

## Programme for the restoration of the masonry instruments at Delhi Jantar Mantar

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### 1. Introduction

In 1724 AD, Maharaja Sawai Jai Singh II of Jaipur built a large observatory at Delhi comprising of huge masonry instruments, with which he made careful observations of the celestial objects. He then built four other similar observatories at Jaipur, Ujjain, Benaras (now Varanasi) and Mathura, so that the accuracy of his observations could be improved. The surviving ones of these observatories, in due course of time, acquired the now well known name of Jantar Mantar.

The masonry instruments at Delhi Jantar Mantar, though fairly well maintained as historical monuments, are unfortunately in such a condition that they cannot be used for astronomical observations anymore. Most of the scales and markings on various surfaces of these instruments are now either erased or mutilated. Thus, considering various historical and scientific aspects, the Astronomical Society of India launched a programme for the restoration of these three-century old instruments in collaboration with the Archaeological Survey of India. This programme is actively supported by the Department of Science & Technology, Government of India. A description of the masonry instruments at Delhi Jantar Mantar and the programme for their restoration are briefly outlined here.

### 2. The masonry instruments at Delhi Jantar Mantar

The Delhi Jantar Mantar (or observatory) consists of four main instruments or yantras. They are the Samrat Yantra, the Jai Prakash, the Ram Yantra and the Misra Yantra.

With these instruments, Jai Singh mainly dealt with the naked eye objects like the Sun, the Moon, the planets and some bright stars.

#### 2.1. The Samrat Yantra

This is an equinoctial sundial, consisting of a triangular gnomon with the hypotenuse parallel to the Earth's axis. On either side of the gnomon is a quadrant of a circle parallel to the plane of the equator. The shadow of the gnomon cast by the light of the Sun on the western

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or eastern quadrants indicates the apparent local solar time before noon or after noon respectively. Further, a movable thin rod, when placed in such a position on the edge of the gnomon as to cast its shadow on the edge of one of the quadrants, would indicate the Sun's declination at that instance.

But, at present, the graduations on both the quadrants are totally erased and the Archaeologists have plastered the surfaces with cement to save them from further deterioration. On the other hand, the graduations on the edges of the gnomon, though done on sandstone are in a badly worn out condition.

### *2.2. The Jai Prakash*

This instrument consists of two complementary concave hemispheres, situated immediately south of the Samrat Yantra. This is used for measuring the altitude, azimuth, declination, hour angle, etc. of the celestial objects by considering the inner hemisphere as the visible portion of the celestial sphere, on which various circles are marked. The rim of the hemisphere is considered as the horizon.

Here also, the Archaeologists have done some cementing for maintaining the shape of the hemispheres over which all the lines and the graduations need to be carefully redrawn.

### *2.3. The Ram Yantra*

This instrument also consists of two large circular buildings, complementary to each other and are situated south of the Jai Prakash. Each circular structure has a pillar in the centre, whose height is equal to that of the circular wall, which is also equal to the measurement from the circumference of the pillar to the inner edge of the wall. This structure is used for obtaining the azimuth and altitude of the celestial object.

In this instrument, the graduations on sandstone floor are badly worn out and those on the walls are almost lost.

### *2.4. The Misra Yantra*

This is the mixed instrument and is so named because it combines four different instruments in one building. Of these, the Niyat Chakra occupies the middle portion and consists of a gnomon with two graduated semicircles on either side, which lie in planes inclined to that of Delhi meridian at angles of  $77^{\circ}16' W$ ,  $68^{\circ}34' W$ ,  $68^{\circ}01' E$  and  $75^{\circ}54' E$ . With this part of the Misra Yantra, it is possible to measure the declination of the Sun at four different instances during the course of a day, apart from that at the time of Sun's meridian crossing at Delhi. The markings on these semicircles, which are made on marble, are in good condition excepting for some minor misalignments of the marble slabs.

On either side of the Niyat Chakra and joined to it, is half of an equinoctial dial. The graduations on both these quadrants are totally erased and the cementing done by the Archaeologists is just able to maintain the respective shapes.

On the east wall of the building is a semicircle called Dakshinottar—Bhitti-Yantra or meridian circle. This is used for obtaining meridian altitudes of the bright celestial objects. However, the markings on the semicircle are totally lost and this too is maintained by cementing only.

The north wall of the Misra Yantra is inclined to the vertical by an angle of  $5^\circ$  and is marked with a large graduated circle. This is called the Karka Rasi Valaya or the circle of the sign of Cancer. When the Sun reaches its maximum northern declination, it shines over this northern wall for a short period. This would cause the shadow of the central pin to fall on the graduated circle, indicating local time. However, the graduations on this part of the circle are very badly mutilated.

### 3. Restoration programme

The Astronomical Society of India in collaboration with the Archaeological Survey of India took up the task of restoring these instruments and formulated a National Executive Committee under the aegis of the Government of India's Department of Science & Technology to go into the details of the works to be undertaken. This Committee drew up a plan of action and agreed to take up the work on the instruments one by one, the first one being Misra Yantra.

A thorough examination of the Misra Yantra revealed that the main problem is the totally erased or badly mutilated graduations on various quadrants and circles. Only the markings on the semicircles of the Niyat Chakra are in a fairly good condition and the point to be noted here is that these graduations are done on marble. It is therefore strongly suggested that the work of re-marking the graduations on the other parts of the structure should also be done using marble slabs. And it is proposed that this restoration will be carried out under the supervision of qualified astronomers — that is, those who understand, appreciate and possess adequate knowledge of the instruments.

### 4. Conclusion

The restoration is expected to make the Delhi Jantar Mantar more as an educational centre, bringing its astronomical significance to the reach of the present day students and intelligent lay public, than just being a tourist attraction and a picnic place. Way back in 1918, G. R. Kaye, the author of "The Astronomical Observatories of Jai Singh" wrote in his book "it (the Delhi Jantar Mantar) consequently will be a notable feature in the Imperial Capital and apart from its historical value, it is desirable that it be made by suitable surroundings and proper restoration, as dignified as possible". This comment is of greater relevance today.