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THE 1874 TRANSIT OF VENUS OBSERVED IN JAPAN BY THE FRENCH, AND ASSOCIATED RELICS[1]

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Abstract: In 1874, Janssen, Tisserand and others went to Japan to observe the transit of Venus. Most of the members of the team set up their instruments in Nagasaki, while two of them observed at Kobe. Details of the expedition are mentioned. In 1998, on the occasion of an international astronomical conference held in Japan, the participants had the opportunity to visit the place in Nagasaki where the 1874 observations were performed. A few relics were preserved there, and these are discussed in this paper. They consist of a pyramid erected by Janssen and two pillars. At Kobe, the column built by the Governor is also preserved.

In 2004, a transit of Venus was observed from Europe. Many observing sites were organized in many countries, including Great Britain and France, with many places for the public, students and amateurs. The event was an opportunity for teachers to give an unusual observing experience to their students.

Keywords: 1874 transit of Venus, Janssen, Tisserand

1 INTRODUCTION

After Edmond Halley (1656–1742), French astronomers were apparently the first to take an interest in his proposal to use transits of Venus to determine the solar parallax. The accuracy could be improved in comparison with the value deduced by Jean Dominique Cassini (1625–1712) from observations he made on the Paris Observatory meridian line, while Jean Richer (1630–1696) went to Guyana. After Halley's death, Joseph Nicolas Delisle (1688–1768) called on his colleagues to observe the 1761 and 1769 transits, and he collected their observations under the leadership of the 'Académie des Sciences'. After his retirement, Jérôme Lalande (1732–1807) took over, in the same way (Dumont, 2004). However, astronomers were disappointed by the results and they decided to leave it to their successors to investigate later transits. The next one to come along was in 1874.

2 THE 1874 TRANSIT OF VENUS

The differences between the values obtained from the eighteenth century transits being of the order of 1.5%, i.e. ±0.13″ (Toulmonde, 2004), the 1874 observations had to be organized carefully, all the more as photography and electrical telegraph did allow some real improvements. In France, the Government asked the Académie des Sciences to set up a Commission to decide on observing sites, and which instruments to use. All the members of both the astronomy and the geography and navigation sections of the Académie composed the Commission (Dumas, 1874). Among the astronomers were Charles Delaunay (1816–1872), as first President, Hervé Faye (1814–1902), who became President after Delaunay's death, Urbain Le Verrier (1811–1877), and Jules Janssen (1824–1907) in 1873, when he was elected a member of the Académie. By that time, Faye had left the group (Canales, 2002), and the new President of the Commission was one of the two so-called 'perpetual secretaries' of the Académie, the chemist Jean-Baptiste Dumas (1800–1884).

Among several possibilities for the location of the stations, the Commission eventually decided to consider only six, all of them being in the appropriate part of the world in Eastern Asia and in the islands north of Australia and to the south of New Zealand. The chosen locations were Campbell Island, Saint-Paul Island, and Noumea in the southern hemisphere and Peking, Yokohama and Saigon in the northern hemisphere (Dumas, 1874).

Figure 1: Portrait of Jules Janssen (1824–1907) from a photograph by Paul Berthier (after *L'Univers Illustré*, 1874: 509; Launay Collection).

3 JANSSEN'S PARTIES IN JAPAN

Jules Janssen (Figure 1), who was in charge of the station at Yokohama in Japan, was also among the fifty people sent out of France for the event, the only

member of the Académie, which he thus represented officially (Dumas, 1874). The Académie, which had just fully recognized all the achievements made by Janssen during all his previous scientific expeditions, was of course quite confident in his capacities for achieving his new mission.

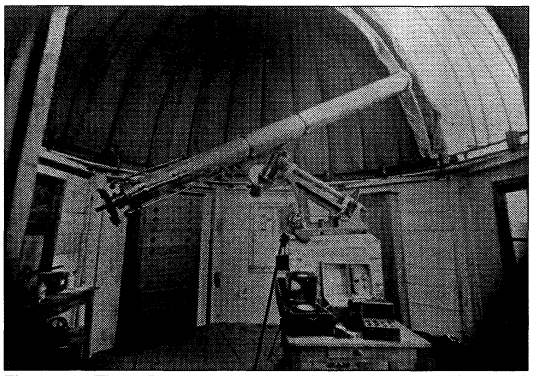

Figure 2: The 8" equatorial used by Janssen at Nagasaki (courtesy Paris Observatory Library).

As usual, Janssen did not know in advance where he would set up his instruments. He was used to arriving at least two months in advance in the country of observation in order to be able to consider several possible sites, taking into account both the probability of good weather and the help he could obtain from the locals. When he arrived at Yokohama, he realized that the weather would certainly be better towards the west coast of Honshu and decided to go to Kobe. Unfortunately, information he received there was not very promising, and he decided to settle further south, at Nagasaki. The location eventually chosen was Kompira Mountain (Kompira-Yama), a hill well "... above the vapours of the town." (Janssen, 1875a: 343) but reachable by road and close to everything he might need. The only difficulty was to carry up to this place the 250 boxes full of instruments and equipment, but it did not take too much time for Janssen to find the five hundred people needed to take on this task (Janssen, 1875a).

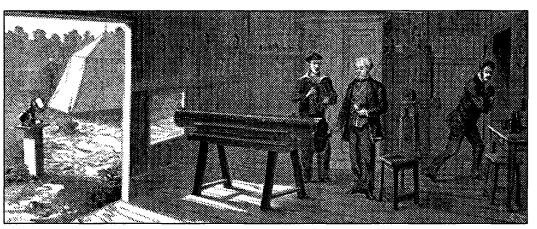

Figure 3: Janssen's photographic revolver in operation (after *L'Illustration*, 1875: 28; courtesy Patrick Fuentes).

As far as the instruments were concerned, Dumas (1874) emphasized in his report that Janssen would use not only the instruments of the Commission, two refractors of 8" (Figure 2) and 6" aperture and a photographic equatorial using daguerreotypes, but also some other photographic cameras and the 'photographic revolver' (Figure 3) that he had specially designed for the event (Janssen, 1876a). This device, which was more widely used by the British (Launay and Hingley, 2005), is now recognized as the precursor of the movie camera. The principle of the instrument (Janssen, 1873) was to record, for each of the four contacts, a series of images taken at regular and short intervals on a circular plate (Figure 4).

The first version of the instrument built by Deschiens did not satisfy Janssen because its clockwork mechanism was causing too much vibration. A new version, a copy of which is preserved at Paris Observatory (Figure 5), was then built by Redier and his son. The device allowed 48 images to be recorded in 72 seconds, the plate being stationary during each exposure. Of course, the precise time of each shot was automatically recorded, and the instrument was automatically driven as soon as the rotation began. The result is shown on the enlarged photo of the practice plate, which is also preserved at Paris Observatory (Figure 6).

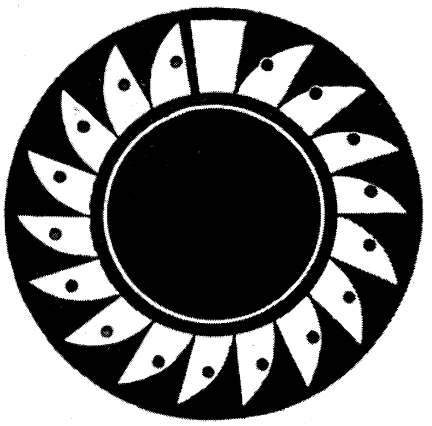

Figure 4: Sketch of the chronographical recording after a drawing by Janssen (after *L'Illustration*, 1896: 446; Launay Collection).

In order to secure the observations on the day of the transit, Janssen sent two members of his team (Delacroix and Chimizou) back to Kobe, while the main part of the group (Tisserand, Picard, Arents, d'Almeida and a few others) remained with him in Nagasaki.

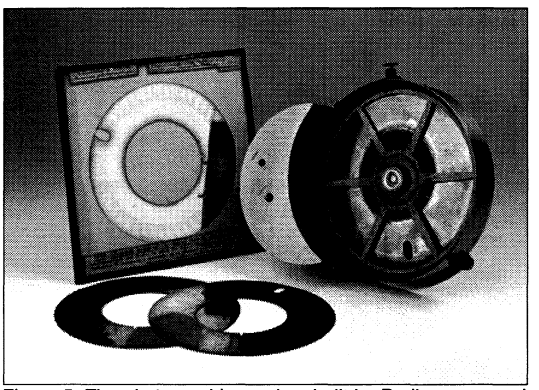

Figure 5: The photographic revolver built by Redier preserved at Paris Observatory (courtesy Paris Observatory Library).

To obtain the value of the solar parallax, an accurate value of the local coordinates of the stations was needed. To do so, Janssen was helped by Félix Tisserand (1845–1896). A graduate of the 'École Normale Supérieure' with a rank of number one, he

was recruited by Le Verrier in 1866 at the Paris Observatory and was asked to accept the Directorship of the Toulouse Observatory in 1873. Through his duties at the Paris Observatory, he was well trained in meridian observations and in geodesy. At Nagasaki, he had to take care of the clocks and chronometers, and to determine the longitude and latitude from his observations made with a portable meridian refractor (Tisserand, 1880). The longitude of Kobe was determined thanks to chronometers telegraphically adjusted to those of Nagasaki, while Janssen (1875b) went back to Kobe after the transit in order to determine the latitude.

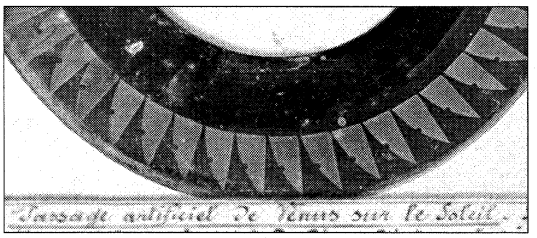

Figure 6: Part of the revolver practice plate preserved at Paris Observatory (courtesy Paris Observatory Library).

4 THE RESULTS

At Nagasaki, the internal contacts were observed by both Janssen and Tisserand, using respectively the 8" and 6" refractors, while Delacroix observed them in Kobe where the weather, incidentally, was better. Both teams, at Nagasaki and Kobe, recorded about 80 photographic plates of the transit, among which were 60 daguerreotypes now preserved at the 'Conservatoire National des Arts et Métiers' in Paris. A plate of the first internal contact was taken at Nagasaki with the revolver, but unfortunately can no longer be found.

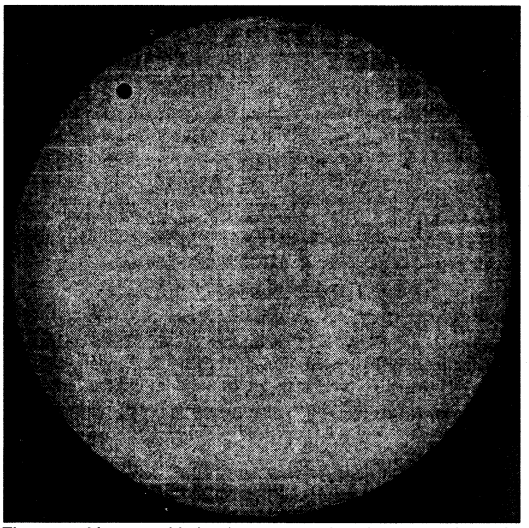

Figure 7: Venus, with luminous aureole, shown on the solar disk on 9 December 1874. This photograph was taken in Japan (after Guillemin, 1877: 946; Launay collection).

The results of the French were no better than those of other nations, and it is well known that, as far as the solar parallax was concerned, the results obtained by all parties all around the world were not very successful (e.g. see Dick, et al., 1998). Astronomers were disappointed: the error of ±0.06″ obtained for all stations was less than that of the eighteenth century, but the astronomers had expected only about ±0.01″. Anyway, as a physicist, Janssen (1874) was very proud to claim that he was able to observe the solar corona eclipsed by Venus before the first contact, using a blue violet filter and, even better (Janssen, 1875c), that Venus' atmosphere was also recorded on the plates taken during the transit (see Figure 7)!

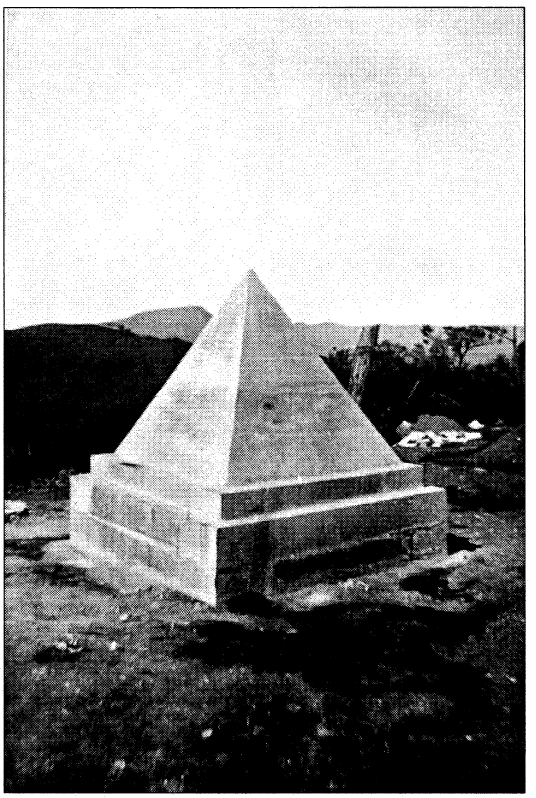

Figure 8: The pyramid installed by Janssen at Nagasaki (after Janssen, 1929: Plate '1876 Fig. 1'; Launay Collection).

5 THE RELICS OF THE 1874 FRENCH EXPEDITION TO JAPAN

In memory of the 1874 French expedition, two monuments were soon erected (Janssen, 1975b). Janssen arranged for a pyramid to be built at Kompira-Yama (Figure 8), and the Governor of Kobe erected a column at Kobe (Figure 9). Both monuments still exist, surviving testimony to the transit of Venus observations, and despite the tragic events that happened at both sites in the twentieth century. At Kobe, one can still admire the column, which is situated in a nice area (see Figure 10).

On the occasion of the 'Third International Conference on Oriental Astronomy', held in Fukuoka (Japan) from 27 to 30 October 1998, Masanori Hirai organized a tour to the Nagasaki area. The participants, including one of us (S.D.), then had an opportunity to visit Kompira-Yama Mountain, 124 years after the French observed the transit there.

The site is well sign-posted both in Japanese and in English, and the pyramid installed by the French is still there (Figure 11). Of course, the inscriptions, which are written in French and in Japanese, are not as

legible as they were in the past. Nearby, was a small pillar (Figure 12) where Tisserand is assumed to have used his portable meridian refractor, and a larger pillar (Figure 13), which probably supported either an equatorial or a coelostat. It was quite impressive to see these 1874 expedition relics so close to the town of Nagasaki.

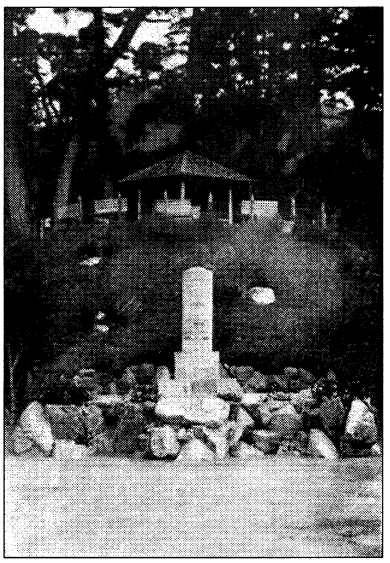

Figure 9: The column erected at Kobe by the Governor (after Janssen, 1929: Plate '1876 Fig.2'; Launay Collection).

Figure 10: Photo of the column taken at Kobe in 2000 (courtesy Marcus Durand, Hubert Durt and Philippe Papin).

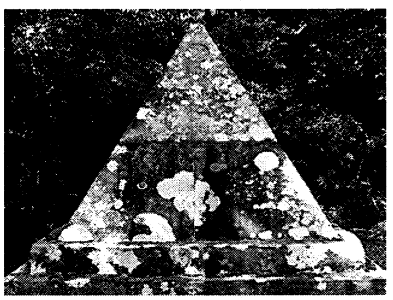

Figure 11: Photo of the pyramid taken at Kompira-Yama in 1998 (courtesy Masanori Hirai).

6 THE 2004 TRANSIT OF VENUS

One of the two twenty-first century Venus transits occurred on 8 June 2004, as predicted long ago by astronomers. On this occasion the chance to observe from Paris Observatory was offered to the general public. This proved a great success, with a great many people and several different instruments available in the garden at the Observatory. An image of the transit could also be seen in the 'Cassini Room', where Janssen's revolver was on display. Many teachers had organized, with their pupils or students, measurements from which they had in mind to determine the solar parallax as an academic experiment.

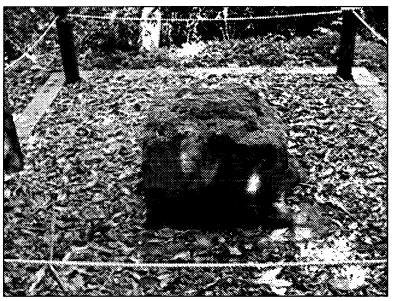

Figure 12: Small pillar at Kompira-Yama (courtesy Kiitiro Hurukawa).

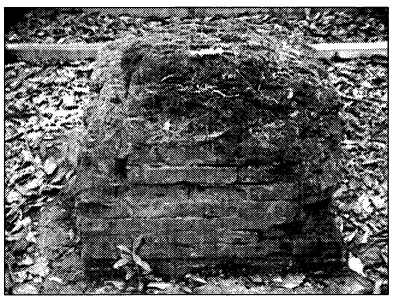

Figure 13: Large pillar at Kompira Yama (courtesy Kiitiro Hurukawa).

At an international level, an IAU Colloquium (No. 196) was organized in Preston (Lancashire, U.K.) by staff from the Centre for Astrophysics. The title of the meeting was 'Transits of Venus: New views of the Solar System and Galaxy', with a part devoted to historical presentations under the title 'Transits of Venus: History, Results and Legacy' and a modern part concerned with the astronomical unit, parallaxes, other planetary transits, distances in galaxies, programmes, etc.

A special day was devoted to the observation of the 2004 transit of Venus, and this included a tour to the place where Horrocks was the first to observe such an event, in 1639. It was also possible to visit the house where Horrocks is thought to have made these observations, thanks to the kindness of the owners.

7 ACKNOWLEDGEMENTS

We are grateful to Patrick Fuentes for supplying Figure 3; Marcus Durand, Hubert Durt and Philippe Papin for Figure 10; Masanori Hirai for Figure 11; Kiitiro Hurukawa for Figures 12 and 13; and the Paris Observatory Library for Figures 2, 5 and 6.

8 NOTES

1. This paper was presented at the meeting of the 'Transits of Venus Working Group' held at the General Assembly of the IAU in Prague on 17 August 2006.

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Françoise Launay made her career at Meudon Observatory as a research engineer operating the French 10-metre high resolution vacuum ultraviolet spectrograph. She has just taken early retirement in order to be able to spend more time on historical research. She took an interest in it in the early 1990s in order to ensure the preservation of old instruments and photographs at Meudon Observatory, and then as a detective looking for Laurent Cassegrain's Christian name. She is now a Research Associate at Paris Observatory, SYRTE Department, and her present main work is on the life of Jules Janssen.