Jantar Mantar (India) No 1338

Official name as proposed by the State Party:

The Jantar Mantar, Jaipur

Location:

Rajasthan India

Brief description:

The Jantar Mantar, Jaipur, is an astronomical observation site built in the early 18th century. It includes a set of some twenty main fixed instruments. They are monumental examples in masonry of known instruments but which in many cases have specific characteristics of their own. Designed for the observation of astronomical positions with the naked eye, they embody several architectural and instrumental innovations. This is the most significant, most comprehensive, and best preserved of India's historic observatories. It is an expression of the court of a scholarly prince at the end of the Mughal period.

Category of property:

In terms of categories of cultural property set out in Article 1 of the 1972 World Heritage Convention, this is a *group of buildings.*

1. BASIC DATA

Included in the Tentative List: 28 January 2009

International Assistance from World Heritage Fund for preparing the Nomination: None

Date received by the World Heritage Centre: 28 January 2009

Background: This is a new nomination.

Consultations: ICOMOS consulted the International Astronomical Union and independent experts.

Literature consulted (selection):

Perlus, B., Jantar Mantar: architecture in the service of science, the astronomical observatories of Jai Singh II, Cornell's CyberTower Website, 2003.

Bouchard, A. E., Le célèbre gnomoniste de l'Inde, le Raja Jai Singh II (1686-1743), *Le Gnomoniste*, vol. IX, 4, December

2002.

MacDougall, B.G., Jantar Mantar: architecture, astronomy and solar kingship in Princely India, *The Cornell Journal of Architecture*, 5, Ithaca, 1996.

Technical Evaluation Mission: 29 September-4 October 2009

Additional information requested and received from the State Party: ICOMOS sent a letter to the State Party on 14 December 2009 concerning the following points:

- Confirmation of whether the Disha Yantra and the Astronomers' House are in fact inside the boundaries of the nominated property.
- Considering the extension of the buffer zone to the south of the property (zones 8 and 12 on the layout plan).
- Strengthening the comparative study to take into account the scientific and cultural concepts that led to the construction of the Jantar Mantar.
- Indicating when the Management Plan was promulgated, or when it will be promulgated; stating the timetable for its implementation and operation; stating which bodies are in charge of coordinating the management of the property by the various partners.
- Justifying the serial nomination that has been announced and setting out the objectives and limits, as well as the process by which a nomination for inscription on the World Heritage List could be made.

The State Party replied on 26 February 2010. An analysis of the documentation provided is included in this evaluation.

Date of ICOMOS approval of this report: 17 March 2010

2. THE PROPERTY

Description

The property is the Jantar Mantar observatory in Jaipur. It includes a monumental ensemble of eighteen main instruments (nineteen in the table on page 12 of the nomination dossier), containing a total of 35 instruments. They are arranged inside an enclosure, and are for the most part monumental in form. Their highest point is 19m above ground level. The masonry structures are clad in lime mortar, usually red with white elements. The surface and alignment finishes used for scientific purposes are in very fine lime plaster and marble. In some cases the instruments have metal parts, such as graduated scales in cast lead. Four instruments have a mainly metallic structure (Unnathamsa Yantra, Chakra Yantra, Krantivritta II, and Yantra Raj). The fixed instruments are interconnected by paved pathways.

The orientation of the astronomical instruments is

primarily in the cardinal directions. However, the boundaries of the astronomical enclosure are aligned with the axes of the city plan, forming an angle of 15° with the instruments.

The main instruments can be classified as follows in terms of their siting:

- instruments sited relative to the horizon and the zenith of the site, i.e. horizontal coordinate instruments (Ram Yantra and Digamsa Yantra);
- instruments sited relative to the equatorial plane and to the axis of the Earth, i.e. equatorial coordinate instruments (Samrat Yantra);
- instruments sited relative to the ecliptic plane, i.e. ecliptic coordinate instruments (Rasivalaya Yantras).

The State Party has defined the levels of precision of thirteen of the eighteen fixed instruments. Four are said to be high-precision (Brihat Samrat Yantra, Laghu Samrat Yantra, Sasthamsa Yantra, and Dakshinottara Bhitti Yantra); the others are said to be medium- or lowprecision.

The eighteen monumental sites that make up the nominated property are as follows:

Brihat Samrat Yantra is a horizontal sundial with a gnomon in the form of a very large triangular meridian wall (height 22.6m, including 3.5m below ground, hypotenuse 50.1m.). It is completed by two quadrant scales with a 15.15m radius. This is probably the largest instrument of its type in the world. It enables local astronomical time to be measured with a precision of 2 seconds, and also the declination of the stars at night. The summit of the gnomon is the highest point of the property; it is accessible by a staircase leading to a small cupola at the summit. The Brihat Samrat Yantra is traditionally associated with forecasting the monsoon and harvests.

Sasthamsa Yantra is formed of four independent units of a meridian dial for measuring angles from 0 to 60 degrees, with two instruments in each of two chambers accessible through doors on the northern and southern sides. They provide a measurement of the declination and zenith of the sun or stars.

Jai Prakash Yantra is a huge hemispherical sundial, which produces an inverted image of the sky with a coordinate system. It is a multi-functional instrument. It has two complementary concave hemispherical bowls, each with a diameter of 5.4 m. The shadow of a suspended disc indicates the trajectory of the sun through the signs of the zodiac and its azimuth and equatorial coordinates. A hole in the disc also makes nocturnal observations possible. The instrument constitutes a complex architectural ensemble with pathways inside the representation of the skies. The hemispheres function alternately. The Jai Prakash Yantra is a significant structural innovation. The *Great Ram Yantra* is a set of two cylindrical structures (4.5m high, with an inside diameter of 6.95m) with a central gnomon. Its primary function is to measure the altitude and azimuth of celestial objects.

The *Small Ram Yantra* has the same design as the Great Ram Yantra, but on a smaller scale.

Dhruva Darsaka Yantra is a small trapezoidal structure, the upper surface of which points to the Pole Star.

Nadivalaya Yantra is an equal-hour sundial used to ascertain the arrival of the sun at the equinox. It consists of two parallel vertical discs with diameters of 3.7m.

Nadivalaya II is a horizontal sundial.

Krantivritta Yantra is a large incomplete instrument for the direct measurement of celestial latitudes and longitudes. It has a circular plate with a diameter of 3.4m oriented in a plane parallel to the equator, but the superstructure is missing.

Krantivritta II is similar to the previous instrument, smaller but complete. It has a graduated ecliptic scale inclined at $23,27^{\circ}$ to the plane of the equator.

Dakshinottara Bhitti Yantra comprises two instruments for measuring the zenith distances and meridian altitudes of celestial objects.

Yantra Raj is a monument mounted on three pillars supporting two beams that carry metal disc instruments, in a plane aligned at an angle of 23° to the plane of the meridian. The first is an astrolabe and the second a circular plate. The dimensions of these metal instruments are very large. With a vertical height of 2.43m, the astrolabe is probably the largest instrument of its type in the world. The circular plate is 2.1m in diameter. The engravings enable the planets in the zodiac to be observed, their speed of rotation to be determined, and the dates of eclipses to be predicted.

Chakra Yantra comprises two large moulded brass rings. The rings are vertical and can move around the vertical axis. They measure the hour that a celestial object reaches the meridian and its declination. An axial hole is provided for the use of a sighting tube.

Digamsa Yantra comprises a vertical pillar about 1m high, surrounded by two coaxial walls. It is used to measure angular distances in a vertical plane in relation to the north point.

Unnathamsa Yantra is a large circular brass ring with a diameter of 5.35m, supported by pillars and axial beams. It is used to measure the height of celestial bodies. A sighting tube may be added to the instrument.

Rasivalaya Yantra is a set of twelve independent instruments, each of which measures the latitude and longitude of a celestial object in one of the constellations

of the zodiac. They are built on the same principle as the Samrat Yantra. The vertical gnomons range from 4.2m to 6.2m and the radius of the quadrants varies from 1.24m to 1.68m.

Kapala Yantra is a set of two complementary instruments with two hemispherical concave bowls laid out on an east-west axis. The western bowl is designed to measure the coordinates of the sun in the horizon and the eastern bowl to transform graphically the horizon system of coordinates into the equatorial system. The hemispherical surfaces are made of marble.

Laghu Samrat Yantra is an equatorial dial similar to Brihat Samrat but of smaller dimensions.

An associated enclosure contains two complementary structures: the Astronomers' House and a square platform (Disha Yantra), the historic functions of which have not been clearly identified. These two elements are located inside the property, and are marked 19 and 20 on the map provided by the State Party in its reply of 26 February 2010, in response to the ICOMOS request of 14 December 2009.

The southern and eastern boundaries of the property are enclosed by a high wall with arched mouldings. The historic portal at the south-eastern end is currently not in use.

History and development

In the early part of the 18th century, the Maharajah Sawai Jai Singh II ruled a largely autonomous princely state that formed part of a Mughal Empire which was by then weakened and in decline. His states were situated in the present-day province of Rajasthan. Locked in a struggle with the Maratha Empire, he asserted his power by creating a capital, Jaipur, of royal stature. Jai Singh II was an enlightened prince, fascinated by architecture, town planning, astronomy, and mathematics. He embraced the great traditions of observational astronomy, particularly of Islamic and Central Asian origin, while remaining open to European influences.

The creation of the Jantar Mantar observatory was closely linked to the plan for the new capital in the late 1720s. In 1734 two French Jesuit scholars precisely determined the latitude and longitude of Jaipur. The construction followed a highly rational plan, close to the royal palace and in the heart of the capital, on a perfectly flat site inside an enclosure. Construction work seems to have culminated in 1734-35, when no fewer than 23 astronomers were participating, alongside masons and engravers. Scientific activity began at the same time. The construction work continued until 1738.

The set of monumental constructions at Jantar Mantar in Jaipur reproduces many instruments which already existed in Arabo-Muslim, Persian, and Western cultures: large sundials, discs or sections of discs, astrolabes, etc., which were given very large dimensions in order to maximize their observational performance. Several innovations, which at the least reflected instrumental and architectural originality, were introduced by Jai Singh II and his astronomers: the combined architecture of the giant sundial of Brihat Samrat Yantra and of the chambers of Sasthamsa Yantra, the huge sundial of the Jai Prakash Yantra consisting of two complementary hemispherical bowls, the set of twelve instruments of the Rasivalaya Yantra for the twelve signs of the zodiac, and the ingenious system of two hemispheres in the Kapala Yantra.

The Maharajah employed a permanent team of around twenty astronomers to observe the heavens systematically and make the corresponding calculations. From a scientific viewpoint, this is a programme of positional astronomy, based on Ptolemaic cosmology, involving the observation of the stars and the updating of tables, the forecasting of eclipses and celestial events, and the establishment and control of local time (Rajasthan time) and the calendar.

Local time and the custom of making it known to Jaipur's inhabitants from the observatory (by drum rolls or the firing of cannon) were maintained over a long period. These local and political rituals were made possible by the central position of the observatory inside the town, close to the royal palace.

Thanks to the results it provided, the observatory also played a part in the prediction of winds, rains, and the announcement of the monsoon. It played a role in astrological predictions both for society as a whole and for individuals. Its results were used in drawing up almanacs until recent times. The observatory constituted an active symbol and a daily demonstration of the exercise of the royal power of Maharajah Jai Singh II, who died in 1743.

In a more general sense, the Jaipur observatory made a major contribution to the completion of the astronomical tables of *Zij*, which originated in Islamic science. The results had an important role in the development of astronomy in India and its dissemination in Hindu society. They were, moreover, expressions of both of the rational practice of astronomy and of the social importance of astrology.

Maintenance of the observatory was carried out in 1771, when various instruments were repaired. This seems to have been the second maintenance intervention. However, around 1800, astronomical activity came to an end and the property was then adjacent to a cannon foundry, which used the property as an annex. A pit was dug and a metallurgical furnace was installed immediately adjacent to the Great Samrat Yantra. In the western part two monumental instruments were dismantled to make room for a temple.

The first substantial restoration of the observatory, which took place during the reign of Maharajah Ram Singh II,

was completed in 1876. Many instruments were restored. The Laghu Samrat Yantra assumed its present-day appearance; the Dakshinottara Bhitti Yantra was moved because of the building of a road. Various minor changes were made to the monuments: the stucco used in some of them was replaced by marble, and lead graduated scales were removed and replaced by other markings. On the Maharajah's death in 1880, however, the observatory was once again abandoned.

During the British period Lieutenant A.H. Garrett, the resident engineer stationed at Jaipur, headed a major restoration in 1901-02. The instruments were completely restored, and some that had fallen into disrepair were rebuilt. There were small changes in the linear or angular dimensions in some cases, such as the positioning of some elements of the Rasivalaya Yantra. There was a growing tendency to replace graduated surfaces made of lime mortar with marble, and this continued in later restorations (1945). Staircases were added or extended; underground accesses were walled up at the Jai Prakash Yantra.

Following the independence of India in 1947, the observatory came under the jurisdiction of the State Government of Rajasthan, becoming a protected monument under the Ancient Monuments and Antiquities Act. Interventions in the post-independence period have consisted mainly of the restoration of the red plaster and paving around the monuments. The boundaries of the site were redefined and protected, and the areas nearby were upgraded. The site was opened for tourist visits.

3. OUTSTANDING UNIVERSAL VALUE, INTEGRITY AND AUTHENTICITY

Comparative analysis

The State Party begins with a rapid overview of astronomical observatories from prehistoric times, beginning with sites such as Stonehenge (1986, criteria (i), (ii), (iii)), up to the Islamic civilization. It notes those that are visually the most monumental, such as the medieval observatory of Baghdad with its large quadrant and very large sextant.

The observatories that are most similar to the Jantar Mantar in Jaipur, and which may have had an influence on it, are then presented:

- The observatory of Maragheh in northern Iran was built in the mid-13th century by Sultan Bulagu at the request of the astronomer Nasir al-Tusi. It contained large monumental instruments and a library. It was abandoned in the 14th century and fell into ruins.
- Gaocheng astronomical observatory in China was built at roughly the same period, at the end of the 13th century, on an ancient observational site. It belongs to the same Mongol culture. Today it is well preserved.

- Ulugh-Beg's observatory at Samarkand dates from the early 15th century. It is inscribed on the World Heritage List as part of Samarkand – Crossroads of Cultures (2001, criteria (i), (ii), (iv)). This observatory had a direct influence on Mughal and Jaipur observatories in India. A large proportion of the original observatory of Samarkand has today disappeared or is in ruins.
- The ancient observatory of Beijing was completed in 1442 during the Ming Dynasty. It includes a number of large bronze instruments and was in operation until 1929.
- Tycho Brahe's observatory at Uraniborg in Denmark was constructed from 1576 onwards. At the end of the 16th century it was the largest in Europe. Its architecture is entirely dedicated to astronomy, but its instruments remain modest in size compared with those of the observatories mentioned above. It foreshadows modern observatories with its domes and instruments that are entirely metallic. It was soon abandoned and its upper structures have now disappeared.
- The observatory of Istanbul was built under the Ottoman Empire, in the second half of the 16th century, to rival the contemporary observatory of Tycho Brahe in Europe.
- The Royal Greenwich Observatory forms part of the Maritime Greenwich property inscribed in 1997 (criteria (i), (ii), (iv), (vi)) and was founded in 1675. The meridian passing through the observatory has been accepted as the Prime Meridian - the centre of world time and space. It is essentially an observatory that uses metal instruments, and in that it is very different from the Jantar Mantar in Jaipur.

In India itself, although many instruments are described in the Hindu school of astronomy, there is no trace of any early Hindu observatory prior to those in the 18th century of Jaipur, Varanasi, Delhi, and Ujjain. The Jantar Mantar in Jaipur forms part of a set of similar monuments which express the same scientific and cosmological culture in the 18th century: the Jantar Mantar in New Delhi, the Man Singh Observatory in Varanasi, and the Jantar Mantar in Ujjain. In its Tentative List India has expressed its intention of presenting them as a serial nomination.

The State Party concludes that the Jantar Mantar in Jaipur is an extensive, diversified, and highly comprehensive example of a 'pre-telescopic' observatory, composed of fixed instruments, most of which are in masonry. It is furthermore the best preserved of all such observatories and is still in a functional condition.

ICOMOS considers that the comparative study of similar but earlier observatories is satisfactory. It rightly highlights the fact that the Jantar Mantar belongs to a long line of observatories with fixed monumental instruments, which were prevalent in Islamic countries, Central Asia, Persia, and China, and to a lesser extent in Europe. They represent the culmination and final monumental expression of a long cosmological tradition.

ICOMOS considers, however, that the comparative study does not sufficiently take into consideration the scientific and cultural conceptions which led to the construction of the Jantar Mantar. The epithet 'pre-telescopic' is particularly ambiguous for an 18th century observatory that was built more than one century after Galileo's observations with the telescope or spyglass. The Jantar Mantars of India are the last monumental witnesses to a long Ptolemaic tradition of observation with the naked eye; they are a continuation of the legacy of Islamic, Persian, and Central Asian cosmology.

In its letter to the State Party dated 14 December 2009, ICOMOS asked the State Party to strengthen this point. In its reply dated 26 February 2010, the State Party indicated in scientific and technical terms the reasons for the installation of the large fixed instruments of the Jantar Mantar. It marked the final stage in the long process of developing this type of masonry instrument, inspired by those installed at Maragheh and Samarkand in the 13th and 15th centuries. This represented the culmination of this type of precision astronomy in India, involving the compilation of the tables and astronomy of Zij, derived from the medieval Arab world, and the raising of this type of astronomy to its apogee. In observations of this kind large fixed instruments in the open air proved to be both more robust and more precise than bronze instruments for observation with the naked eye. Furthermore, the State Party went further by providing tables that compared the Jantar Mantar observatory with around ten astronomical properties currently on the Tentative Lists of various State Parties.

ICOMOS also asked the State Party to consider indicating its overall strategy for the presentation of the announced serial nomination of the four similar Jantar Mantar observatories. A thorough study comparing these properties with one another is clearly essential, it being understood that the Jantar Mantar in Jaipur is the most important and the best preserved.

In its response dated 26 February 2010, the State Party referred to the significance of the group of four observatories built in India by Sawai Jai Singh II, at Jaipur, Delhi, Varanasi, and Ujjain, with similar types of instruments and observation programmes. It confirms its intention first to make a national serial nomination, in accordance with paragraph 139 of the *Operational Guidelines,* followed later by a broader international serial nomination.

ICOMOS considers that the comparative analysis justifies consideration of this property for the World Heritage List. The strategy of a possible subsequent serial nomination, chosen by the State Party, is not a matter to be considered by ICOMOS at this stage of the nomination procedure.

Justification of Outstanding Universal Value

The nominated property is considered by the State Party to be of Outstanding Universal Value as a cultural property for the following reasons:

- The Jantar Mantar, Jaipur, contains a particularly diversified and representative set of fixed instruments for astronomical observations with the naked eye. The dimensions of several of the instruments are exceptionally large and others incorporate significant innovations.
- Forming part of a line of observatories with large fixed instruments which developed in the Islamic world, Central Asia, Persia, and China in earlier centuries, it very comprehensively represents the culmination of this approach. Amongst similar Indian observatories dating from the same period (Delhi, Ujjain, and Varanasi), the Jantar Mantar in Jaipur is the most significant and the best preserved.
- The Jaipur observatory made a major contribution to the *Zij* mathematical tables. These tables derived from Islamic science played an essential role in the development of astronomy in India, particularly for the Hindu almanacs and calendar.
- Through the efforts of its creator, Sawai Jai Singh II, the observatory opened up intellectual awareness of the astronomical knowledge available in India at the time; it was a meeting place between the Islamic and Hindu cultures, and between astronomers and astrologers.
- In the way in which the observatory functions it expresses a collective concept of astronomy and its participation in the social realities of the period. It marked the passage of time in the urban environment, and it made possible the prediction of stellar and geoclimatic events, transcending astrological practices. It was a symbol of the exercise of royal power and it was a popular icon of large scientific instruments.
- The observatory is a specific architectural achievement which reflects an encounter between scientific, political, and religious needs. Its architecture is closely linked with the rational planning of the city of Jaipur, the first of this type in India.

ICOMOS considers that this justification is adequate overall. It takes on its full significance in the general historical framework of the long tradition of Ptolemaic cosmology, and of positional observation with the naked eye, of which it constitutes both an architectural culmination and the final programme.

Integrity and Authenticity

Integrity

The integrity of the current set of monuments was affected in the 19th century by the demolition of one fixed instrument, the moving of another, and a small reduction in the perimeter of the observatory. However, the existing set of monuments is sufficiently large and comprehensive to ensure that the expression of the site's value has been conserved, in respect of its various attributes.

Some of the monumental instruments have been altered and changed during the many repairs and restorations of the site, particularly in the early 20th century (see History). However, the integrity of their initial scientific functions has been retained for the great majority of the large instruments. Architectural integrity has been significantly affected in the case of three of them, and less significantly in the case of a fourth. All the other instruments satisfactorily meet the conditions of architectural integrity.

The integration of the observatory in its urban setting seems to have conserved the main features of the 18th century town-planning scheme. However, major alterations took place in its environment in the 18th and 19th centuries: metallurgical plant, creation of streets nearby, construction of an electricity sub-station, etc.

ICOMOS considers that the condition of integrity has been met with respect to the set of monuments and the scientific functions of the instruments.

ICOMOS considers, however, that particular consideration should be given to the condition of integrity of the observatory's environment, and that a report should be drawn up on the environmental and landscape aspects of the property, including historic documents and a systematic photographic record of the surrounding area as viewed from the Jantar Mantar.

Authenticity

Several of the monumental instruments required substantial restorations or rebuilds between the end of the 18th century and the beginning of the 20th century (in particular the Rasivalaya, Nadivalaya, Dakshinottara Bhitti, Laghu Samrat, and Ram Yantras).

Ashlar together with red and white lime plaster were used in this work, even though these materials were not used for the initial construction. Furthermore, most of the instruments whose original graduated scales were inscribed in lime plaster (to which lead was added in some cases) were rebuilt in engraved marble as early as the 19th century. Moreover, the 1901 restoration changed the initial graduations to the western time scales of hours, minutes, and seconds. Nothing is known for certain today of the original graduations.

The repairs also reflect a general long-term tendency to embellish the instruments, so as to enhance their architectural appearance and their aesthetic value.

ICOMOS considers that the authenticity of the property has been affected on several occasions during the many restorations carried out in the course of its history. The alteration in the conditions of authenticity is essentially architectural; with regard to the graduation systems, their initial form is no longer known. The conditions of authenticity of the monumental instruments in scientific and cultural terms are satisfactory, as is their overall significance (see Integrity).

ICOMOS considers that the State Party should:

- Make every effort to evaluate any scientific alterations that may have been made during past restorations to the graduated scales of the instruments;
- Take care to ensure that future maintenance policy is focused on maintaining the conditions of authenticity of the instruments in not only scientific but also architectural terms.

ICOMOS considers that the Jantar Mantar observatory in Jaipur meets the conditions of integrity and authenticity. ICOMOS recommends, however, that a report should be drawn up concerning the environmental and landscape aspects of the property, that any scientific alterations made to graduated scales during restorations should be evaluated, and that attention should be paid to maintaining the authenticity of the instruments in architectural terms.

Criteria under which inscription is proposed

The property is nominated on the basis of cultural criteria (ii), (iv), and (vi).

Criterion (ii): exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;

This criterion is justified by the State Party on the grounds that the monumental composition of the Jantar Mantar, Jaipur, expresses the cosmological order of the world of Sawai Jai Singh II, in his desire to understand and control space, time, and all other conditions of human existence. It expresses continuity with similar observatories constructed from the 13th to the 15th century in the Islamic world, Central Asia, Persia, and China. It uses instruments which for the most part were designed by earlier civilizations, to which it gives exceptional monumental expression.

ICOMOS considers that this criterion has not been fully justified, and that the arguments presented are more

relevant to criterion (iii), which is concerned with cultural traditions. The Jantar Mantar seems to be a late and ultimate culmination of a very long tradition of Ptolemaic cosmology and observation with the naked eye, rather than exhibiting important significant cultural interchanges in the history of astronomy, the international development of which subsequently took different directions, with the use of other methods.

ICOMOS considers that this criterion has not been justified.

Criterion (iv): be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) of human history;

This criterion is justified by the State Party on the grounds that the Jantar Mantar is a remarkable example of an amalgamation of science and religion, through the architectural creation of a very comprehensive and unique set of astronomical instruments. Several of the instruments are exceptional in size and are the largest in the world. The Jantar Mantar represents the culmination of 'pre-telescopic' concepts of the large observatory devised in the medieval world, while contributing important scientific, architectural, and urban innovations.

ICOMOS considers that this criterion has been demonstrated, provided that the term "pre-telescopic" (which is extremely ambiguous in this period) is replaced by a more explicit reference to instrumental observation with the naked eye, during the final flourishing of Ptolemaic cosmology.

ICOMOS considers that this criterion has been justified.

Criterion (vi): be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance;

This criterion is justified by the State Party on the grounds that the observations made at the Jantar Mantar were based on and led to the culmination of the *Zij* astronomical tables, which were first produced as early as the 15th century by Ulugh-Beg. They are a concrete assimilation of the astronomical concepts of Ptolemy and Euclid into the Islamic civilization. Greek, European, and Arabic astronomical treatises were translated into Sanskrit at the time of Sawai Jai Singh II. The results of the body of work conducted at the Jantar Mantar are of very great scientific value.

ICOMOS considers that the observational information and scientific knowledge contributed during the 18th century by the astronomers and astrologers of Jaipur were of great local, regional, and national importance. They bear testimony to the dissemination, and a final flourishing, of Ptolemaic cosmology in India. These contributions do not, however, fully justify an Outstanding Universal Value.

ICOMOS considers that this criterion has not been justified.

Criterion (iii): bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;

This criterion was not proposed by the State Party, but ICOMOS considers that it applies to the Jantar Mantar, Jaipur.

The Jantar Mantar in Jaipur is one of the final testimonies, both grandiose and exceptional, of Ptolemaic cosmology and practices based on observing the sky with the naked eye. It is a monumental and popular illustration of the cosmological, astronomical, and scientific traditions that are attached to this very ancient culture. It was a dominant concept and a knowledge of the celestial world which was shared by a major set of European, Middle Eastern, Asian, and African civilizations and religions for more than fifteen centuries.

ICOMOS considers that criterion (iii) is fully demonstrated by the arguments presented and by the attributes of the property's value.

ICOMOS considers that the nominated property meets criteria (iii) and (iv) and conditions of authenticity and integrity and that Outstanding Universal Value has been demonstrated.

Description of the attributes

- The Jantar Mantar observatory in Jaipur constitutes the most comprehensive and best conserved set of fixed monumental instruments built in India during the first half of the 18th century; some are amongst the largest ever built.
- The observatory forms part of the tradition of Ptolemaic astronomy which was shared by many civilizations. It contributed to a final culmination in the improvement of astronomical tables through this type of observation. It forms a late and ultimate monumental expression of this tradition, in the context of India at the end of the Mughal Empire.
- Through the impetus of its creator, the prince Jai Singh II, the observatory was a meeting point for different scientific cultures, and gave rise to widespread social practices linked to cosmology. It was also a symbol of royal authority, through its urban dimensions, its control of time, and its rational and astrological forecasting capacities. The observatory is the monumental embodiment of the coming together of needs which were at the same time political, scientific, and religious.

4. FACTORS AFFECTING THE PROPERTY

Development pressures

The property faces no direct development pressure because of its status as public property; it is also publicly managed.

External pressure arises mainly from noise pollution and air pollution caused by intense traffic on the major roads close to the buffer zone.

ICOMOS considers that present and potential pressure from urban development and traffic in the environment of the property and beyond the current buffer zone should be given greater consideration by the State Party. The property could also be affected by changes to the skyline caused by high-rise urban buildings in the environment of the property.

Tourism pressures

In the view of the State Party, the growth of tourism is the main threat currently facing the site. Visitor numbers amount on average to 3,500 people a day, with peaks of 10,000 people. In the past tourists were allowed access to the instruments, which resulted in wear and damage. The policy today is to regulate the flow of tourists, and access to the most fragile instruments is sometimes denied. However, one of the aims of the management programme is to continue to enable visitors to gain a good understanding of how the instruments work.

Over recent years some small buildings have been added to provide facilities for tourists, which are inappropriate for the site. These facilities have now been moved inside the museum (toilets) or integrated into the architectural ensemble (entrance building) as part of the 2007-2008 programme of works.

Private activities, often linked to tourism, have developed in the vicinity of the property. The intention is to control them more effectively as part of the buffer zone management process.

ICOMOS considers that tourist facility issues are one of the major challenges to be faced by the property, in order to ensure that the its Outstanding Universal Value is satisfactorily preserved in a long-term perspective.

Environmental pressures

The intensive watering of the lawns of the property has caused infiltration which could damage some foundations. ICOMOS considers that this issue must be addressed in the future management of the site.

The property is also subjected to general urban air pollution. However, no specific impact from this cause has been detected on the monuments.

Natural disasters

Jaipur is in a Level 2 seismic zone, on a scale ranging from 1 to 5. A moderate potential threat therefore exists. A slight earthquake took place in 2006. A masonry building such as the Brihat Samrat Yantra (27m) could be affected by a horizontal seismic thrust of an average level. The technical evaluation of this possibility is being considered by the State Party.

Impact of climate change

ICOMOS considers that the general impact of climate change does not at present appear to constitute a threat to the property.

ICOMOS considers that the main threats to the property are control of tourism development and the insufficient consideration given to urban development in the immediate environment of the property.

5. PROTECTION, CONSERVATION AND MANAGEMENT

Boundaries of the nominated property and buffer zone

The surface area of the nominated property is 1.87ha.

The area of the buffer zone is 3.24ha.

As currently defined, it consists of public circulation space and public buildings:

- the police headquarters, which is to be moved, resulting in an upgrading of the eastern approach to the site, placing the emphasis on tourism development;
- the historic palace of Hawa Mahal, the conservation plan for which is closely linked to that of the Jantar Mantar.

There are no inhabitants inside the property boundaries. There are fifty inhabitants in the buffer zone (2007-2008).

In its letter dated 14 December 2009, ICOMOS asked the State Party to give consideration to extending the buffer zone to the south of the property (zones 8 and 12 of the layout plan) and if possible extending it as far as the City Palace (zone 1) to the north-east of the property. In its reply of 26 February 2010, the State Party proposed a greatly enlarged buffer zone, demonstrating its concern to reinforce protection of the environment and urban setting. The extensions correspond in most cases to public buildings and spaces (City Palace, Jaleb Chowk space, police headquarters, school, temples and monument of Hawa Mahal, etc.). The southern part corresponds with the electricity substation and private properties. ICOMOS considers that the boundaries of the property are adequate and that the enlarged buffer area proposed by the State Party is satisfactory.

Ownership

The nominated property is owned by the Government of Rajasthan. Ownership rights are exercised by the Department of Archaeology and Museums, on behalf of the Department of Art, Literature and Culture of Rajasthan.

Protection

Legal Protection

The Jantar Mantar is protected under the Rajasthan Monuments Archaeological Site and Antiquities Act, 1961, under Sections 3 and 4.

It was designated a monument of state level importance in 1968, and is thus protected by the Department of Archaeology and Museums. This protection takes the form of administrative and scientific monitoring of the conservation of the property and the provision of financial and human resources carrying out works.

The extension of the buffer zone modifies its protection, and particularly the legal texts applying to the various forms of ownership and the conditions of their application. The Rajasthan Monuments Act (1961) applies to the historic parts of the buffer zone. The landuse framework law of the municipal authority (1970) results in the application of a series of existing urban regulation texts:

- the municipal street plan,
- the joint conservation plan for the Jantar Mantar and the Hawa Mahal,
- the future management plan for the district, which provides for an upgrading of the eastern part of the buffer zone.
- the new Master Plan for Jaipur, which is in preparation and should be promulgated for the period 2010-2025.

ICOMOS requests the State Party to provide information, when available, about the decisions to be taken in the next Master Plan for Jaipur concerning the property and its buffer zone, and the upgrading projects for the eastern district of the buffer zone.

Effectiveness of protection measures

The protection measures appear to be effective, in respect of the conservation of the property and the control of an enlarged buffer zone, provided that details are given about the measures taken to protect the buffer zone. ICOMOS considers that the legal protection in place is adequate, provided that details are given about the measures taken to protect the buffer zone.

Conservation

Inventories, recording, research

The inventories and public documents concerning the site are deposited with, and managed by, the Department of Art, Literature and Culture, Government of Rajasthan, Jaipur.

The Department of Archaeology and Museums has a library and an archive unit which compiles documents about all the works carried out since 1968.

The City Palace National Library contains archive documents about the property, including maps and photographs.

The most recent study campaign (2007) consisted of an update of the inventory of the property by means of a set of comparative photographs.

Present state of conservation

In the view of the State Party, the property is in a good general state of conservation. In line with the Integrated Conservation Master Plan (2005), a large programme of repairs and restoration was carried out in 2007-2008. It respected the integrity and authenticity of the instruments by using traditional materials. The landscaping was improved and the visitor circulation plan was modified. None of the instruments is today incomplete or shows any notable deterioration.

Some problems of water infiltrating into the foundations should be mentioned, and the poor condition of some bronze and iron elements. Some wooden elements are also in poor condition.

Finishing and weatherproofing works are currently in progress.

Active conservation measures

The Integrated Conservation Master Plan was drawn up in 2005 and led to active conservation measures in 2006-2008. It ensured that basic work was carried out to maintain or restore the conditions of integrity and authenticity of the architectural and scientific components of the instruments.

The 2009-2013 Management Plan continued the process, and is particularly aimed at:

upgrading the landscaping of the site in its historic context;

- the monitoring of architectural conservation;
- maintaining the instruments in a functional condition.

The Management Plan has not yet been promulgated and so is not yet being applied in the field of conservation. In principle the plan makes the following provisions for conservation (pp. 36-38):

- The restoration of the landscape around the property, including preliminary studies to permit an understanding of the historic elements;
- Greater thoroughness in conservation work with regard to the authenticity of materials such as wood, and special consideration for foundation problems;
- A programme to show the instruments actually working in order to fully express their value.

Maintenance

Routine maintenance of the property is carried out by a technical team of seven people, which belongs to the property management company. Its actions are based on the monitoring reports and the property conservation plan, under the control of an engineer. The cleaning and upkeep of the premises are carried out by a private company on the basis of annual contracts.

Effectiveness of conservation measures

Overall, the property conservation plan has been actively implemented over recent years. It inherited a complex and long-standing legacy of repairs and restorations which led to the raising of some questions relating to authenticity (widespread use of marble, renewal of graduated scales, rendering); these repairs and restorations did, however, ensure that the bulk of the instruments were maintained in what corresponds to their original scientific state.

ICOMOS considers that the state of conservation of the property is satisfactory.

Management

Management structures and processes, including traditional management processes

The Department of Archaeology and Museums is the manager of the site. It is subject to the authority of the Department of Art, Literature and Culture of Rajasthan, which must approve its main decisions.

A management society registered under the Rajasthan Societies Registration Act 1958, the Rajasthan State Museum and Monuments Management & Development Society (RSMMMDS), has been set up within this Department. The RSMMMDS commissioned the Jantar Mantar management plan in 2005 and subsequently coordinated its implementation.

The Department subcontracts certain auxiliary functions by granting annual contracts to private companies for cleaning, gardening, the bookshop, the snack bar, and the security service.

The very large number of visitors (over 700,000 in the last two years) generates substantial revenue. This revenue, however, is paid to the Public Treasury. Financing for conservation and management comes entirely from the Department's annual budget.

Policy framework: management plans and arrangements, including visitor management and presentation

The management system currently in force for the property consists of:

- The Integrated Conservation Master Plan for the Jantar Mantar and Hawa Mahal, a monument located in the buffer zone of the property (2005);
- The everyday management of the property;
- The tourism policy of the Department.

A series of plans and programmes of the State of Rajasthan, the region of Jaipur, and the town also apply to the property, directly or indirectly, in conjunction with the property management system:

- The Rajasthan Tourism Unit Policy of 2007, concerning directives for hotel development and tourist facilities. The Master Plan of the region of Jaipur, drawn up in 1991 and currently undergoing revision.
- The Urban Development Plan, 2006.
- The Management and Heritage Plan of the City of Jaipur, 2007, under the responsibility of the Jaipur Heritage Committee.
- The municipal programme for the renovation of the fortifications of Jaipur, 2008.

A new Management Plan is currently being introduced for 2009-13. It has been drawn up in the context of the nomination of the property for inclusion on the World Heritage List and of the guarantees that must be provided concerning long-term conservation. It also reflects the Department's approach of strengthening participation and the exchange of information with the other stakeholders (the municipal authority, the tourism department, education and tourism professionals etc.). The aim is also to achieve a harmonious and integrated tourism policy. The Plan has not, however, yet been promulgated and is therefore non-existent from a legal viewpoint.

The sites of several buildings inside the buffer zone (Anand Bihari Krishna Temple, Police HQ) are being transferred (or their transfer is planned) to the public site-management authority, with a view to facilitating visitor reception. This will also make it easier to improve control of landscapes close to the site. A thorough restructuring of the functions of the approaches to the current buffer zone should follow.

In its letter dated 14 December 2009 ICOMOS asked the State Party to give details of the management bodies, and their coordinated operation in relation to the various stakeholders, in the context of the 2009-13 Management Plan. ICOMOS also asked the State Party to indicate when the management plan would be promulgated.

The State Party provided in its reply dated 26 February 2010 details of the institutional relations between the central departments of the two ministries of the regional State of Rajasthan in charge of the property and its buffer zone: the Ministry of Culture and the Ministry of Urban Development. The organization chart suggests that the Jaipur municipal authority has direct relations with the second of the two ministries, but not with the first. Furthermore, the Department in charge of the management of the property has institutional relations only with its supervisory ministry, and it does not appear to be an overarching authority coordinating all the stakeholders in the management and conservation of the property. Furthermore, the Management Plan has not been promulgated to date. Promulgation has, however, been announced for May 2010.

ICOMOS recommends that greater attention should be focused on the landscape impact of the restructuring being considered in the immediate vicinity of the property.

ICOMOS considers that it is important to ensure an integrated policy for visitor reception, both inside the property and in its vicinity. The tourism policy must show respect for the property, particularly for its integrity and authenticity, and must focus on the pedagogical presentation of its values.

Risk preparedness

The Management Plan includes a section on risks, with an intervention plan that can be applied on the site in the event of a serious incident.

Involvement of the local communities

The municipal authority of Jaipur is directly involved in the management and future development of the environment of the property.

Resources, including staffing levels, expertise and training

There is a permanent team of eleven staff on the site who handle daily management tasks and supervise visitor reception. A specialist engineer makes regular visits for monitoring the property. The personnel of the contractor companies working on the site and at the entrance total some thirty people. The Department of Archaeology and Museums has technical services (Engineering, Electricity, Telecommunications, etc.).

The management society RSMMMDS has twenty conservation architects at its disposal in the State of Rajasthan. Specific tasks such as the preparation of the Conservation Plan and the Management Plan require the hiring of professional consultants.

The conservation work programmes are entrusted to specialist companies.

The professionals of the Department and of the management society and those who directly manage the property take part in activities to ensure that their skills and competencies are kept up to date. The Rajasthan Heritage Conservation Institute provides the training.

ICOMOS considers that the Department of Archaeology and Museums of Rajasthan, the main scientific organization involved in the management of the property, must reinforce its capacities and skills with a view to managing a property inscribed on the World Heritage List.

Effectiveness of current management

The current management of the property is satisfactory and effective. It must, however, set up a genuinely overarching management body and promulgate the Management Plan.

ICOMOS considers that the property management system is appropriate, provided that a genuinely overarching management body is set up, and provided that the Management Plan is promulgated. In addition, ICOMOS recommends the strengthening of the scientific competencies of the organizations in charge of the management of the property.

6. MONITORING

The monitoring of the property has been defined in the Integrated Conservation Master Plan (2005) and the Department of Archaeology and Museums is responsible for its implementation. The same monitoring approach is embodied in the Management Plan (2009). The plans define the human and material resources for work on the site, in order to set up a policy of regular recording and checking. This consists in particular of a daily visual inspection, checking the scientific functioning of the instruments, and comparative photographic campaigns.

In addition to the permanent monitoring of the monuments that form the property and its territory, monitoring is carried out for visitor access and signage, projects in the buffer zone, risk evaluation, and urban traffic and its consequences for the property. ICOMOS considers that the monitoring of the property is satisfactory.

7. CONCLUSIONS

ICOMOS recognizes the Outstanding Universal Value of the Jantar Mantar astronomical observatory in Jaipur.

Recommendations with respect to inscription

ICOMOS recommends that the nomination of the Jantar Mantar, Jaipur, India, be *referred back* to the State Party in order to allow it to:

- Promulgate the management plan without delay and apply it, and implement a programme of conservation works in this context;
- Set up, as part of the management plan, an overarching authority for the property in order to facilitate coordinated management of the property and its buffer zone;
- Provide information about the decisions to be taken in the upcoming Master Plan of the city of Jaipur, with regard to the property and its buffer zone, and about the plans for the upgrading of the eastern district of the buffer zone.

ICOMOS further recommends that the State Party give consideration to the following:

- Draw up an environmental and landscape report on the nominated property, based on existing early documentation (maps, photographs of site showing its environment) and on systematic contemporary photographs of the environs seen from the Jantar Mantar;
- Carefully evaluate any scientific alterations made during past restorations to the graduated scales of the instruments;
- Take care to ensure that future maintenance policy pays close attention to maintaining the conditions of authenticity of the instruments not only in scientific terms, but also in architectural terms;
- Give greater consideration to present and potential constraints arising from urban development and traffic in the environment of the property, outside the current buffer zone;
- Ensure that an integrated policy of visitor reception is applied in the property and its environs, while ensuring that its values are respected and taking care to present them in a pedagogical way;

- Give greater attention to the landscape impact of the restructuring being considered in the immediate vicinity of the property;
- Reinforce the management capacities and competencies of the Department of Archaeology and Museums of Rajasthan.



Map showing the revised boundaries of the nominated property



General view of the Jantar Mantar



Brihat Samrat Yantra



The Great Ram Yantra



Rasivalaya Yantra