

2 or 3 years, it is very doubtful, if we should be aware of its presence.

It is not necessary however to suppose that planetoids are uniformly distributed throughout space as that they all are of equal size and mass. Indeed judging by the distribution of the observed Novæ and the Wolf-Rayet Stars, which are associated with them, we may conclude that the Planetoids are confined largely to regions very remote from us in the vicinity of the Galactic Equator. It is quite possible too that they may frequently travel in clusters like stars or like meteors. A cluster composed of a few thousand such bodies even if they are separated by many millions of miles would be a very dangerous object for a star to encounter and yet at the same time would be of insufficient mass and brightness.

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### THE MAN MANDIR OF BENARES.

BY MR. P. C. BOSE.

The old Hindu Philosophers classified knowledge into two stages—(1) *Bignan* i. e. knowledge of special subjects which comes under the meaning of Natural Philosophy and (2) *Paragnan* or *Brahmagnan* i. e. the knowledge of the Supreme Being. They used to aver that those that dabbled in *Bignan* can scarcely attain the stage of *Paragnan* because the earthly charms which surround it blind their visions from the deeper and permanent bliss which is the outcome of the later just like a brimble-bee that remains enraptured with the painted lotus.

Those beings that could rise above the *Bignan* stage and attain the *Paragnan* were called *Devas* or *Suras* and those that could not were called *Apadevas* or *Asuras*. These *Asuras* in later mythologies were divided into four classes viz. *Yakhas*, *Rakhasas*, *Gandharvas*, *Kinnaras* according to their various callings. These beings were something higher than human beings and not so bad as some of the mythologies paint them to be. We shall for the present leave the other

demigods and confine our attention to the *Rakhasas* only. In this dynasty the greatest was Ravana, the king of Lanka whom deeds of valours have been depicted in the Ramayana we know so well. From the description of Lanka there we can very safely say that Science attained the same degree of perfection as the Rakhasas there are described to be able to fight in the air, under water, could appear or disappear or could take any shape or size at will by Maya, a science least understood and therefore the least explained. That astronomy made great progress at the time is an undoubted fact though it is not known now as to who the Royal Astronomer was among the host of mighty warriors of Ravana. The time of Lanka was at that period considered to be very correct and was accepted all over India. The present standard time of India is the time of a place very near to Allahabad whose line of longitude passes through Ceylon and so it seems that people then enjoyed a sort of standard time at that remote period.

Perhaps it is excusable in man to copy the doings of the demigods and most probably after the fall of Lanka the sciences of the *Rakhasas* entered India. Then came centuries of darkness and confusion in which we lose sight of the history of the perfection attained by the various sciences especially astronomy in this most fertile soil of India. We see later on, the Saka kings perfecting their calendar, but we do not know whether they had any observatories from which regular observations were made. Immediately afterwards, in the time of Vikramaditya, further steps were taken to advance the cause of astronomy and we have the name of Barahamihir, a great mathematician, one of the nine gems of the court of Vikramaditya-Ujjaini. Vikram's capital became the seat of learning and gave time to India. Then comes Bhashkaracharya, the greatest mathematician that India has seen, who discovered the theory of gravitation and explained the phenomena of the eclipses in his famous book the *Goladhya* or a chapter on the spheres although we do not now-a-days find any traces of an observatory at Ujjaini ; but from

the descriptions of the motions of the heavenly bodies and the methods given there of determining their positions and to tell times from them it is not difficult to imagine that the astronomers then had some means in actual practice which let them to draw inferences as they did.

A great doubt has been expressed in some quarters as to whether the Old Hindus had any method of knowing time independently of the heavenly bodies. I am not in a position to discuss that here to-day, but I remember to have read in the *Samhitās* descriptions of Peacock clocks, Monkey clocks and *Tambis* or Clepsydræ. In the Peacock clock the image of a peacock was placed on a pedestal and a long string of pearl beads was suspended from its beaks. By means of a secret mechanism the peacock was made to swallow a bead every *danda* or 24 minutes. In the Monkey clock the image of a monkey gave out a chattering noise every *Prohar* or 3 hours. The *Tambi* is very well known in this country and is even now used at the Pujas. It is a light copper cup with a minute hole at the bottom. This is floated in a water vessel and as it fills it sinks and as it sinks it is taken out and floated. But these instruments were looked upon more as curiosities than as serious scientific things and were discarded and forgotten altogether as time passed on.

## ( II )

Raja Mansinha of Jaipore was a Minister of Akbar, the great Mogul, and was an ardent student of Astronomy. He built three observatories in India which were used to determine time in a very practical manner. One was built at Jaipore, his capital, one at Delhi and one at Benares. It is this last one which is the subject matter of to-day's paper and I shall try my best to convey to your minds a clear idea of the observatory, the instruments and their uses.

On the western bank of the Ganges near Dasasnamedeh Ghat stands the old observatory. A short tramp through a narrow lane named after the observatory Manmandir Lane brings one to the gate of this three centuries old temple of Astronomy on which is inscribed on a marble slate the following :—

“This building was erected by Raja Mansinha about the year 1600 and was used as an observatory in the time of his descendent Sawai Jaysing the founder of Jaipore.”

This gate is now closed to the public, as the buildings attached to the observatory are used for other purposes, but a flight up modern iron stairs to the left takes one at once to the roof on which are the various instruments I shall now describe.

Diagram I will give you an idea of the plan of the observatory and the instruments that are stowed away at different places of the roof. The big instrument A to the right is the big *Yantra Samrat* or the king of instruments. It is a big sundial, a detail description of which is given below. B. is a smaller *Yantra Samrat*. C. is *Degansa Yantra*. D. is *Chakra Yantra*. E is *Naribalaya Dakshina and Uttara Golu*.

*Yantra Samrat* :—It is a big sundial with two parapets about 40ft. in length running up to the top with 25 steps running along the middle. On the two sides arcs are graduated the hours, half-hours, quarters and smaller minutes divisions. The parapets are faced with sandstones on which are marked the degrees and could be read from either edge of each of the arcs. The shadow of the hypoteneuse is thrown on either of these arcs, wherby daily sun-time could be ascertained. There is also an arrangement in the *Yantra* by which the altitude of the heavenly bodies could be taken.

In taking the altitude measurements two men and a tube of about 5" diameter were necessary. One man was sent up the stairs and the observer sat either to the North or South side of the arc. The man on the stairs held one end of the tube and the observer the other and by careful manipulation brought a star at the centre. The man on the stairs then read the degrees at his end of the tube and the observer read the degrees marked on the edge of the arc. This, it will be observed, is a much simpler form of taking the R. A. and Decl. measurements which was subsequently done by a more modern instrument the *Chakra Yantra*.

*Dakhin Vittī Yantra* :—On the body of the big Samrat Yantra are drawn two quarter arcs (quadrants) cutting each other at the base as in the illustration. They are divided into  $90^\circ$  each with two pegs at the tops. The idea was to rest one end of a tube on one of the pegs and the observer looking at a star North or South, when on the meridian, could read the angle on the arc close to him cut by the tube. These are in fact big astronomical quadrants.

On the vertical side of the big Samrat Yantra are two pieces of projecting stones, a bit bigger than ordinary bricks, one about 2 or 3ft. vertically above the other and in which are round holes.

The use of these have not been described by any author so far as I know. To me it seems probable that these were used as a sort of Zenith Transit instrument.

*Dignasa Yantra* :—At the Eastern End is a round walled instrument called the Digansa Yantra. The diameter of the outer wall is about 28ft. Inside there is another concentric round wall half the height of the outer wall and about 20ft. in diameter. In the centre is a pillar of the height of the inner wall and from the centre of the pillar rises a straight rod to the height of the outer wall. At the base of the rod is a cross shaped piece of iron with holes punched at the ends. This piece of iron cannot move up from its position. Four pieces of wires coming from the top of the outer wall from pegs fixed at the four cardinal points of the compass are attached to this piece of iron. The top of the inner wall was graduated from  $0^\circ$  to  $180^\circ$  both ways, the North point being considered  $0^\circ$ . The central pillar is divided into four quadrants each being graduated from  $0^\circ$  to  $90^\circ$  the zero points in this case being the E and W points.

The central pillar is conceived to be the Earth and the outer space the Ocean of Space. At the inner case of the outer wall below the N. and S. points are two insignificant mounds about  $\frac{3}{4}$ inch in height called the *Uttra Meru* and *Dakshin Meru* respectively whose edges coincide exactly with the N. and S. points. The outer walls cut off the heavens

to about  $25^{\circ}$  above the horizon. The instrument is used thus. Suppose a star to be at a certain point in the quadrant between N and E then an observer standing at the pillar can occult the star by means of the central rod and by carefully reading the angle vertically down in the quadrant between the S. and W. can determine the azimuth of the star. I was told that with this instrument it was possible to determine the altitude also; but how such a thing could be done with the present arrangement is beyond my humble comprehension.

*Chakra Yantra* :—Is an equatorially mounted tube.

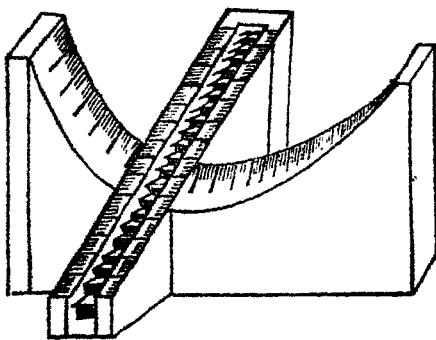
*Naribolya Dakshina and Uttara Gola* :—This is another instrument for determining the solar time. It is a slab of stone placed parallel to the equator graduation marking with pegs at the centres. Solar time could be found at any time of the day throughout the year.

The name "Man Mandir" may mean Raja Man's temple or it may mean the temple where measurements of time were carried on. People then had no clocks or if any experience had shown them that they could not rely on them so all sorts of dodges were resorted to, to get correct mean solar time. The observatory of Benares though comprehension is at best but a very poor thing when compared with the observatories at Jaipore and Dehli. Most probably Raja Jaising used it as a sort of pocket observatory when out on pilgrimage to the sacred city. At full swing the small observatory required 8 men to carry on observations per night.

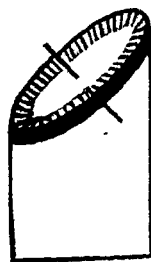
Now with clocks and watches of various degrees of accuracy and the Alipore Observatory to correct with a thundering voice our erring time every day we have our habits so well regulated that we do not put much stress on the value of time, but conditions then were altogether different and one feels special pride in studying the various devices that were discovered to arrive at approximate correct time.

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**THE MAN MANDIR OF BENARES.**



*Samrat Yantra.*



*Naridataya Dakshina  
and  
Uttara Gola.*