GIOVANNI VIRGINIO SCHIAPARELLI (1835-1910): A TWO-FACED JANUS

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Abstract

When in the night of the 23 of August 1877, Schiaparelli turned his new 218 mm refractor Merz to Mars in a favourable opposition he didn't presume to dedicate a regular series of observations to the red planet.
Schiaparelli wanted test if the Merz, excellent in the observation of double stars, had good optical qualities for observing planet surfaces. But that short raid on the red planet changed his scientific life. From 1877 until his death Schiaparelli studied Mars.
In my paper I'll analyse the seven Schiaparelli's memoirs on Mars published on the *Atti dell'Accademia dei Lincei* from the 1878 to 1910. Then I'll analyse some of the articles he wrote on popular magazines.
I'll show that while in the Lincei memoirs he is rigorous, in his divulgation papers he dares hypothesis on the intelligent life on Mars which were not scientifically grounded. And I'll try to answer to the question of this contradiction.

1. Giovanni Virginio Schiaparelli (1835-1910) (from now on: S.), originally from Piedmont, sent to Milan after the unification of Italy, had studied abroad at two of the leading astronomy centres in Europe – with Johann Franz Encke in Berlin and Otto Struve and Friedrich August Winnecke in Pulkovo (near St. Petersburg). In 1862 he was appointed director of the Observatory; by 1877 he was already famous for having discovered the asteroid Hesperia, and for his studies on double stars, comets, falling stars and meteorites.
When, on the night of 23 August 1877, S. pointed the telescope with which he was observing double stars at Mars in opposition, he did not intend dedicating a regular and continued series of observations to the red planet.
S. wanted only to see whether the 218 mm Merz refractor telescope, which had proved excellent in observing double stars, had the appropriate optical qualities for studying the surface of the planets. That brief visit to the planet did not however end after a few hours: from 1877 until the end of his days S. continued to study Mars, his fame depending a great deal on the pioneering studies on the topography of the planet.
At that time there was a great deal of information on Mars, albeit fragmentary and little known: the mosaic of available knowledge, with the use of terrestrial terms such as "continents", "seas", "caps" and "channels", although disorganised, gave however the overall idea that Mars was very similar to the Earth.
S. described the planet not by hemispheres or drawings from sight, but in accordance with geometrical principles and methods, similar to that performed on Earth when its topography is to be described.
Undertaking topographical studies of a far-off planet was an act of intellectual courage for S..
At that time only the description of the movement of the planets in the solar system, of their satellites and the comets, caused by the reciprocal gravitational effect of the Sun and other planets, was considered scientifically proper for an astronomer.
Within astronomical disciplines the physical exploration of the surface of a planet and its changes in time was considered unworthy of attention.
S. read at the Accademia dei Lincei the results of his observations of Mars carried out from August 1877 to March 1878. They were published in 1878 in a paper of over 160 pages, full of descriptions and calculi, in the prestigious *Atti della R. Accademia dei Lincei* (*Proceedings of the Accademia dei Lincei*).
S. above all calculated the axis of rotation of the planet, basing on micrometric measurements of 62 points of its surface. They were used as a basis for the first map of the planet, in Mercator's projection. It was the most detailed of all those published to date.
Attached to the article, in addition to the map, there were a stereographic description of the austral hemisphere of the planet and various orthographic projections with the centre at various longitudes and latitudes. There was no description of the boreal hemisphere, not visible during the opposition of 1877-78.
In terms of representation S. used a different technique from that of his predecessors. They had given greater importance to the colour or tone of the picture rather than the line and stroke, which produced a description of the planet as a collection of spots.
S. instead concentrated on the line and contours, also taking care with the smaller details displayed in the observations. This allowed him to transform a qualitative observation into a description based on geometry and calculus, similar to the description of the Earth's surface: it was the first time that the method used Earth's maps was introduced for planetary observations.
All this was greatly appreciated by astronomers, yet more attention was attracted, even by laypersons, by the use of terms such as "seas", "emerged land" or "channels", although they were not introduced by S. and although he warned that these indications should not be taken too literally.
The use of these terms was decisive in the analogy with Earth phenomena – how would the Earth appear if observed from Mars? The Earth's continents reflect a considerable part of the light they receive from the Sun and, if they were observed from Mars, would be luminous. Instead the seas of the Earth, composed of a transparent liquid, absorb part of the sunlight and, should they be observed from Mars, would appear as dark spots.
In the terminology of scholars of Mars therefore the dark spots of the planet were christened "seas" and the lighter parts "continents". But it was therefore difficult to make non-expert readers believe that the use of such

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"terrestrial" terms was a pure linguistic device, and inevitably the same names were associated with the same objects.

Another element which led laypeople to believe that Mars was increasingly similar to the Earth was the phenomenon confirmed by S., and already observed by W. Herschel and others, of the periodical variation of the extent of the surface of the polar caps. The Milanese astronomer assumed that the Martian caps were the result of condensation of the vapours of the atmosphere of the planet, similar to the alternation of the seasons which causes snow on Earth to appear and melt.

Finally, from the observation of vapours, clouds and ice, he assumed the existence of water on the planet, also confirmed by the spectroscopic observations of W. Huggins and others.

The first paper on Mars published by S., and later ones, created in subsequent decades one of the most gripping disputes on the type of formations observed on Mars and the possibility that they were trodden and, probably, designed and built by intelligent beings. The resulting discussions saw participation by professional astronomers and laymen who, also through articles published in the daily newspapers and popular magazines, gained knowledge of the new discoveries and their interpretations.

It was one of the first examples of the diffusion of scientific issues outside of the community of specialists who were surprised by the mixture of scientific and non-scientific elements which fuelled the dispute. S. himself was not always able to participate in the debate with the cold and vigilant eye of the scientist, as he intended, ready to sharply cut "facts" from "interpretations". We know that he took part in a spiritualist session to contact possible inhabitants of Mars. The famous medium Eusapia Paladino was go-between for the unlikely encounter with the Martians. She had already attracted the attention of important intellectuals, scientists and philosophers such as Cesare Lombroso, Pierre Curie, Arsène d'Arsonval and Henry Bergson. The phenomenon was widely covered in daily newspapers and Luigi Barzini senior wrote about it in the *Corriere della Sera* newspaper in 1907.

After the first paper published in the *Atti della R. Accademia dei Lincei*, S. published, in the same journal, between 1878 and 1910, six other papers for a total of over 600 pages. The paragraphs are numbered serially from 1 to 1052, to indicate the unitary pattern which inspired them. The seven papers refer to observations of Mars made in the oppositions of 1877-78, 1879-80, 1881-82, 1883-84, 1886, 1888 and 1890.

S. continued to observe Mars after 1890, but did not feel he could publish other papers, with drawings, on the subsequent oppositions. He was afraid in fact that the gradual weakening of his sight could cause him to commit serious errors of representation. In January 1910, at the Accademia dei Lincei, a few months before his death, he read the last paper relating to the observations and drawings made during the opposition of 1890.

At the end of the first "Lincei" paper S. sketches a hypothetical interpretative picture of the observations made, the only one presented in the seven papers published in the *Atti della R. Accademia dei Lincei*. He later regrets having abandoned himself to this type of consideration.

The presence of polar snows, of clouds and mists demonstrate, according to S., that in the atmosphere of Mars there is a meteorological circulation. In certain regions vapours are raised and in others they are condensed. Such a circulation cannot only take place at a higher level, but has necessarily to involve the surface of the planet. If the vapours of Mars are condensed in the caps in the form of snow crystals, they will condense somewhere else in a liquid form. These liquid condensations are collected in the lower parts of the planet thus creating seas of varying sizes. The water reaches the sea via channels, and thus the hypothesis of a marine and continental formation of the surface of Mars is highly plausible.

The picture presented by S. ieft no doubt as to the profound analogy he found between Mars and the Earth, all given with a great deal of details, placed in a rational and logical context and described in a technical language appropriate for a scientific article on astronomy and with all the difficulties of reading and understanding which articles of this type present for the layman.

However the article had too many elements which aroused the curiosity of the common people. What caused the greatest sensation above all were the "canali": already intriguing in themselves, they acquired a wholly special significance due to the ambiguity of the term in Italian in relation to the English one. In English "canale" can be translated both as "canal" and "channel". Since "canale" was translated as "canal", English readers understood that these were manmade channels, and hence implicitly assumed the possible existence of intelligent beings, capable of designing and building them.

In the opposition of the 1879-80 the Milanese astronomer was struck by the major changes which he saw had occurred on the surface of the planet compared to the opposition of 1877-78.

The changes showed that a grandiose system of natural processes was active on Mars and the planet was not therefore an arid desert of stones. According to S., Mars was alive, and its life was apparent at the surface like a very complicated set of phenomena, some of which took place on a sufficiently large scale to be observable from the Earth.

2. The answer to many of the questions posed by the first two papers was sought in the observations made during the opposition of 1881-82. S. published the results of his observations in a paper dated 1886. It is accompanied by a map of the planet in Mercator's projection with the toponyms, the same map without toponyms to make the details of the surface more visible, a stereographic description of the boreal hemisphere and drawings.

The new opposition raised new questions, again due to S. who claimed that he had observed the phenomenon of gemination: on the right or left of an existing channel

another channel formed, identical and parallel to the first, at a distance which varied from 350 to 700 km. The phenomenon of geminations could represent the greatly sought-after proof of the existence of intelligent beings on the planet. The subject was too hypothetical for S. to include in the paper published in the *Atti della R. Accademia dei Lincei*, where he merely described the "facts". He did in fact describe it in the first article published in *Natura e Arte*, which I'll discuss further on.

3. The opposition of 1883-84 did not allow very sophisticated observations.
The opposition of 1886 was also not very favourable for observation, yet there was a major novelty for S.: the glorious 218 mm Merz telescope had been pensioned off. It was the first paper on Mars that had convinced the Italian government, within which S. boasted friends and sympathizers, which funded the purchase of a new instrument, a 488 mm diameter Merz-Repsold which, for a short time, held the record of the largest instrument in the world, surpassed in 1887 by that of Nice and later that of the Lick Observatory in California.
The opposition of the spring and summer of 1888 did not show Mars in the best conditions either and the planet was very low on the horizon.
The opposition of June 1890 was the last for which S. published the results in a paper published twenty years later, a few months prior to his death. The paper is accompanied by a map of the planet, a map of the boreal hemisphere and various drawings of features of the planet.
With the opposition of 1890 S. ended the cycle of observations of the planet started in 1877 and condensed in the seven long papers.

4. What emerged from this impressive work? Extremely briefly I could say the "channels" and "geminations", described in the first three papers on the three oppositions of 1877-78, 1879-80 and 1881-82. From the fourth paper onwards S. himself claimed that there was nothing or very little that was new.
S., after 1890, continued to observe the planet but did not produce drawings due to the deterioration in the sight of his left eye which he used to observe, and he decided not to publish his observations.
Nevertheless the most widely read article at that time was that which the Milanese astronomer published in 1893 in the magazine *Natura e Arte,* translated into English and even Russian.
In the first part of the article S. gives informations on the myths and legends surrounding the planet, red symbol of the god of war right from ancient times.
The Moon and all the planets in the solar system had been ruled out as possible custodians of intelligent forms of life, with the exception of the planet Mars, which had recently raised high hopes of being able to identify extraterrestrial intelligent life. In modern times, according to S., Flammarion had attempted to remove the subject of the plurality of worlds inhabited by intelligent beings from the imagination of poets and support the hypothesis of the plurality of worlds by the whole scientific apparatus available at that time.
For this reason S. decided to describe, systematically yet concisely, all the definite results acquired when observing the planet and their possible interpretations.
Steam in the atmosphere of Mars is the first assumption on which the reasoning of the Milanese astronomer is based: the subsequent steps are logical consequences of this first one. For this reason S., in order to claim the presence of water on Mars, did not only rely on the analogy with the Earth, but also bases on the spectroscopic investigation by W. Huggins and Hermann Carl Vogel who had confirmed the presence of water. Unfortunately for S. the first step in the reasoning is wrong, as demonstrated later in 1894 by William Wallace Campbell.
After having described the caps, S. goes on to describe other parts of the planet. It mostly consists of a large sea which winds in a labyrinth of emerged land known as "continents"; they are grooved in every direction by a grid of numerous thin lines whose appearance varies greatly – the famous "canali" (canals/channels). The "canali" were originally caused by the geological conditions of the planet and constitute a real hydrographic system. When the polar snows melt they become wider, and their dimensions follow the seasonal cycle of the snows.
The most surprising phenomenon is that of geminations, which apparently occurs in the period prior and subsequent to the floods caused by melting of the snows in the boreal hemisphere. Geminations are phenomena which actually occur on the surface of the planet and were noted by other observers.
Geminations are such regular phenomena, continues S., that some scholars have attributed them to the work of intelligent beings inhabiting the planet. He refrains from adopting a stance on this hypothesis, but does not rule out that this is the right one. This could explain the great variability of the appearance of the geminations from one season to the other due, for example, to extensive work of cultivation and irrigation.
Why did S.'s article arise such interest? Because for the first time all the elements of the Mars enigma were taken into consideration and an attempt was made to organise them. The article contains a considerable internal logic, strict use of the observation evidence available prior to 1877 and that collected later by the most important observers and, finally, an exciting subtopic – life on Mars.

5. In 1895 S. published for *Natura e Arte* the article "Life on the planet Mars". In the article S. outlines a unitary framework of observations and hypotheses revolving around Mars.
The "canali", according to the Milanese astronomer, form the irrigation system of Mars. That which we see from the Earth are not the real channels but the vegetation which grows due to water from the poles carried by the channels. On the subject of geminations he does not refute the idea that they are due to intelligent beings.

The scenario could be the following: Martian engineers have built dams at various levels along the slopes of deep valleys crossed by waterways. When the spring floods begin, the Minister of Agriculture orders opening of the highest locks and fills the upper channels with water. The water flows in two lower lateral zones where the valley changes colour and the astronomers on Earth see a gemination. The water gradually reaches the lower parts of the valley, fertilising them and causing vegetation to appear which we see as a single channel.
According to S., there must be an adequate social order on the planet for a system of such complex technology. That which in his opinion is most suitable for conflict-free management of the water resources is collectivist socialism. Each valley of the planet allegedly formed an enormous phalanstery, a true haven for terrestrial socialists. He claims that it would be worthwhile investigating whether each valley forms an independent state within a system of federations, or whether a monarchy rules the complex system of the waters with enlightened wisdom.
The working of a such a complex system presupposes finally that mathematics, physics, hydraulics and the science of constructions have reached a high degree of development on Mars.
However at this point S. realises that he has largely breached the border between "facts" and "interpretations", and this to him is an unacceptable misdemeanour. He therefore decides to dismount from the Hippogryph, in any case inviting the reader to continue flying if he or she so chooses.
The article of 1895 represents the most unconventional work of S., although still with the same discipline of reconstruction, based on careful analysis of the evidence available. However in no other written work did S. launch into such daring considerations even in the social and political fields, where moreover he had always been very cautions.
It is no coincidence that the comment he wrote himself on the copy which was reprinted was *Semel in anno licet insanire* (insanity is permissible once a year).

6. When however, during the 1894 opposition, the new 83 cm refractor was set up at Meudon, Antoniadi discovered a totally different world from that which he had drawn hitherto.
For several weeks Mars showed Antoniadi its detailed and varied geography, rich in shading. When however the distance of the planet from the Earth, after the opposition, began to grow, Antoniadi saw straight lines where there were details and shading.
Antoniadi thus demonstrated that with telescopes such as those of S. (maximum of 488 mm), the lines could not be resolved into separate points. Cerulli, at the same time, had given a physiological explanation of how it was possible to reconstruct lines, channels, geminations etc. from separate points.
A totally different demonstration of the non-existence of steam on the planet was given by the physicist G. Johnstone Stoney. In 1897 he tackled the problem of the atmosphere of Mars and showed that it consisted only of heavy gases such as nitrogen, argon and carbon dioxide. At a very low temperature the carbon dioxide solidified into white masses which could be seen at the poles of the planet.
So the unitary structure outlined by S. in his article of 1893 was by then opposed by another. The polar caps consisted of carbon dioxide in the solid state; the lines which were interpreted as channels, observed with more powerful instruments, are resolved into dark points, arranged, somewhat randomly, along narrow luminous regions. The geminations are produced when these regions are large enough to force the eye to trace two lines instead of one.
If there is no water there cannot be life; any channels are natural, and there probably are some, and there is no reason to believe Martians exist.

7. S. never accepted these conclusions. In the article "Il pianeta Marte", published in December 1909 in *Natura e Arte*, S. reiterated his arguments concerning the planet point by point.
It was a detailed defence of arguments which he considered scientific for all effects and purposes. It was also a defence of his personal history, although unnecessary: the astronomy community had already included him among the greatest astronomers of all time as the founder of planetology. He had been the first observer to make observations aiming at studying the physical nature of the planets of the solar system, following a strict method and basing, to interpret the data obtained, on the earth sciences: geodesics, geophysics and meteorology. Orthodox astronomers, till S. researches on Mars, considered this method foreign to traditional research in their area.

8. The "Hippogryph", "Semel in anno licet insanire" (insanity is permissible once a year): these are the key words for understanding S.'s thoughts. He believed that the issue of the intelligent life on Mars was not scientific albeit exact observations could help to tackle the problem. Duty of a good astronomer was to give a description as exactly as possible of the observed objects. So his articles on popular magazines hasn't to be judged from a scientific point of view.
But he didn't realize that, when a scientist becomes famous outside his scientific community, people continue to perceive him as a scientist also when he speaks about not scientific issues. And under the pressure of discussions coming from the outside of his community the scientist is obliged to decide also about questions that, from scientific point of view, he would have left unanswered.

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