

once again to collect the finer sludge left by the grinding. This stage having been completed a fresh lot of material for the next must be washed as before. Stir and settle as before for half minute and then make the second settling for three minutes. This will give a much finer grade. Similarly grade after grade must be made according to the following times, the grinding with each being continued until the marks left by the one before have disappeared :—

1', 3', 6', 20', 30', 60', 90'.

From the 30' grade onwards it will probably be found an advantage to use a little soap in the water with which the mirror is wetted when the material is put on. This makes the grinding smoother and assists in obtaining a fine surface. Some people use saliva and it is certainly simple and effective. The grades above having been gone through, if the directions have been carefully followed the surface of the mirror should now be beautifully fine and uniform to the edge of the mirror and it should be possible to see the irregularities of the pitch at the back through the disc. The sun's reflected disc on the wall should now be very sharp and clear and the focal length about the required distance. The mirror is now ready to be polished, and this I will deal with in my next paper.

A Paper on some References to Meteoric Showers in the Ramayana.

By P. C. BOSE, Esq.

At our last meeting there was an interesting paper on a solar eclipse during the battle of Kurukshetra. The authors found it difficult to reconcile the position of Venus as given in the Mahabharata with what it ought to have been according to modern calculations. Our Ramayana and Mahabharata are only epic poems, and accurate scientific information cannot be expected from them. Poets sometimes twist facts so out of shape in order to extol the prowess of their heroes or gods that it becomes very difficult to distinguish between fancies and facts at this distant age. The events at the birth of Hanuman, the monkey god, as described by Valmiki in the Ramayana will serve to illustrate my meaning very clearly. It is said there that just after the birth of Hanuman his mother leaving him alone in a cave entered the forest in search of food.

Young Hanuman in the meantime got very hungry and having nothing to eat and seeing the rising Sun, he mistook it for a big ripe fruit and jumped at it and tried to get hold of it. Now, what do you make of this? Can't it all be construed to mean that a partial solar eclipse took place at dawn just after the birth of Hanuman? I think that is the only rational construction of it. Fancy Hanuman clearing 93 millions of miles at a jump, and that too just after his birth, to satisfy his hunger! They say that there is just a step between the sublime and the ridiculous and I think that it is nowhere better illustrated than here. But we have no other scientific works left of those periods from which we can draw more authentic information. Poets cannot be expected to be either astronomers or mathematicians, and it is very likely that they used to draw their astronomical information from the astronomers of their respective periods. Therefore if there is any difficulty in understanding them it must be due to one or other of the following causes:—(1) Errors in the calculations of the ancient astronomers; (2) Misunderstanding on the part of the poets; (3) Omission of facts which the ancient astronomers thought unimportant but which might have been of great value to us now; (4) Our ignorance of their methods of calculation. There is also another peculiarity which any casual reader will notice, and it is this: that in the whole range of our Puranas you will never find the mention of a date of any important event. You will find the month, the positions of the Sun, the planets and the stars given, but no mention of year. The only explanation that I can suggest is that perhaps the ancient Rishis thought that an era might change with the change of a king or a dynasty and in that case the mention of a year might lead to confusion, so they had recourse to giving the positions of heavenly bodies: from which it would be possible in future to determine the dates approximately. So when modern authors find fault with the calculations given in the Puranas, we do not wonder. We have all seen how some of our learned men have sweated in vain to fix the dates of some past important events. Whenever there is a question of this nature you will find high intellects trying in vain to trot out a pet theory or two of their own, and ordinary people wrangling over what they seldom really understand, and the result is that the question for all practical purposes at least remains as abstruse and unsolved as ever. I beg to be excused if I mention here that the inference that the rotation of the Earth is slackening about $\frac{1}{2}$ sec. per annum per century, from the calculations based only on the record of a lunar eclipse left by a Babylonian astronomer 2,700 years ago, is also open to doubt. Such an

important conclusion should have been drawn from some indisputable scientific basis. The Royal Observatory at Greenwich is now about 250 years old and the records of time kept there are as accurate as can be humanly possible; so it can be urged that if there is any difference in the rotation of the Earth it could have been found out from a comparison of the present records with those of the past, and that would have been far more reliable.

In the cases of the meteoric showers to which I shall refer presently you will see that there are no mentions of any dates neither are there any mentions of radiant points, and I have no hesitation in saying that the method of determining meteoric systems by means of radiant points was unknown to the ancient astronomers. I shall now enumerate in order the places in the Ramayana where such references occur.

The first occurs in the Lankakandam 57th Swarga 35th Sloka, where Prohastā is described as going out to fight Rama. There we see that the falling meteors are considered as presages of ill omen.

The other occurs in the same Kandam 96th Swarga 47th Sloka, and there we see that the meteors are described as falling with the noise of thunder. These battles were fought during the months of Pous, Magha and Falgoona, corresponding to the latter half of December, January, February and the first half of March, and in each of these months we have some showers, though of minor nature, in our present day.

In the next one you will see something like a prediction of a meteoric shower, and I shall narrate briefly the incident in connection with which the reference occurs and which will be found in the Uttara Kandam 93rd and 94th Swargas. It is this: Rama the King of Ayodha once asked the sage Bharawaja about the origin of the wilderness of Dandakaranya. The sage in answer said that long, long ago in the Satya Yuga in the pleasant month of Chaitra, a King named Danda went to the hermitage of the sage Bhrigu. While there he insulted Arāja the charming daughter of the sage and fled to his own capital. This deed so aroused the wrath of the Muni that he cursed him in the following words:—
“Behold ye all the ruin—terrible as a flaming tongue of fire—that will overtake the over-weening Danda, the sinful wretch, who ever delights in evil ways, for his sand has run out and the day of reckoning is at hand, yea, for like a fool has he stretched out his hand to grasp the flame that consumes all. Terribly has the wretch sinned and terribly will his sins be visited upon him. For in a week from now the evil King will be no more and all of his race will perish together with

all that wait upon his bidding, for Indra the Just will rain down burning stones and ashes and dust over the length and breadth of his lands, yea, for a distance of a hundred joyanas all round will He do it and thus destroy him. Verily whatever lives and moves and is within that area will He thus destroy. Far as his sway extends, nothing existing therein will escape this dreadful rain of stones and ashes and dust—terrible as that on the world's last day of dissolution." The Kingdom of Danda was reduced to ashes together with all of his race and his following within a week as the truthful one (*i.e.*, the Muni) had said. This, the scene of the terrible visitation, lying as it does between the Sybal and the Vindhya ranges, has ever since been called by the name of the Dandaka forest in memory of that dreadful punishment of its King.

Now from the above you will at once see that the raining of burning stones and ashes and dust cannot mean anything but meteoric stones and meteoric ashes and dust, and further that the Muni knew that a shower of meteors was expected about that time. From the description it is also evident that the shower was a big one and that some of the meteoric stones did strike the Earth and cause some havoc. The month of Chaitra corresponds to the period between the months of March and April, and we have some meteoric showers but they are not at all important. It is therefore reasonable to argue that the meteoric system referred to above has either spent itself or has changed its orbit. Now let us try to calculate the date and see where it will lead us to. According to our Purana, Rama was the king of Ayodhya in the Treta Yuga consisting of 1,296,000 years, then comes Dwapara Yuga consisting of 86,400 years, and now we are only 5,013 years in the Kali Yuga. Adding up all these figures we get 2,165,013 years, so the event must have taken place more than 2,165,013 years ago approximately. Modern Historians on the other hand fix the date of Rama at 1400 B.C., and adding 1912 to it we get 3,312 years. So you see how difficult it is to arrive at a definite result or anything approaching it. I naturally argued that a race which in the far Satya Yuga could produce astronomers who could predict meteoric showers must have had followers who at some period or other pushed the science some degrees towards perfection, and while searching for more information on the subject I came across the names of several Hindu Astronomers, of whom I shall for the present select two only just to show you the method in which they understood and studied the subject. To understand this a slight knowledge of the disposition of the heavenly bodies according to the old Hindu system will be necessary, and the diagrams which are given on page 76

will, I hope, give you some idea of it. The first then is Barahamihir who flourished in the reign of King Vikramaditya about the 6th century A.D. In fact he was one of the nine gems of the court of Vikramaditya. He classified the meteors into five distinct heads, *viz.* :—

- (1) *Asani or detonators*.—Which are round and fall with deep detonations.
- (2) *Bidyout or lightning*.—Which are of irregular shape, sparsed, and fall with rattling noise.
- (3) *Dhisna or burning stones*.—Are like burning charcoal about 2 cubits long and have short trails.
- (4) *Tara*.—Are about one cubit long; have long trails white or copper coloured; shoot up or plunge downward or move in a zig-zag path.
- (5) *Ulka*.—Have wide-spreading heads and expand as they fall; size big; have thin trails. These ulkas are of various kinds.

From observation of facts to attempts at explanation it is but a step, and in the next man Sripati, whose time I could not determine, we see the first attempt to explain the appearance of meteors. He explains it thus:—"Those bodies whose movements can be determined by means of the Science of Astronomy and which are situated far above the moving orbs called Tarakas or Stars. But those bodies that have no regular movements are called Taras or meteors. They follow the track of the Moon and glow with the light which they receive from the *Sun*. They are situated above the region called the region of the wind Prabaha. When this region becomes temporarily quiet and inactive, then owing to their own weight and former impetus they fall on the surface of the Earth." The so-called wind Prabaha perhaps meant some subtle force or energy which forced the planets as well as the stars to move along their courses with some sort of regularity.

You see how in trying to explain the bright trail of a meteor he hit upon a very simple truth: that of a heavenly body reflecting the light which it receives from the Sun. There are many other Hindu astronomers who also have dealt with these celestial wanderers, but as it will take me more time than I can devote to it at the present moment, interesting though the enquiry is, I will ask our members to await another paper on this subject where I hope more fully to thresh out the question in all its aspects.

I am at the present moment trying to find out all that the

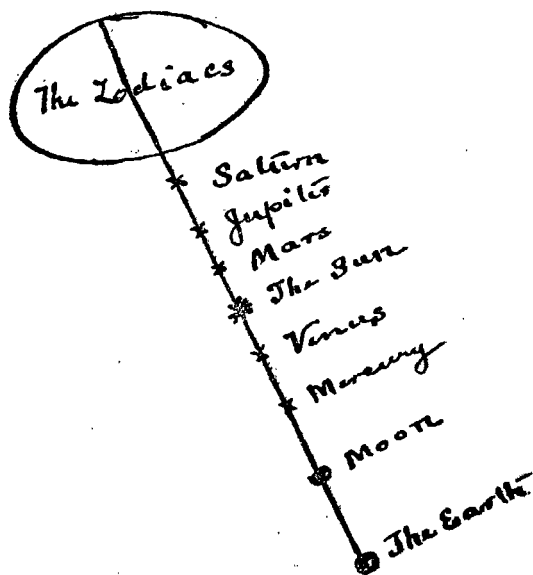


Fig. 1.



Fig. 2.

ancient Hindu astronomers had to say about these mysterious visitants, and I have hopes that the curiosity roused by these enquiries in the astronomical works of the ancients will enable some of us to arrive at a solution of certain knotty problems in ancient astronomy which have so long been baffling the attempts of some of our most erudite countrymen. For instance, is it not a curious thing that the Hindu astronomers of old with their crude ideas about the celestial bodies should still have succeeded in not only perceiving that the Earth is a round body but that it is floating in space? Where is the basis of this belief of theirs? Had they any conception of the force of gravity? How could they prove that the Moon shone simply because it reflected back the rays of the Sun? To these and many such other questions we must, I regret to say, remain silent. Our Society, though not formed for such antiquarian researches, would no doubt benefit much if its members could offer us a solution of these problematic issues.

The torch of knowledge which was first lighted in the East went out ages ago, and it has been a long, long night with the East; and now if at the beginning of the 20th century—the dawn of her re-awakening—she looks to the West for a helping hand surely that hand will not be withheld.

“The East is the East and the West is the West,” says the poet, but the claims of humanity are greater than the claims of nationality. And the day is perhaps not far distant when the East and the West will walk hand-in-hand on the glorious path of knowledge towards that ultimate realisation of human destiny—the regeneration of mankind.

Notes on Saturn.

SATURN has been observed here with the 5" Cooke Refractor on every available evening since the telescope was mounted in the middle of November. Throughout the latter part of November and December the planet has been excellently situated in the eastern sky. On about half the nights the definition has been poor even though the sky, with a few exceptions, has been clear. A brilliant night is by no means a sign of a good night for telescopic work. On good nights—and these as a rule are those with a low humidity—the definition is sharp and the planet is remarkably well defined in this telescope. Saturn bears a high magnification, but the highest power—350—can only be used with advantage on exceptional nights.