which was also seen by Aerts on March 6. Aerts remarked that the rift had been easier to see in 1980. All these records are of the end of the rift at longitude ***circa*** 330°; as in 1980, there are no convincing observations which show the other end of the rift commencing.

The seasonal separation of ***Olympia*** from the cap was very well documented in 1982. On February 15 Dragesco shows a slight notch in the edge of the NPC at about longitude 170°; on the same date McKim drew the dark spot ***Deucalidonius Lacus*** on the snow-line at the same longitude. The two observers did not observe ***Olympia*** detached but the ***Rima Borealis*** rift which separates ***Olympia*** from the NPC commences at this longitude. Capen's drawings of February 24 and March 1 show ***Olympia*** detached; thus separation began at $\eta = 175°$ as far as the observations available indicate. Viscardy's fine photographs of March 10 and 15 hint at the presence of ***Olympia,*** but the first UK observer to see this detached portion of the NPC was Rogers on April 13. By now the separation of ***Olympia*** from the NPC was made obvious by the very dark ***Rima Borealis*** rift which had widened as the cap retreated to leave ***Olympia*** behind. Numerous

subsequent drawings by Anton, Capen, Doherty, Dragesco, McKim, Osawa, Rogers, Sturdy and others show that ***Olympia*** and ***Rima Borealis*** were most prominent during April. Dragesco, Osawa and Rogers continued to see them during ***May,*** and ***Deucalidonius Lacus*** was re-observed by Doherty on May 31, but ***Olympia*** gradually diminished in size and was last seen with certainty by Osawa on June 29 (η = 233°).

A further detached portion of the cap was observed by Osawa between April 14 and June 29; this feature was located in ***Ierne*** and was smaller than ***Olympia.*** Dragesco and Sturdy show a similar but larger and more variable feature at about this longitude in late April; probably most of their observations were of haze or frost near the NPC. The NPC remnant had a serrated edge to Aerts on May 10, and to Osawa on May 21 in excellent seeing. ***Hyperboreus Lacus*** was an intensely dark spot at the edge of the summer cap; Osawa was probably the first to observe it on March 20. McKim first saw it on March 26 at intensity 5.5, while on March 31 it had darkened to intensity 7.0, and it remained very dark for the rest of the apparition until Dragesco made the last certain observation of it on June 6. It was observed by Anton, Capen, Dragesco, Falorni, Heath, Hollis, Osawa, Parish, Sturdy and the writer. Thus the NPC again appeared with a wide dark border at this longitude. Figures 1a, b and 1, 3a-c, 5a, b and f, 9a and 9j all show ***Hyperboreus Lacus,*** while figures 1d, le, 2a, 3e, 5c, 7a-c and 9e show ***Olympia*** and ***Rima Borealis.*** Osawa's drawing of April 14 (figure 6a) shows both detached portions of the cap. The ALPO[10] charted a third detached portion of the cap centred at longitude ***circa*** 310° in ***Cecropia,*** but we have no drawings of this feature. On April 24 Osawa shows a rift cutting into the cap at longitude ***circa*** 50°; this is perhaps Antoniadi's ***Rima Hyperborea.*** Aerts also shows this feature as an indentation in the outline of the cap on May 10. At the same longitude, ***Iaxartes*** was well seen as a dark streak uniting ***Hyperboreus Lacus*** with the N end of ***Mare Acidalium.*** All these features of the NPC are shown in the map of figure 11.

The regression of the cap from 1982 January to July (η = 155-239°) is shown in figure 10, constructed from measurements of the cap latitude on the CMs of 655 disk drawings by 33 observers, taking means over every 5° in heliocentric longitude, as in 1980'. Too few accurate drawings were available before 1982 January to extend this plot further back in time. Close accord with the average curve of Dollfus for 1946-50[12] will be noticed, as was also the case in 1980. Occasional positive deviations from the mean curve may reflect the presence of haze over the cap from time to time. The ALPO also recorded a positive deviation in their 1982 regression curve[11] at η= 157°, the so-called aphelic chill. In 1980[1] this phenomenon was most noticeable at η = 186°. Between η = 190° and 229° the cap was essentially static, and the averaged latitude of its S edge was +84°.7, corresponding to a summer cap remnant some 11° in diameter. A large number of drawings show that the NPC was often surrounded by arctic hazes from mid-February onwards. Hollis shows haze surrounding the cap on February 11 and various later occasions, as does Capen from February 24, Coates from March 5, McKim from February 22 and Terwangne from mid-March onwards. Other observers show haze surrounding the cap at various times but it was not a constant phenomenon; for example, McKim found it less prominent in May than in March and April. Blue filters enhanced this haze and often the cap could not be distinguished from the surrounding haze in blue light. Possibly the arctic hazes occasionally obscured the true cap; Adamoli found the NPC somewhat indistinct in good seeing on May 21, and Sturdy thought the NPH was covering the cap on May 22; Dragesco thought the cap to be large on May 22, possibly confirming these observations, while McKim had the same impression around this time. There is the further possibility that the occasional dust storms observed during the apparition may also have affected the behaviour of the NPC.

Figure 10 also shows the sudden increase of the cap '•'ze at η — 230°, due to the onset of the hazes forming the polar hood which covered the true cap. Study of all the June and July drawings gives an accurate date for the first appearance of the NPH. The NPC was not hidden up to June 20. On June 22-27 the NPH made its first temporary appearance, but the cap was again visible from June 28 to July 4. On July 6 the overlying

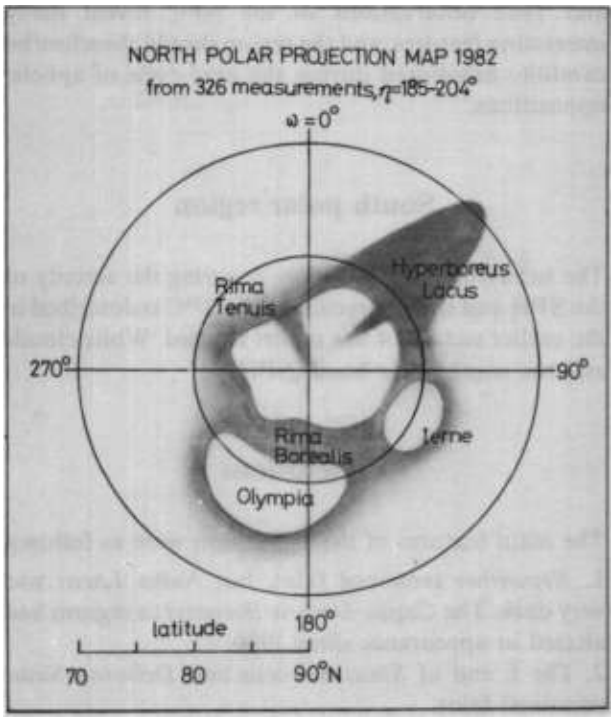

Figure 11. Map of the NPC at η = 185-204° on polar projection. The isolated bright patch in *Ierne* was positioned from measurements on three drawings of Osawa between η = 197-233°.

NPH reappeared on an essentially permanent basis; one or two observers may have detected the cap a few more times on a transitory basis (notably Capen on July 16 and Marshall on July 18). Osawa considered the NPC survived till early August. We conclude that the NPH was essentially permanent after July 6 (η = 237°).

A polar plot of the summer NPC area is given in figure 11. Figure 10 indicated that optimum analysis would be possible from η = 185° to 204°, and the latitude data from the 326 disk drawings covering this period were combined by taking 30°-means in CM longitudes. These data referred only to the main snow mass and were therefore augmented by measurements with overlay graticules on good drawings showing the rifts and detached portions already described. The resultant chart represents the polar snows at an average heliocentric longitude of 195°, a later Martian Date than the 1980 BAA NPC map[1]. Comparison may be made with Dollfus' more detailed chart for the same heliocentric longitude[12], and with his detailed drawings of the cap in 1982[5]. Dollfus found the fine structure of the NPC exactly as he had observed it during 1946-52. Our NPC rifts ***Rima Tenuis*** and ***Rima Hyperborea*** may be reconcilable with features drawn by Dollfus, although on his chart they join up inside the cap, splitting off another portion of the cap. Antoniadi[13] shows this too on his 1933 polar plot, though not in his general map in ***La Planète Mars***[14]. Iwasaki and Saito[15] have also discussed their NPC observations for 1982, and have compared their work with measurements by the ALPO. Clearly, the 1980 and 1982 observations of the NPC reveal many interesting features, and the region should therefore be carefully monitored during the next cycle of aphelic oppositions.

South polar region

The behaviour of this region, covering the activity of the SPH and the emergence of the SPC is described in the earlier section of this report entitled 'White clouds and the south polar hood (SPH)'.

Conclusions

The main features of the apparition were as follows:

1. ***Nepenthes*** remained faint, but ***Nubis Lacus*** was very dark. The ***Casius-Umbra-Boreosyrtis*** regions had altered in appearance since 1980.
2. The E end of ***Sinus Sabaeus*** and ***Deltoton Sinus*** remained faint.
3. The ***Claritas-Daedalia*** feature persisted but was less prominent than before.
4. The ***Aetheria*** secular darkening was prominent and widespread.
5. White cloud activity was normal for Martian N spring and summer, with many diurnal limb hazes, and circular afternoon clouds in the ***Tharsis*** region.
6. Yellow cloud activity was rather high for the Martian season; activity was most notable in ***Elysium-Aeolis, Chryse-Xanthe-Tempe-Tharsis-Thaumasia-Mare Sirenum*** and ***Libya-Syrtis Major.***
1. The surface features were generally well seen in blue-violet light.
8. The NPC showed normal seasonal behaviour. ***Rima Tenius*** was recorded, as in 1980. ***Olympia*** detached from the cap over the period η = 175-233°, and the NPH effectively formed from η = 237° onwards.
9. The SPH frequently covered the S deserts of the planet. The SPC was seen from about η = 252° onwards.

Acknowledgements

Thanks are due to Mr Richard Baum and Professor Jean Dragesco for close collaboration, to Mr Julian Baum for help in preparing the photographs in figure 1 for publication, and to Mr Konrad Kuijken for an English translation of Mr Aerts' report. Thanks are also due to all those who contributed to this report on one of the best observed oppositions of Mars in the recent history of the BAA.

Errata in 1980 report

In the 1980 report[1], the drawings in figures 3 and 6 have been transposed. The published captions are in the correct positions. In the text, for ***Coloe Pons*** read ***Coloe Palus.*** Dr R. L. Waterfield has kindly lent me his observing notebooks, and it should be recorded that he also observed the ***Rima Tenuis*** rift in 1933, along with those whose names were listed in the 1980 report.

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