Mars Observations in 2003, Part Ⅱ

Masatsugu MINAMI*

(Abstract) As a Part II of the preceding Report (*Bul. Fukui City Museum of Natural History,* No. 58, 1-10 (2011)) we here pick out two interesting phenomena observed in 2003. The first one is the dust occurrence checked on 4 July 2003 at the eastern end of Sinus Sabaeus and Deucalionis Regio, and the second is a projection from the dawn terminator which was detected on 4 November 2003. This projection proved to appear again on 7 November in the same form, and so it was concluded this was not the dust phenomenon, but might have been related with the Solar wind which was active at that time.

Key words: Martian dust cloud, protrusion from the dawn terminator

0° Introduction :

As described in Part I (*Bulletin of the Fukui City Museum of Natural History,* No. 58. 2011), the great apparition of the planet Mars in 2003 occurred as follows: It was closest to the Earth on 27 Aug 2003 at 09:52 GMT and its maximal diameter was 25.11" (arc seconds). The planet repeatedly approaches us every 2 years and 2 months, but every apparition is not the same. On the occasion of the aphelic oppositions the maximal diameter is around 14" (sometimes down to 13.7") while the perihelic oppositions give us the big diameter around 24". This repetition needs 15 years or 17 years, during which we can observe the whole seasons of the planet Mars. Conversely saying it will need 15 years or 17 years to observe every season of Mars. On the occasions of aphelic apparition, the diameter δ is smaller, while we can observe the winter Northern hemisphere which is difficult to observe otherwise. On the contrary, when we encounter the perihelic oppositions we can observe the Southern summer season.

The 2003 apparition was of the perihelic opposition. Let us denote the season of the planet Mars by λ employing the areocentric longitude of the Sun. For example, when λ=090° Ls, the season comes to the Northern winter solstice (or Southern summer solstice). In the case of 2003, the present writer started his observation on 25 October 2002 at the Observatory of the Fukui City Museum of Natural History by the use of a 20 cm refractor set on the rooftop when λ=086° Ls. His observation ended after one year and a half on 4 June 2004 when the Martian season was λ=043° Ls before the next λ=086° Ls, a bit short for the Martian one year: This is because the Martian one year implies nearly two on the Earth.

During the period the present writer obtained a total of 1,156 drawings. Every sketch was made in 20 minutes, and hence he spent a total of 23,120 minutes=385 hours in observing the surface of the 2003 Mars.

However, the summer season in Fukui was forecast to be worse because of the rainy season and hence the present writer made an expedition on 23 June 2003 to Naha City of the Okinawa Prefecture where the rainy season was already over. Helped by Tetsuo WAKUGAWA and Hiroshi ISHADOH in Okinawa, the present writer could observe Mars atop a nearly 10 story building almost every night from 23 June 2003 to 30 August 2003 by the use of a 25 cm speculum (polished by WAKUGAWA), and obtained a total of 433 drawings. During the period, δ went from 15.4" up to around 25.1".

We repeat here how this 2003 apparition was unusual: It is well known that every 79 years the planet Mars approaches unusually. For example before the 2003 apparition its approach on 24 August 1924 was the closest one during the 20th century (the largest diameter was δ=25.01"). The largest diameter in 2003 was larger than the data in 1924. The case in 2003 was far from the cases, and it was the best after these 57,000 years, i.e. since the time when the Cro-Magnons were active. On the other hand, about 79,000 years ago, the maximal apparent

*3-6-7 Midori-ga-Oka, Mikuni, Sakai, Fukui, 913-0048 Japan

diameter is known to have grown larger than 26" according to the calculation by Jean MEEUS who also showed that in the coming 2208 we will have a chance where the diameter is similar to the case in 2003, and in 2287 the case will pass the 2003 case. The years when δ is larger than 25" occurred just once in the 19th century and also once in the 20th century. In the 21st century we will have another occasion in 2082 when the diameter will attain 25.06".

These cases are however quite far beyond our observation, and it is a pipe dream to wait the cases. It is not so long ago when the human beings began to have an interest in the phenomena on Mars. This conversely implies that we have not enough knowledge about the planet. And if we are concerned with ourselves personally, even the chance to meet with the great opposition which visits us every 79 years is no more than once during our life.

We should so here come to ourselves and notice that it is stupid to chase the planet only when it makes a great opposition since our objective at present is to observe the possible phenomena in all seasons. To do so we should pay our attentions equally to other minor apparitions.

Just the apparition like the 2003 case is advantageous to us in the following sense: Since the planet remains near us longer than the other cases, we can stretch our observation period quite longer. For example in 2012 the planet made an aphelic opposition, and at the beginning of March its diameter went up to the largest δ=13.9 arcsecs but no larger. It was only possible to see the planet whose diameter was larger than 13.0" for nearly one month from 15 February to 27 March in 2012, while in 2003 the apparent diameter was larger than 13.0" for about five months from 6 June 2003 to 15 November 2003. In mid-August 2003, δ was near 25 arcsecs, and the present writer experienced surprisingly the situation where the apparent diameter was accurately growing larger every night in the eye field.

It was a bonus of this year to be able to see the minute details i.e. of the inside of the south polar cap (spc). However here we shall skip such details and will restrict ourselves just to a review of two happenings: One is concerning the dust occurrence observed in Okinawa on 4 July 2003, and the other is about an auroral projection witnessed on 4 November at Fukui at the morning terminator. The description of the two cases will show our attitude and standpoint when we observe the planet Mars.

1° About the Occurrence of an Interesting Dust Cloud on 4 July (λ=215° Ls): First of all, we here make a statement how we classify the dust phenomena.

For example, by the occurrence of the dust storm, we mean the moment when a dust accompanied by a bright and definite core appeared. In its preceding stage, we may have the case where a denser dust flows in the atmosphere. However this is usual in the dried Martian air. A dust shows its appearance near the morning limb. The Martian atmosphere may sink low throughout the preceding cold night. If it is partly warmly disturbed by receiving a Solar energy at dawn, the disturbance may make a core. Once it is arisen, the core will go to the evening side in the day time without another disturbance, though we admit an activity inside the day-time core. As the night comes, some core may disappear or some other will be turned back to its initial stage. If it contains still a potential, it will be reorganised as a dust core in the early stage of the next day. In almost all the cases, the reconstructed core may look deformed, that is, the new form is different from the form seen in the preceding day. It implies there is a broken gap between the preceding core and the new core. However if the disturbance continues day by day, the dust cloud may stay also in the night and in the next morning it may show another similar form, implying that the cool down in the night stops, and the dust may become global. The great dust storm in 2001 traced typically this way. Note that we don't adopt the view that the global dust storm is the one developed from a local dust. Any global dust has a potential power from the outset.

We are now in a position to tell the story of the typical dust cloud observed on 4 July 2003 at Noachis.

The first cycle of the present writer's observations at Fukui was only until 21 June 2003. On 21 June, he observed from 16:30 GMT (01:30 JST on 22 June) to 19:50 GMT (04:50 JST on 22 June) at Fukui by using 400×20 cm refractor, and then he took a flight at 08:35 JST from Komatsu and reached Naha at 10:40

JST. On the night, WAKUGAWA and ISHADOH kindly set up the 25 cm Newtonian on the rooftop of a mansion in the Naha City and we could observe from 16:30 GMT (23 July at 1:30 JST). The Martian season was λ=209° Ls with δ=15.4". The first day was not successful because of a strong wind, and just observed twice. On 24 June GMT we observed four times at 17:30 GMT, 18:40 GMT, 19:20 GMT, 20:00 GMT when Mars shined near the meridian while it was near dawn. On 25 June it was impossible to observe the planet because of the cloudy condition. On 26 June it was also windy while the seeing improved. So the present writer started at 16:30 GMT (01:30 JST) and observed seven times every 40 minutes up until 20:30 GMT (05:30 JST). It was interesting to see the details of the rifts inside the spc. The last one was made at dawn but not yet the sunrise. It was also windy on the night of 27 June, but the present writer started at 15:50 GMT (0:50 JST) and observed eight times every 40 minutes. The δ was 16.1". The evening side of the spc looked rather reddish. At 19:30 GMT Solis Lacus appeared brownish.

On 28 June, ISHADOH and WAKUGAWA kindly constructed an observing site with a windbreak, and we could use the magnification 550×. The seeing improved around 17h GMT. The inside of the spc was very complex while the spc shape was roundish. It was easy to see Iuventae Fons. The present writer observed 8 times every 40 minutes up until 20:30 GMT (at 05:45 JST, the Sun rose). On 29 June (λ=212° Ls) he started from ω=028° W when Sinus Meridiani began to be checked. Novus Mons is visible. Nilokeras is dark on the morning side. At around 16:30 GMT the seeing was good at ω=037° W. On the night it was possible to chase nine times under good seeing until 20:30 GMT: δ=16.6" and λ=213° Ls. On 30 June, we caught Sinus Sabaeus at 15:50 GMT and at 16:30 GMT, but the place is never unusual.

On 1 July, the present writer observed eight times from 15:50 GMT to 19:10 GMT. Actually he observed also at 20:00 GMT, but the condition of the sky deteriorated. On 1 July the surface with ω=009° W came to us at 15:50 GMT, whereas no extraordinary aspect was seen around S Sabaeus. Afterward it was reported in the US that S Sabaeus was invisible at 9h GMT, while from our side S Sabaeus was quite clearly seen at 15:50 GMT on the day. From our point of view, no dust must show up in the daytime. On 2 July we started also from 15:50 GMT when ω=359° W, and could check the whole area of S Sabaeus, but it was usual without any disturbance at the eastern end of S Sabaeus. It was the same also at 16:30 GMT. We continued until 18:30 GMT.

On 3 July, we had a trouble at the telescope part, and we were forced to start late a bit, and the first one was made at 17:10 GMT (where ω=009° W). S Sabaeus was clear in a tint of chocolate without any disturbance. The present writer observed then at 17:50, 18:30, 19:10, 19:50, 20:30 GMT, when S Sabaeus went to the rear side. The chocolate colour of S Sabaeus may imply that the dusty floats at the area of S Sabaeus have had blown away to the eastern direction.

Now the 4th day of July (λ=215° Ls) came: The first observation made at 15:30 GMT (ω=336° W) readily proved that a new dust was entrained at the eastern side of S Sabaeus and Deucalionis Regio.

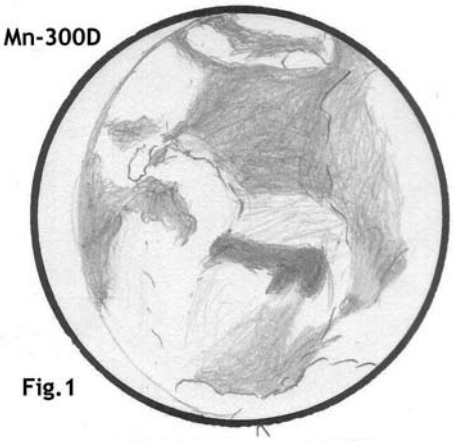

Fig.1

This was apparently a new dust stream which clearly split S Sabaeus into two at the eastern part of S Sabaeus. The remaining area of S Sabaeus showed a very characteristic aspect: The western part of S Sabaeus was thick in a tint of chocolate. This implies the western part was governed by a high pressure atmosphere so that a descending current of air was at the western side still blowing the dusty matter to the eastern side. Thus the dusts at the dust stream must have been accumulated at the eastern side. The area of Oxia Palus was also clearly visible dark.

This happening must have occurred when the area was at the dawn on 4 July. No precursory

state was there on the preceding days. Just the chocolate colour of the part observed on 3 July may imply a hint, but if the dust occurred on 3 July, it was possible for us to catch it within the day. On the other hand the area of S Sabaeus was brownish on 2 July, and so it must have been impossible for the disturbance to occur on 2 July.

To sum up we now know in the following way: The dust stream was caused at the eastern side because the part remained to belong to the low pressure part. The western side on the other hand belonged to the high-pressure part so that the area

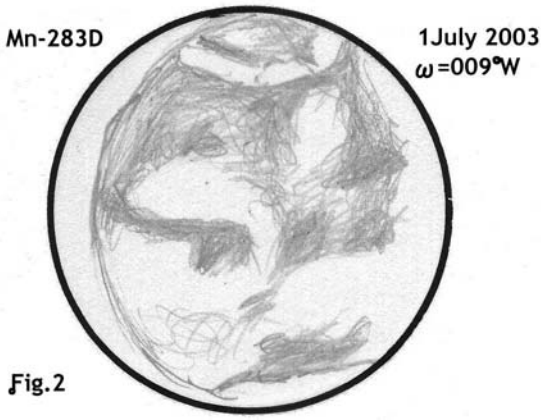

Fig.2

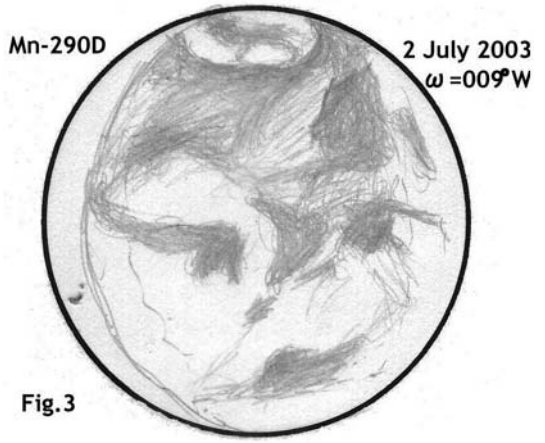

Fig.3

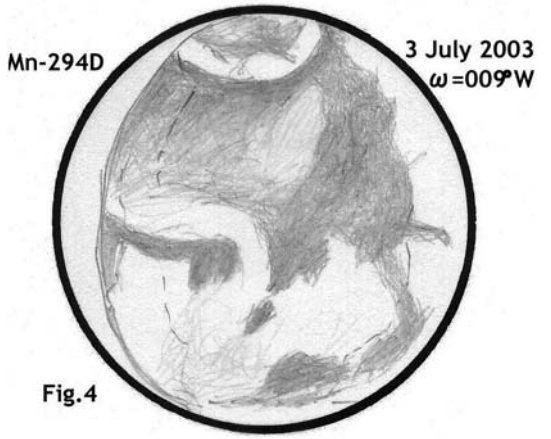

Fig.4

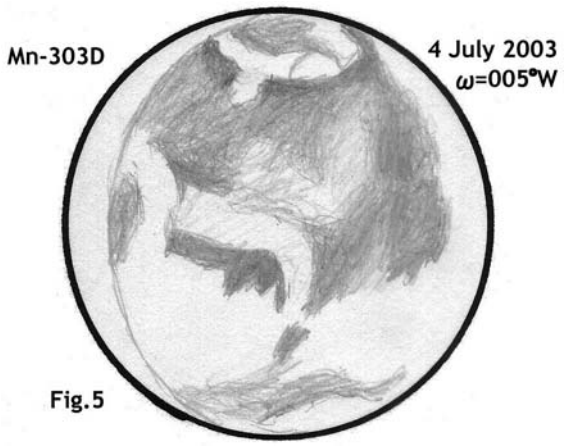

Fig.5

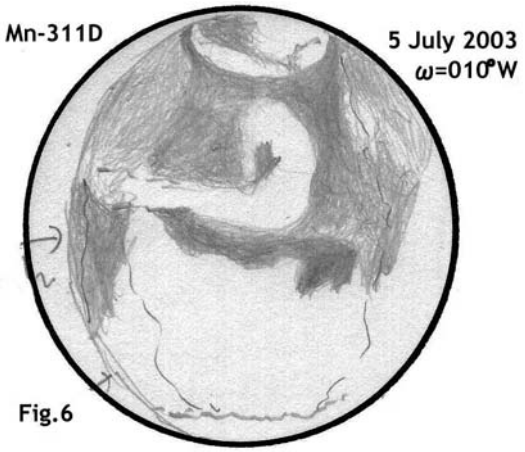

Fig.6

stayed transparent. Here Figures show the area of the S Sabaeus from 1 July to 5 July (Figs. 1~5). Figure 4 and Fig. 5 show the change of the dust storm (more detailed sequence presentation was given in Plate IV of Part I).

This dust cloud thus deformed again on 5 July, and S Sabaeus was recovered and a different dust cloud distribution was seen on the southern hemisphere (cf. Fig. 6). The dust which invaded the southern hemisphere showed a remarkable change every day, and hence these changes are interesting but we will regard it as another story and postpone the description until the next occasion. Here we just touched on the first development of the dust storm (on 5 July). Just we should say that any big dust change did not occur within the following days. The configurations on the following days until 10 July are shown on Plate IV of Part I article. The influence of the dust disturbance however continued to be seen. The most conspicuous change of the configuration was continued to be visible at the part of Mare Serpentis : It became broader and darker. This implied that the dust accumulation staying and floating at the area was

blown away. (Refer to the drawings Mn-551D, Mn-566D, Mn-754D in Part I.)

2° Morning Auroral Projections Observed in November 2003: Among several interesting phenomena observed in 2003, the protrusion phenomenon at the morning terminator checked in November should be said very particular and interesting. On 4 November (λ=292° Ls) when the present writer had already come back to Fukui and was observing by the use of the 20 cm refractor of the Fukui City Observatory, he suddenly detected a strange protrusion which was found along the morning terminator on the occasion of the third session on the day: Namely to the eye of the present writer a subtle protrusion from the terminator was recognised at 09:20 GMT (ω=203° W) (the observation started from 09:10 GMT and ended at 09:30 GMT) (see Fig. 7). On the day, he started to observe every 40 minutes from 07:50 GMT (=16:50 JST, sunset time). The planet showed us the surface ω=183°W at 08:00 GMT. The third observation of the day was from 09:10 GMT to 09:30 GMT and so the observation time was fixed at 09:20 GMT (ω=203° W). The protrusion looked to have risen around from the area preceding Eridania-Ausonia (see Fig. 7).

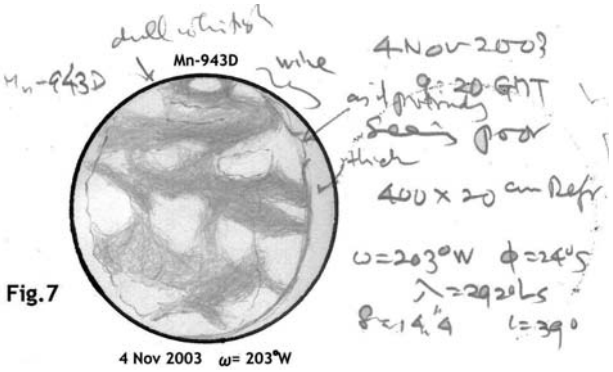

Fig.7

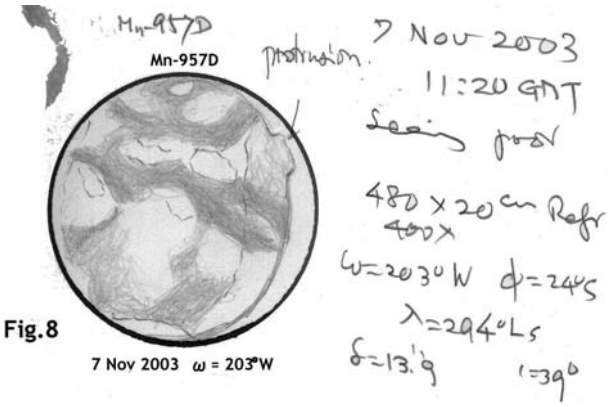

Fig.8

This observation was reported in our Web Site: http://www.hida.kyoto-u.ac.jp/~cmo/cmomn2/2830AA/index.htm in which we wrote: "Apparently from the terminator stood there a convex protrusion which was not so vivid, nor cloud-like but just like a broad brush protruded from the terminator, or a silent broad steam. It was constantly visible. " The width looked to occupy about 10°, but the height looked lower "compared with the width, and the upper boundary was not obvious because it gradually faded. However he (the present writer) was sure that it was a real phenomenon on Mars, while thought that it was a kind of phenomenon he had never experienced or heard in his long observational life."

Unfortunately however 40 minutes later we were not able to detect it again on the night because the seeing became broken though we were chasing until 03:20 GMT (at ω=261° W).

The sky remained poor on the following 5 Nov and 6 Nov so that we could not see the aftermath of the protrusion for a while. The present writer was so almost going to forget about it. However on 7 November (λ=294° Ls, δ=13.8"), the seeing improved, and surprisingly at the same angle (ω=203° W) at 11:20 GMT the same protrusion made its appearance again (see Fig. 8). On the day it was still definite even at ω=214° W. Hence the present writer took it appropriate to make a phone call to Isao MIYAZAKI at Okinawa and asked him to check the protrusion by his 40 cm Newtonian. Afterward we heard that the sky at Okinawa was rather cloudy on the night. At Fukui we could chase the protrusion until 12:20 GMT (at ω=218° W), but soon the seeing was broken and could not chase further.

The projection seen on 7 November was quite the same as the one we witnessed on 4 November.

This fact is very important, because it proves that the protrusion is not any kind of dust clouds: If it is a dust cloud it could not have appeared at the same place in the same shape on the following days.

Fortunately on the following 8 November day, MIYAZAKI was able to detect the same kind of projection by the 40 cm Newtonian. He detected it by the naked eye as well as realised it on the ToUcam images. The above report in the Web says "he (MIYAZAKI) could not detect any at around 10:00 GMT (ω=174° W), but at 11:00 GMT (ω=189° W) the projection was very obvious to his eye which was clearly standing from the terminator, and it was

perfectly visible until 12:50 GMT (ω=215° W) when it became cloudy."

As reported to us afterwards, Yukio MORITA in Hiroshima had already succeeded in shooting the projection on 7 November at ω=211° W and 221° W. See

http://www.hida.kyoto-u.ac.jp/~cmo/cmomk/2003/031107/Mo07Nov03.jpg

It may be possible to say that MORITA also took the phenomenon on 6 November at ω=221° W, 230° W, 240° W. See

http://www.hida.kyoto-u.ac.jp/~cmo/cmomk/2003/031106/Mo06Nov03.jpg

At present we have no definite answer about what kind of matter of this protrusion was. Just we should not confuse it with the so-called dust cloud. In fact no real dust cloud appeared near the terminator on the following days. Conversely we don't hear any observation of some dust cloud which showed up the protrusion at the terminator (mostly we observed the dust clouds when they went to the rear side from the evening terminator).

We however suppose that the area was near at (Ω=180° W, Φ=40° S~50° S) (where Ω is the longitude system on the Martian surface, and Φ is the latitude), and hence it lied between Argyre and Hellas (if counted to the West direction). This area is known as the special area where the crustal magnetism is stronger on the surface.

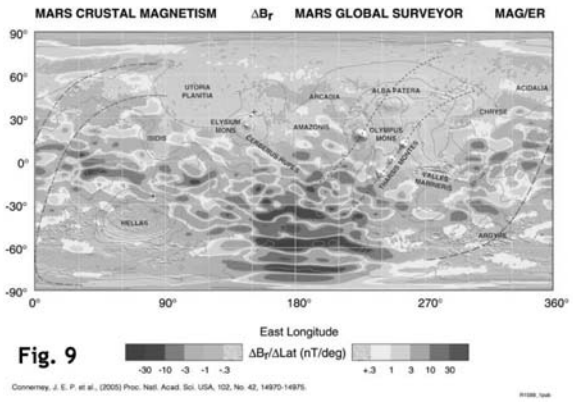

Fig. 9

Refer here to a map in Fig. 9, a citation from http://mgs-mager.gsfc.nasa.gov/publications/pnas_102_42_connerney/pnas_102_42_connerney_fig1.jpg This was originally, based on the data by the MGS, made by P CONNERNEY *et al.* in which the distribution of the strength of the crustal magnetism on the planet is shown (here the East longitude is employed while we always use the West longitude system, and hence this is a upside-down map from our usual point of view).

It is so natural to consider that the phenomenon was due to the magnetism which reacted to the Solar wind activity: In fact the Solar activity was conspicuous from the end of October to the beginning of November so that a strong Solar wind attacked Mars as well as the Earth. We should note the Solar activity region AR#10486 gave rise to an X17 class flare on 28 October at 09:51 GMT.

The proton activity continued further: On 4 November at 19:29 GMT another flare of X17.4 occurred. Further on 6 November at 06 hrs GMT a bigger flare of X28 was emitted. It will take some time for the Solar storm to reach the planet Mars. Hence at that time when the proton storm must have reached the planet, the place or angle where the protrusion may occur was away from our Observatory in Japan. Unfortunately no news about any protrusion arrived from the foreign countries.

Note Added: In 2012, a similar kind protrusion was detected at Minsk and other places several times. See the B column of the 2012 CMO News in the Façade of the CMO/ISMO

http://www.mars.dti.ne.jp/~cmo/ISMO.html

where a description about the phenomenon in 2012 is found. This fairly proves that the visual observations in 2003 were quite correct, and the phenomenon is quite general.

2003年の火星（その２）

南　政次*

（要旨） 福井市自然史博物館報告:第58号 1-10 (2011) の第一部の続編として，やはり2003年に発見し追跡した7月の火星黄雲と11月のオーロラ型の突起現象を報告した．前者はデウカリオニスの東部に現れ，第一日目はシヌス・サバエウスを切断する顕著さを見せた．第二日目以降は南下して現れ，ノアキスで活動した．後者は南半球の朝方の縁に突き立つように突起現象として現れたもので，珍しい観測対象であった (2012年になって同種の現象が，ベラルーシュやアメリカ，欧州などで観測された)．太陽風の強まるときに現れるものと思われる．

キーワード：黄塵，縁からの突起現象

*〒913-0048 福井県坂井市三国町緑ヶ丘4-6-73