The first Pic du Midi photographs of Mars, 1909

Audouin Dollfus

This short paper comprises an English translation of the article '1909; Premieres photographies de Mars au Pic du Midi', by Audouin Dollfus, published in *l'Astronomie*, 2009 November, pp. 27–30, and printed here with the assistance of the Director of the BAA Mars Section, Dr Richard McKim.

In early 1909 September, on the Pic du Midi in the Haute Pyrenées, construction of the new dome and its equatorial mounting had just been completed by the Baillaud brothers. Count Aymar de la Baume Pluvinel (1860–1929) and Fernand Baldet (1885–1962) reached the summit by climbing the mountain on foot with the 'caravan' supplying the site. Their purpose was to study the surface of Mars by photography: the first use of the Pic du Midi telescope.

De la Baume Pluvinel, aristocrat, bachelor and wealthy scientist, had his own research laboratory in his castle at Marcoussis. He was an expert in the study of the solar corona at eclipses. For that purpose he visited Guyana in 1888, Greece in 1890, Senegal in 1893, Spain in 1900, Sumatra in 1901, Cairo the same year, Spain again in 1905 and he would be in the Crimea in 1915. He had also worked at Janssen's observatory atop Mont Blanc and had just accomplished a notable spectroscopic study of comet Morehouse at Flammarion's Juvisy Observatory, together with Fernand Baldet.

The year 1909 saw the planet Mars at its minimum distance from Earth. The opportunity favoured a study of the enigmatic markings and features observed upon its surface, and their variations with time. Moreover, it was also a good time to clarify the nature of the faint linear 'canals' suggested by the Italian Giovanni Schiaparelli in 1877 and documented by the American Percival Lowell. The mystery was interesting, and triggered the enthusiasm of Camille Flammarion. One method of study involved taking photographs of the planet.

Figure 1. Fernand Baldet at the Pic du Midi telescope in 1909. The eyepiece of the 23cm refractor and the cell of the 50cm mirror are seen at the bottom of the telescope.

Some attempts had already been made during the previous perihelic opposition of 1907. Low in the European skies, but high in the southern hemisphere, the planet was photographed from the Arequipa station of Harvard Observatory in Peru. Furthermore, a remarkable expedition was directed by Percival Lowell in the Taracapa–Atacama desert region of Chile, at an altitude of 1400m [4593ft], where rain never falls. The powerful 45cm diameter Amherst Observatory refractor was loaned by David P. Todd and moved to the Atacama, where it could safely be left in the open air. In June 1907, Percival Lowell, David Todd and Earl C. Slipher arrived at the site with seven tons of material. 14,000 photographic images of Mars were recorded. Slipher selected the twenty best, showing the planet at all longitudes. Some of these images apparently showed 'canals', the purpose of the expedition. But Lowell, to promote the result, committed the fatal error of publishing photographs upon which the canals had been redrawn, enhanced in order to be made more obvious, which disqualified the demonstration.

The expedition to Pic du Midi, no less daring, preserved all its objectivity. At the top of the mountain, de la Baume Pluvinel and Baldet settled into the new ten-metre diameter dome holding the equatorial mounting, carrying jointly a 50cm Newtonian reflector and a 23cm refractor (the latter 6m long). The telescope's power was at least competitive with Lowell's Chile 1907 instrument, but located at a high altitude site [2800m, 9186ft] on top of a mountain. Operation of the instrument was apparently not easy. The observer had to be on a small platform at the top of the tube and alongside the opening of the dome, in the dark and in the wind. The telescope was guided at the eyepiece of the refractor, at the lower end of the tube. But perfect good weather arrived and stayed for a long time. Such is a property of the Pic du Midi: after a long period of bad weather; the sky will suddenly clear, and then it remains so for several weeks. The telescopic seeing reaches perfection, and in the second part of each night the images are rock steady.

In contrast to Slipher in Chile, who recorded long sequences of continuous photographic shots all night long, Pluvinel & Baldet chose to watch the seeing at the eyepiece of the telescope, and to shoot only at the best moments, about twenty times on the same plate. Each exposure needed about fifteen minutes. Then, the plate was processed in the darkroom and submitted to a quick scrutiny. The same operation was repeated again one hour later. Meanwhile, the planet had rotated by about 15° in longitude. After six hours

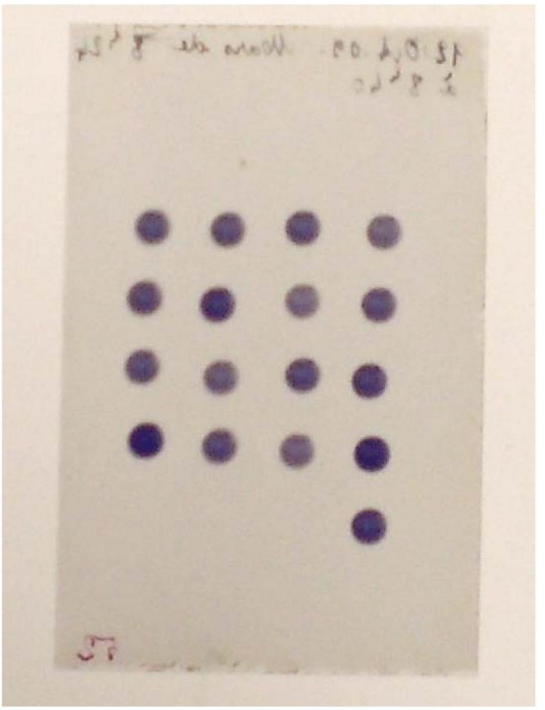

Figure 2. One of the 79 photographic plates recorded at Pic du Midi in 1909. The plate, 6×9cm in size, contains 19 images of Mars. The best of these images was printed as a positive enlargement. Later, several of the best images were selected and stacked to produce a single composite image of higher quality.

of such observations, Mars had displayed 90° of its surface. In addition, some images were recorded through a blue filter. Next night, the planet having a period of rotation of 24h 37m – slightly slower than the Earth's – the planet is seen with a shift of about 10° in longitude. After a few weeks, the same presentations in longitude recur, making it easy to make comparisons and to analyse the variations in Martian surface configurations.

The observations ended on 1909 October 20. A total of 79 plates was collected, from which the two astronomers selected 49 of the best. They processed a high contrast positive copy of the best image from each of these plates. A large scale display of these 49 selected images enabled easy analysis.

Subsequently, the astronomers of Meudon Observatory reprocessed the plates with the 'composite' technique advocated by Bernard Lyot in 1941: for each plate, the eight or ten best images are selected and stacked under the enlarger, to produce a single averaged image. The graininess of the image is reduced, small defects are washed out, and the sharp faint features are enhanced. The IAU Planetary Photography Centre at Meudon processed the complete sets of planetary images recorded by observatories throughout the world, brought together for the purpose. In 1909, during the period of the Pic du Midi observations, good images of Mars were also obtained by E. C. Slipher at Lowell Observatory, Arizona, but they do not always attain the sharpness of the Pic du Midi plates. At Yerkes observatory, the skilful observer E. E. Barnard produced a few exquisite images which, when processed with the 'composite' technique, show subtle details.

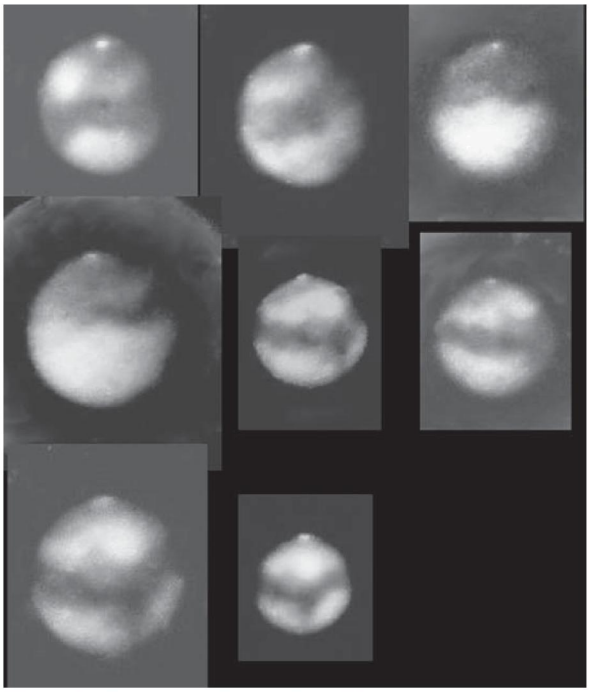

Figure 3. Enlarged positive prints of Mars, processed by de la Baume Pluvinel & Baldet in 1909 (as seen telescopically, with South up). The set of eight images covers all longitudes of the planet.

As a first result of the Pic du Midi operation, the photographic images did not show 'canals' upon the surface of Mars. At the same time, Eugène Antoniadi was observing visually with the large 83cm diameter Meudon Observatory refractor. In perfect seeing conditions, he also noted the absence of any features which could not be considered as natural.

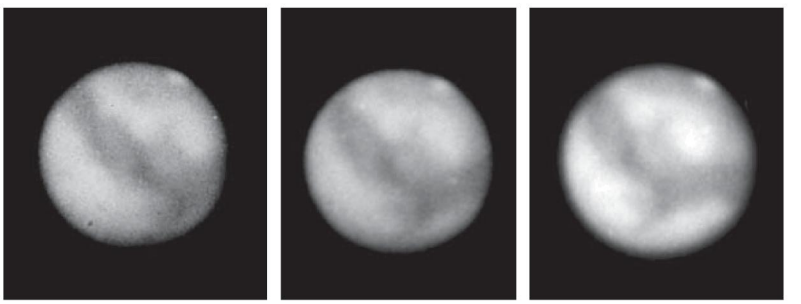

Figure 4. Composite images of Mars on 1909 September 27 at 12h 35m, 13h 35m and at 14h 20m (times in Greenwich Mean Astronomical Time [GMAT] reckoned from noon, as was usual at the time). Each image represents the superposition of several images from the same plate, in order to reduce the graininess and enhance the subtle details.

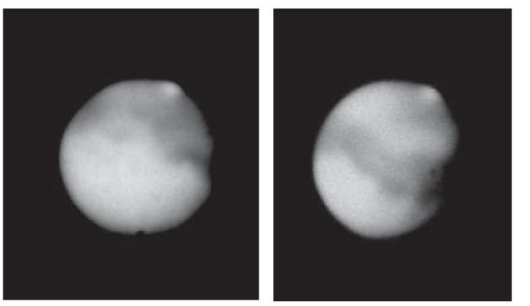

Figure 5. Composite images of Mars on 1909 October 7, at 10h 40m and 1909 October 20, at 9h 15m (GMAT).

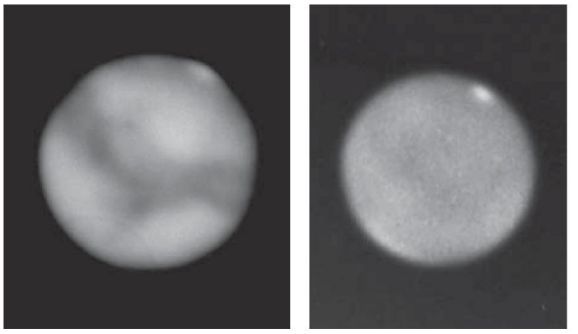

Figure 6. *Left:* Image of Mars on September 27 at 14h 15m GMAT in white light. *Right:* Same presentation, but in blue light. The surface features are no longer visible. The white polar cap is very bright.

The two astronomers were also surprised to find that, on images taken with the blue filter, the features of the surface of Mars are no longer visible. Only the white patch of the polar cap can be seen. The same effect was recognised on photographic images taken at Meudon with the large refractor. This peculiar effect was also discovered independently by E. C. Slipher at Lowell Observatory. Later, when observing again during the next periods of close approach of Mars with the Earth, Slipher noted some circumstances during which the Martian surface configurations seemed to reappear in blue light. He suggested this could be caused by the presence of a 'blue haze' in the planetary atmosphere, which was veiling the surface but occasionally able to dissolve (the 'blue clearing'), making the markings reappear. Conversely, the astronomers at Meudon showed that the dark features disappear in blue because the lighter areas of the surface (which are yellow in colour) darken sharply toward blue wavelengths and equal the reflectivity of the dark features in blue light. Occasionally, some white hazes or mists occur, preferentially over the bright continents, reproducing the surface configurations when observed in blue light.

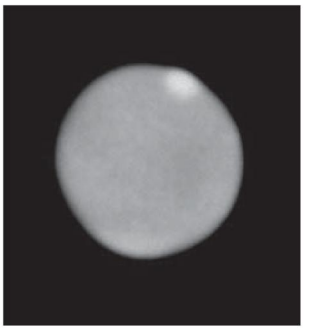

Figure 7. Image of Mars on 1909 September 15, in blue light. The surface features are not seen at all.

The 1909 Pic du Midi plates have also added their contribution to the global study of the evolution of the Martian surface configurations conducted at Meudon Observatory, on the basis of all photographic images of Mars taken throughout the world from 1907 to 1971. It was concluded that the shape and contrast variations are not due to vegetation, as was frequently suggested at the time, but are related to the transportation and deposition of dust under the effects of winds, at the places and during the periods when the heating of the ground by solar insolation is at maximum.

Such were the results of these exciting 1909 observations, which marked the start of astronomical research at Pic du Midi.

Address: 77 rue Albert Perdreaux, 92370 Chaville, France. [audouin.dollfus@obspm.fr]

Appendix and short bibliography

After the 1909 observations, 32 years elapsed without a serious planetary research programme at Pic du Midi. It restarted with Bernard Lyot in 1941, with the 50cm telescope replaced by a 38cm refractor (F= 6m) as described in: H. Camichel, M. Gentili & B. Lyot, 'Observations planétaires au Pic du Midi', *Bull. Soc. Astron. France*, **57**, 49–72 (1943).

Later, Lyot replaced the instrument with a 60cm refractor (F= 18m), the optical beam being folded twice by reflection. The instrument and site appeared to be of outstanding quality, fully justifying a large research project: B. Lyot, 'L'aspect des planètes au Pic du Midi dans une lunette de 60cm d'ouverture', *Bull. Soc. Astron. France*, **67**, 3–21 (1953); A. Dollfus, 'Etude visuelle de la surface de la planète Mars avec un pouvoir séparateur de 0.'2"', *ibid.*, **67**, 85–106 (1953); H. Camichel, 'Détermination photographique du pôle de Mars et de son diamètre et de ses coordonnées planétocentriques', *Bull. Astron.*, **18**(2), 81–190 (1954).

Later three review papers about the Pic du Midi planetary work were published: A. Dollfus, 'Visual and photographic studies of planets at Pic du Midi', in G. P. Kuiper & B. M. Middlehurst *(eds.), The solar system III – Planets and satellites*, Chicago University Press, 1961, pp 534–571; A. Dollfus, 'Polarization studies of planets', *ibid.*, pp 344–399; A. Dollfus, 'La nature de la surface des planètes et de la Lune', *Handbuch der Physik*, **54**, 180–239 (1962).

Of special interest to BAA planetary observers are: A. Dollfus, 'Etude de la planète Mars de 1954 à 1958', *Annales d'Astrophys.*, **28**, 722–747 (1965) and R. J. McKim & J. Dragesco, 'A Visit to the Pic du Midi Observatory', *J. Brit. Astron. Assoc.*, **97**(5), 280–287 (1987).

An overall review paper summarises the whole Pic du Midi planetary programme (except for the Moon), with a complete bibliography of the papers published: A. Dollfus, 'History of planetary science. The Pic du Midi Planetary Observation project: 1941–1971', *Planet. Space Sci.*, **46**(8), 1037–1173 (1998).

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