An article (below in *italic*) about the planet Mars that has been circulating around through email for quite a while. For your information and knowledge there are a few serious errors in the article. Here, I wish to point them out one by one and hopefully that the next time when you receive this article, you will be able to know what is right and what is wrong.

Mars is going to be a second moon of earth for a day

NO ONE ALIVE TODAY WILL EVER SEE THIS AGAIN.

*The **Red Planet (MARS)** is about to be spectacular! This month and next, Earth is catching up with Mars in an encounter that will culminate in the closest approach between the two planets in recorded history.*

The next time Mars may come this close is in 2287. Due to the way Jupiter's gravity tugs on Mars and perturbs its orbit, astronomers can only be certain that Mars has not come this close to Earth in the last 5,000 years, but it may be as long as 60,000 years before it happens again.

*The encounter will culminate on **August 27th** when Mars comes to within 34,649,589 miles of Earth and will be (next to the moon) the brightest object in the night sky. It will attain a magnitude of -2.9 and will appear 25.11 arc seconds wide. **By August 27, Mars will look as large as the full moon to the naked eye**. Mars will be easy to spot.*

At the beginning of August it will rise in the east at 10p.m. and reach its azimuth at about 3 a.m. by the end of August when the two planets are closest, Mars will rise at nightfall and reach its highest point in the sky at 12:30a.m. That's pretty convenient to see something that no human being has seen in recorded history. So, mark your calendar at the beginning of August to see Mars grow progressively brighter and brighter throughout the month.

Share this with your family, friends, children and grandchildren.

The title of the above article itself had already created the excitement in most of us. Just imagine *"Mars is going to be a second moon of earth for a day"* and "*NO ONE ALIVE TODAY WILL EVER SEE THIS AGAIN"*. If one proceeds to read on, he/she will become more and more excited and are looking forward to 27th August to see Mars as large as the full moon with the naked eye (without using any optical aid such as binocular or telescope).

So, do you really believe that you will be able to see Mars as large as the Moon on 27th August?

1. The Date

First of all, the date only mentions the day (27th) and the month (August), but it did not mention the year. Does this mean that every year on the 27th of August, we will be able to see Mars as large as the Moon? But according to the article, it says, "*NO ONE ALIVE TODAY WILL EVER SEE THIS AGAIN"*, so it must mean that this event only happen in one specific year and this specific year is 2003 which is 2 years back.

2. The Title: *"Mars is going to be a second moon of earth for a day"*

Another interesting sentence in the article is the title itself: *"Mars is going to be a second moon of earth for a day"*. Mars is definitely not going to be our second moon but the more interesting question is why a day? Why not a month? Is it trying to say that on the day before the 27th, Mars will be normal Mars (which is small and not obvious), then suddenly on the 27th it will be as large as the Moon to be our second moon and then the next day, on the 28th it will be back to normal again?

Everyone knows that Earth and Mars have their own orbit around the Sun, so when Earth is "catching-up" with Mars, we will see Mars growing bigger day by day. After it reaches its maximum size, Earth will "overtake" Mars and Mars will become smaller and smaller (see diagram). It is going to be a gradual changes in size not a big leap. So if Mars is going to be a second moon, it is more logical to say for a month than for a day, but never mind, both are wrong anyway because Mars will never be our second moon for even a second.

3. The Brightest Objects in the Night Sky

Another sentence in the article is "...and will be (next to the moon) the brightest object in the night sky. It will attain a magnitude[(1)] of -2.9...". There is a slight inconsistency in this sentence. Next to the Moon, we still have Venus that will shine brighter that Mars (only during this time, other time we still have Jupiter and other brighter stars which can shine brighter than Mars).

But since Venus is not visible during 27th August 2003, one may say, "If Venus is not visible then we don't count Venus in.". Seems to solve the problem. But one check on the calendar one will find that on 27th August 2003, it was New Moon, meaning that the Moon is also not visible. So for consistency one should either count both Venus and the Moon in or both out.

4. The Most Serious Error: *"...Mars will look as large as the full moon to the naked eye."*

Next, it says that Mars will look as large as the full moon to the naked eye and this is DEFINITELY WRONG. How could it be possible? Mars is only twice[(2)] the size of the Moon but is about 144 times[(3)] much further away from the Earth than the Moon during 27/08/2003. Since the size of an object seen in the sky is inversely proportional to its distance, Mars will have to be at least 144 times larger than the Moon to look as large.

A very good example is our Sun. Our Sun is the only natural object in the sky that will look as large as the Moon. Although the Sun is about 400 times much further away than the Moon, it has a diameter 400 times of the Moon, therefore the Sun will appear about the same size as the Moon in the sky.

If we look at the angular size[(4)] of Mars given by the above article, it says that Mars will appear 25.11 arc-seconds wide [during 27/08/2003] and this is correct. Now let's compare this size to the size of the full moon. A full moon will appear 30 arc-minutes wide to the naked eye. One looks at these two figures one may jump into conclusion that since the difference between 25.11 and 30 is small, then Mars should be almost as large as the Moon. Wrong again! Just be careful of the unit, 25.11 arc-SECONDs and 30 arc-MINUTEs! 1 arc-minute is equal to 60 arc-seconds. This is just like trying to say 25 mm are almost the same length as 30 cm!

The Truth

So, what is the message of that article? Actually, that article is trying to tell you about an event called the Mars Opposition happened in 29th August 2003 (Precisely, 2003 Mars Opposition happens on 29th August and not 27th). If the Sun, Earth and Mars (or any outer planet) are in a straight line with Earth in the middle, then Mars is said to be in opposition (see diagram). Opposition comes from the word opposite because during an opposition, as seen from the Earth, Mars stands at the opposite side of the Sun.

This is the time when Mars, in its orbit around the Sun, comes close to Earth. Mars Opposition happens every 2 years and 2 months or every 26 months. Due to the fact that the orbits of Earth and Mars are not circular and they do not centre exactly on the Sun, the distance between Earth and Mars can vary for each opposition (see diagram).

For example, during a Mars Opposition the distance between Earth and Mars can be as far 100,000,000 km or as near as 55,000,000 km. The 2003 Mars Opposition is so spectacular because it is the closest approach (Earth-Mars distance $\approx$ 55,500,000 km) for the past 60,000 years. So "no one alive has ever seen Mars this close" and it also true that "no one alive today will ever see this again" because as mention by the article above, the next time Mars may come this close is in 2287.

Still remember the 2 years and 2 months? If you add this figure to August 2003, you will end up at October 2005. Yes, you are right, this year in October we are going to have another Mars Opposition but although it is not as spectacular as the one in year 2003, it is still worth observing because Mars will appear quite "big" with a maximum of 20.2 arc-seconds wide. Just for comparison, normal time Mars can be as small as 10 arc-seconds or even smaller, which will only appears as a tiny little disk in telescope.

During Mars Opposition, the planet is best placed for observation because it will appear bigger and brighter and one can observe it for the whole nightlong. A look through telescope will reveal Mars as a small disk with some obvious surface details especially its polar ice cap. Please bear in mind that if you have the chance to look through a telescope for Mars, never to expect it to look as big and as details as those splendid photographs you seen in books or magazines. Even at its maximum size of 20.2 arc-seconds wide, Mars is going to appear only as big as a 50 sen coin seen from 270 m away with the naked eye.

Teoh Hui Chieh (Ms.)
Malaysian Amateur Astronomer
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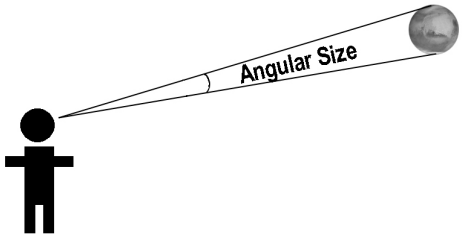
(The author of "Messier Objects Handbook")

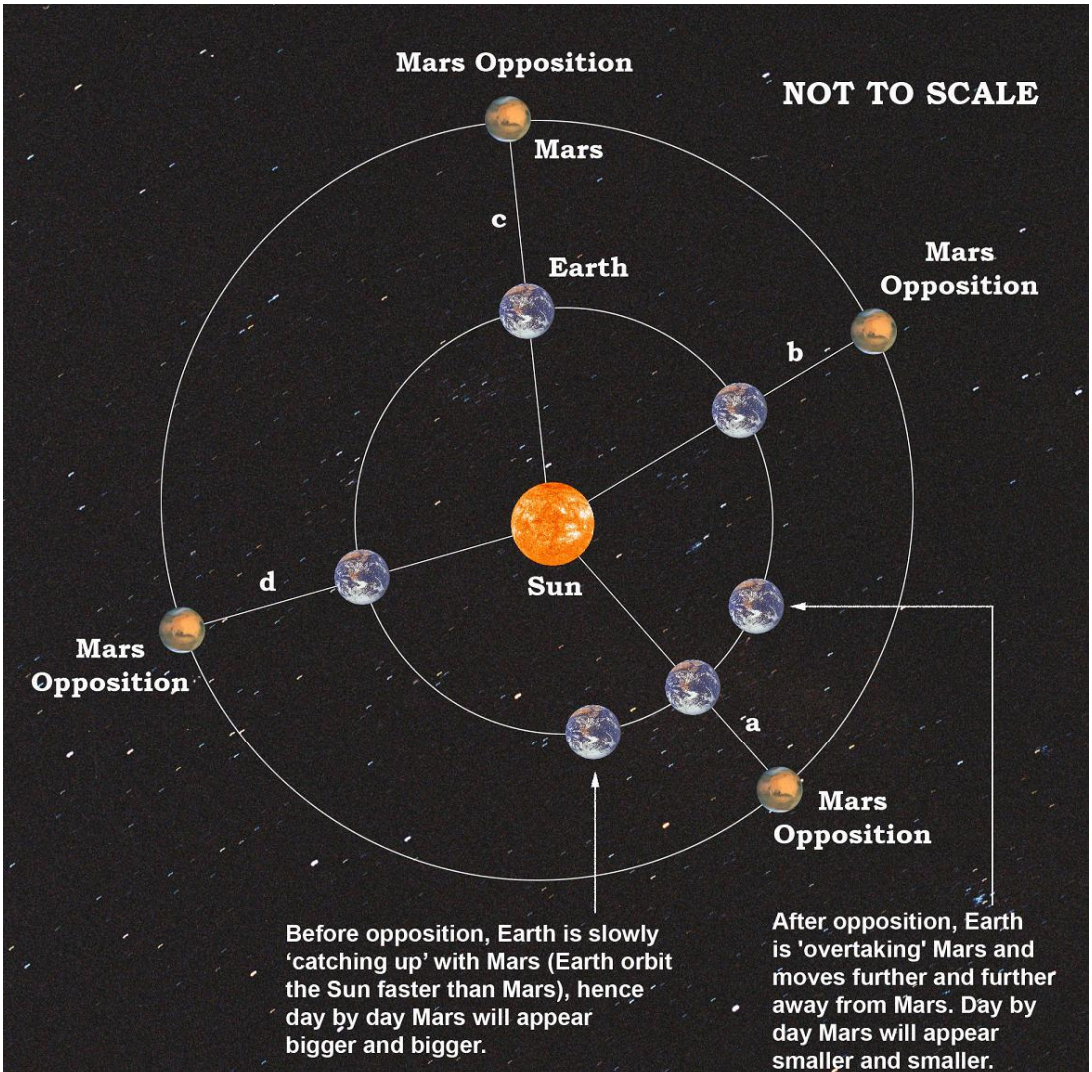
(1) Magnitude – a logarithmic unit used to measure the optical brightness of an object in the sky. The more negative the number, the brighter an object will appear. Our naked eye will be able to see objects down to 6th magnitude. Sun = -26.8 magnitude, Moon = -12.6 magnitude, Venus = -4.0 magnitude, Jupiter = -2.0 magnitude, Sirius (brightest star in the night sky) = -1.4 magnitude.

(2) Diameter of Mars = 6,786 km and diameter of Moon = 3,476 km

(3) The above article mention Mars distance is 34,649,589 miles = 55,439,342 km and Moon average distance is 384,400 km, therefore Mars is (55,439,342/384,400) 144 times much further away.

(4) Angular Size – The common measurement to state an object's size or the distance of 2 objects in the sky. Unit can be degree (°), arc-minute (') or arc-second ("). 1 degree = 60 arc-minutes and 1 arc-minute = 60 arc-seconds.





DIAGRAM

Due to the orbit of Earth and Mars that are not circular and do not centre exactly on the Sun, so if one observe the Earth-Mars distance carefully during opposition (i.e. distance a, b, c and d), one will find that during each opposition, the distance between Earth and Mars vary, there will be time when it is nearer (distance a) and time when it is further away (distance c). The 29th Aug 2003 Mars Opposition is the same case as (a) where Earth-Mars distance is the minimum, hence we will see Mars bigger and brighter than ever before.