



The Journal of the Astronomical Society of India.

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[No. 2.

Report of Meeting of the Society held on Tuesday, the 26th November 1912.

THE Ordinary Monthly Meeting of the Society was held on Tuesday, the 26th November 1912, in the Imperial Secretariat (Treasury Buildings), at 5 P.M.

W. J. SIMMONS, Esq., *President*, in the Chair.

C. V. RAMAN, Esq., M.A., *Secretary*.

The minutes of the previous meeting were read and confirmed. The following presents to the Society were then announced by the Secretary and a vote of thanks was accorded to the donors :—

1. Monthly Notices of the Royal Astronomical Society, Vol. LXXII, No. 8.
2. The Journal of the British Astronomical Association, Vol. XXII, Nos. 9 and 10.
3. Rivista Di Astronomia, Anno VI, Nos. 7, 8, 9 and 10.
4. Monthly Weather Review of the Alipore Observatory for March, April, May and June 1912.
5. The Journal of the Royal Astronomical Society of Canada, Vol. VI, Nos. 3 and 4.

6. Kodaikanal Observatory Bulletin, No. XXVI.
7. Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the year 1910.
8. Experimental Investigations on the Maintenance of Vibrations. (Bulletin No. 6 of the Indian Association for the Cultivation of Science.)
9. Colori Stellari Osservati a Rama Negli, *Anni* 1844—1846.
10. The Collegian for July, August and September 1912.
11. Bulletin of the Astronomical Society of Barcelona for November 1912.

President.—Ladies and Gentlemen, I am afraid I am departing from the usual procedure in asking you to listen to an address so shortly after another was made at our last meeting by Mr. Tomkins. I then said that I would put my views before you, and the earlier I do so the better. (*Address.*)

Mr. Tomkins.—May I make three remarks, Mr. President, on the address you have just made us? It struck me when you mentioned the somewhat unfavourable conditions under which we labour here in Calcutta that an analogy existed at Greenwich. At Greenwich also they suffer from the atmosphere as in Calcutta, and a good deal was said about the comparative excellence of the conditions in America some years ago. Several of the American Observatories, of course, enjoy about perfect conditions under which to study the heavens. In spite of its drawbacks, however, Greenwich discovered the eighth satellite of Jupiter; they made the most of what they had and the discovery was the result. I think Calcutta may take a lesson from this and not be discouraged. As a matter of fact our skies in Calcutta are, I think, very much better than those they get at Greenwich.

The second point is the question of classes which the President has just mentioned. The Council have done me the honour of appointing me as Director of Classes, and I propose to take up the work at once. I hope that any members who wish to join will send their names to me at once. I propose to give the instructions chiefly in writing, so that the members may have something done in black and white to guide them.

Thirdly, as to the question of getting more members I should like to make a practical suggestion. If each member would obtain a form of application and secure us one member, our membership would be doubled. This should not be difficult.

President.—I have to make one further announcement which should have been made earlier. At the last meeting of our Council it was decided that we should circulate tickets of admission to our meetings. People who are invited by members sometimes forget the date of the meeting or the place, and to meet this it was decided by the Council that we should have tickets of admission for guests printed. (*Reads ticket.*) At the close of the meeting tickets will be given to those members who are present and after that they can get them from the Secretary upon application.

President.—Mr. Raman will read the next paper on "The Determination of Ancient Dates from Astronomical Data," by Dr. Royds and Mr. Sitaram Aiyar. This paper is one which deals with the fixing of the date of the war. In some parts of the paper I see that they are not certain about the dates and wish us to help them in finding them. (*Reading of the paper.*)

President.—As usual the paper is now open for discussion. Of course, it is obvious that it is of a somewhat technical character, but I hope we shall have remarks from our members on it. I would suggest that when the paper has been printed in the JOURNAL and circulated the members should be invited to bring it up for further discussion.

Mr. Tomkins.—I should like to suggest that the authors of the paper be asked to let us know more about the research later on so that we may get some definite information on the subject. At present they do not seem to have arrived at any definite conclusion as to dates. At any rate it will be of great interest to us to know what they have to say.

President.—Any further remarks?

Mr. Raman.—It seems to me the question is one which could with advantage be examined by such of our members as are familiar with the methods of Ancient Hindu Astronomy, and could therefore throw light on doubtful points.

Mr. Tomkins.—I think that Mr. Sarada Chandra might be able to help us as I think he knows a good deal about some of these ancient dates. He spoke some time ago on a similar question to this. We have also another member at Cawnpore who wrote to say that he would make a translation of ancient Sanskrit works. It would be a good thing to bring the paper to their notice.

The President was of opinion that anything sent to the Society from Kodaikanal should be carefully considered, and that the paper just read ought to be discussed further, after it had been reproduced in the JOURNAL. Though he did not himself know Sanskrit he had read translations of portions of the Mahabharat, and also something of what scholars had to say about the great epic. He deemed it would help to guide future discussion if he put a few points before them which they could consider at their leisure. The object the authors of the paper had in view was to deduce a date from certain references to astronomical phenomena which occurred in the poem. Mr. R. C. Dutt in his "Ancient India" had suggested something of the sort. Reference to Chambers' book on *Eclipses* would show how the dates of some ancient battles (Platæa for instance and Salamis) had been thus arrived at by allusions in classical authors to eclipses. He would remind them that in dealing with the question of the age of ancient writings, such as the Mahabharat, two classes of evidence had to be taken into consideration: External evidence and internal evidence. The authorities he had consulted went to show that the central legend of the poem, though not necessarily the poem as it now stands, was referred to by writers ranging in date from about 400 B.C. to about 80 A.C. Inscriptions showed that the poem had assumed its present form before 500 A.C. These authorities believed that the poem was a composite work, added to from time to time, and not composed by one man. Its reputed author's name, *Vyasa*, is said to mean a person who arranges presumably already existing materials. The internal evidence is believed to show that episodes have been introduced into the epic at different periods. Of such interpolated episodes, the famous *Bhagavat-gita* is itself one example. It seems the poem itself states that in its earliest form it consisted of 8,000 slokas (couplets). It subsequently grew to 24,000 slokas, and it now has reached about 1,10,000 slokas. The Buddhist religion and the Greeks are said to be mentioned in the poem. Buddhism arose in 543 B.C. and was an Indian religion till about 1000 A.C. The Greeks under Alexander invaded India in 327 B.C. and the Greek Indian period extended to about 160 B.C. All this served to bear out what the authorities the President had referred to laid down. It seemed to him, therefore, in using references to astronomical phenomena mentioned in the epic for the purpose of fixing dates, what had to be determined was—the date thus arrived at, that of (1) the war of the Pandavas; or (2) the age of the episode in which the reference occurred; or (3) the date of the poem in its present form. That some of the lays embodied in the Mahabharat went back to a very early age was highly probable; but in its present form

competent authorities consider it was probably not composed till the Greek period, and portions might be even later. The President threw out these points as mere suggestions to guide the fuller discussion which he trusted the paper just read would receive at the hands of the members of the Society. The thanks of the Society were due to the writers of the paper for having brought the interesting subject it dealt with before them.

President.—The next paper will be one on “The Grinding of Mirrors,” by Mr. Tomkins. I hope I am giving no secret away when I say that it is to be one of a series of six, all of which are sure to prove very interesting. (*Mr. Tomkins’ paper.*)

President.—The questions I should like to put are what kind of glass ought one to use in making these mirrors and how do you secure accurate curves?

Mr. Tomkins.—Any good glass will do, provided it is free from air bubbles and other imperfections. The glass I first used was from port-holes in ships. A friend of mine bought about 20 glasses from port-holes, and I believe he made excellent mirrors of them. Suitable glass can be had from Ahmuty & Co. with no flaws or bubbles. As regards the curve it is obtained accurately by taking great care not to put pressure on the mirror in fine grinding. You should move round the tub slowly and not get the curve too deep. In fine grinding you will not probably get some humps and dumps, but either a ring or a turned up or turned down edge, all of which can be easily dealt with.

Mrs. Voigt.—Is it to be a hand telescope?

Mr. Tomkins.—No. It is to be fixed on a stand and it is 6 inches long.

Mrs. Voigt.—And the diameter?

Mr. Tomkins.—6 or 8 inches. If you yourself intend making one, I should recommend the 6-inch telescope so as not to be too heavy for you to grind.

President.—I am sure we are much obliged to Mr. Tomkins for the advice he has given us as to how we can make our own telescopes, and I will ask you now to record a hearty vote of thanks to him for his paper.

The next paper is entitled “Spectroscopic Notes,” by Mr. C. V. Raman, M.A. (*Reading of the paper.*)

Are there any remarks any of you would like to make ?

Mr. Tomkins.—May I suggest that Mr. Raman tries to get some photographs of spectra with the Presidency College instrument ? They would be of considerable interest to everybody.

President.—Mr. Raman should give us another paper on Spectroscopic work with experiments. We have all read how the spectroscope revealed the chemical constitution of the stars, and that it also taught us something about their motions. Such a paper would be useful to the Society.

Mr. Tomkins.—It would be an excellent suggestion.

Mr. Tomkins then showed two slides of Mars which he had brought with him ; they were taken at Mount Wilson by Professor Hale and were much admired.

The meeting was then adjourned.

Address by the President.

A President is required at the close of each year of his office to put before you a résumé of the work done during the past year ; as well as to deal, if he sees fit, with some special topic or to review the work of astronomers in other parts of the world. Perhaps it may be well for a President entering on his office to place before you his views, in general terms, as to the scope, influence and object of societies such as ours ; and also as to what he considers are the best methods of securing the best outturn of work. And here I may say it is a pleasure to me to find myself so much in accord with the views expressed by our retired President in his address delivered in this room on the 5th of this month. We must endeavour to encourage original research and original observation amongst our members. We, however, must not forget that the conditions which obtain in this " premier city of India " do not admit of all of us who reside in its midst devoting our days to the earning of a few rupees, and our nights to the systematic observation of the stars. Though in this connection I would observe that there is no surer method of rising above the worries and anxieties of daily life than to watch, as systematically as you can, the night skies, for when you do so :—

Earth and Earth-born jars
And human frailties are forgotten quite.

Then, again, there must for every one of us be breaks in the course of our studies. We live, be it remembered, on the western edge of the Gangetic Delta, on a marshy tract of country, but little raised above sea-level ; and our vapour-laden

atmosphere is not unfrequently ill-suited to astronomical research. Our city, too, is rapidly developing as a manufacturing centre; and the sooty vapours poured forth from an ever-increasing number of chimneys, and from the overcrowded busties of Calcutta and its suburbs, are not conducive to the amelioration of the natural physical conditions of our environment. The glare from the city lights is itself a serious impediment to our study of the stars, especially when they lie near the horizon. But ours is the Astronomical Society of India, and not of Calcutta only. Our members are distributed over the whole vast area which stretches from the Himalayas to Comorin, and from Quetta to the Shan States. As your President I am proud to say that scarcely a meeting is held in this room at which we are not privileged to hear something about the excellent work which is being done by the watchers of the heavens in Kodaikanal, perched as they are at an altitude of 7,700 feet above sea-level, a site which was selected for their Observatory in preference to the Presidency City of Madras, and also because the station enjoys greater freedom from mist and cloud than even Ootacamund. Let it, then, be admitted that though Calcutta is not an ideal site for an Astronomical Observatory, there are many places within our jurisdiction as a Society which are well suited to that purpose.

It would, in my opinion, be unwise to ignore our disadvantages. They exist, and we have to recognise and to grapple with them; but there is another side to the picture. Your record of work during the past two years has, in spite of the drawbacks to which I have referred, been most encouraging, and shows that your difficulties have but inspired you with a determination to overcome them. This, of course, is as it should be. Again, when our skies are favourable for astronomical work, a glorious span of the starry heavens is spread above Calcutta. No protracted twilight prevents us from observing such a comet as Halley's after its perihelion passage. During the course of the year magnificent views of all the principal constellations can be obtained. We in Calcutta never can see anything of the five southern circumpolar constellations: Octans (in which the South Pole Star is situated), Chameleon, Mensa, Hydrus and Apus; while only portions of Musca, Carina, Volans, Toucan, Pavo and Triangulum rise above our horizon. But we can see from Calcutta itself portions of the six constellations lastly named, and nothing less than the whole of the principal remaining constellations figured in our star charts. Our catalogues show that however many millions of stars may be registered by photography, there are after all only twenty-one of the first magnitude. Of these six are never

seen in England, *viz.*, Alpha Argus (Canopus); Alpha and Beta Centauri; Alpha Eridani (Achernar); and Alpha and Beta Crucis. Now every one of the 21 first magnitude stars can be seen from Calcutta. No one who from a terrace here giving an unimpeded outlook on the southern sky has watched Alpha Centauri, through even a 3-inch telescope, can ever forget how weirdly that coloured double—the nearest to us of the fixed stars, though it is 25 billions of miles from us—flashes its green and red lights on Calcutta every year in April and May. Extending a line drawn through Alpha and Beta Centauri westwards, it passes through the famous Southern Cross, which approached from another direction lies under Corvus, the Raven, known to seamen as Spica's Spanker. You can thus accurately identify the constellation of which the Australians are so proud, but which some people declare is not visible in Calcutta! You will remember in Tennyson's "Dream of Fair Women" he refers to the lamps which outburned Canopus in the Court of Cleopatra? Canopus lies low down on our horizon to the south of Canis Major, almost directly south of Sirius; and is visible here from January on till March. It is necessarily seen several degrees higher in the sky in Southern India, and its brilliancy has there attracted attention for centuries. My Indian friends will remember that the first Brahmin settlers in Southern India proceeded thither as hermits and rishis; and diffused a higher civilization around them amongst their Dravidian neighbours. Now the earliest of these Brahmin colonies was led by one Agastya before whom it is believed, the Vindhya Mountains prostrated themselves as he passed from the Aryan tract to the wild territories of the south. He is still worshipped near Cape Comorin as Agasteswara, the Lord Agastya, but though he has passed from history into the misty realms of myth, he lives for ever in the heavens; and it is Agastya who looks down on you and me in Calcutta, in the bright star Canopus. Eridanus is a very old constellation to which additions have been made as explorers went southward. Eridanus was the name originally given by the Latins to the River Po in Italy, but the constellation which bears the name is older than that. The celestial Eridanus—the stream within the sea of stars in heaven—was probably identified by the old Akkadians with the Euphrates; and Eridu, the sacred Eden City situated in the Abyss of the Creation Legends, was washed on two sides by "the stream within the sea." The Egyptians identified the constellation with the Nile. Achernar, which means "the end of the river," was the name applied by Al-Sufi (903—986 A.D.) to the star we know as Theta Eridani, a star at that period of the first, but now of the third magnitude, which is 17 degrees further

north than the present first magnitude star of Eridanus, which we call Achernar, and which is five degrees further south than even Canopus. Ball referring to Theta Eridani says "this is one of the clearest cases of a star having lost a large percentage of its light within historical times." A line drawn through the two easternmost stars of the Great Square of Pegasus, which while I speak is just about overhead, will roughly guide you to Achernar, that is, the brightest star in the constellation Eridanus will be slightly to the left, or east, of the line I have suggested you should draw. Achernar is about level with the top star of the Southern Cross ; but you must not expect to see the two constellations at the same season of the year.

In dealing thus sketchily with the stars visible from Calcutta, but which are not seen in England, I have gone a little beyond what some critics may regard as Astronomy proper ; let me, therefore, add I have not gone beyond what you can glean from thoroughly practical books on Astronomy ; for Astronomy is not all made up of angles and astrolabes, and logarithms and similar difficulties. My object has been to show you how interesting the study of the science can be to anyone who goes in for it even in Calcutta ; and here I note an important point, namely, that I consider one of our first aims should be to popularize our branch of science, and to make it attractive to all sorts and conditions of men. As a means to that end, I consider we should do all we can to induce members to join our classes. If you wish to make practical observations, you simply must at the very outset learn to identify the principal constellations and the principal stars in each. To achieve that, is to learn the A.B.C. of astronomical science ; and you cannot learn that alphabet by merely attending our meetings here, nor yet by merely reading books. You must go out for an hour or so at night, at least two or three times a week and for eight or nine consecutive months ; and with a Star Atlas in hand, lighted by a bicycle lamp, pick your way through the hosts of heaven. There is nothing difficult about it, and you will quickly find that it is intensely interesting work. You will thus incidentally learn more than the mere names of the star groups and of the principal stars themselves. You will realize what the diurnal and annual revolutions of our Earth mean ; why all the stars do not set, but why some circle round our north pole star, while others, like Canopus and Alpha Centauri, describe limited arcs low down in the southern sky. You will also learn, better than ever you could by reading a whole library, how to trace the path of the Moon and the planets through the ecliptic, and of the meteors as they flash forth from the radiant points whence they emanate.

You will realize, and it is important you should do so at an early stage of your career, that all this is work for which no telescope is needed; remember, the principal constellations were all mapped out, and named, hundreds, aye, some of them thousands, of years before ever the telescope was invented. Instruments of research have been perfected and multiplied in these latter days, but much of the star alphabet of astronomy has come down to us from the old times of Shumir and Accad.

Another thing we must do is to increase our membership. A Scientific Society, worth the name, must run a JOURNAL; and the cost of maintaining a JOURNAL is a thing to be reckoned with. Our subscription is purposely kept low to enable as many as can to join us. While we on the Council strive to work the Society as a whole, you who are not yet members of that responsible inner circle, can yet render us material help by bringing in new members. And in this connection let me make a few observations based on my own actual experience. Just two years ago a professional brother, who perhaps gauges the value of things too exclusively from the financial view-point, enquired of me what the Astronomical Society was doing? I gave him the information he asked for, and invited him to join our Society. He at once asked me in a somewhat peremptory tone: "What is the use of it?" I endeavoured to show him that as in law so, too, in science, the first object is to obtain a mass of relevant and reliable facts; and the next to sift out facts from facts; and finally from the residuum to draw sound conclusions. My arguments, however, failed "to rope in" my friend as a member of our Society; but I mention the incident in order that you may be prepared to meet similar enquiries. Never forget this claims to be an eminently utilitarian age; and the stereotyped phrase "What is the use of it?" is one which can be used—and also grossly misused—as much as ever you please, if only you have the world along with you! What is the use of anything for that matter? Let us, however, restrict ourselves to the consideration of the uses of science. Professor Huxley says: "Religion flourishes in exact proportion to the scientific depth and firmness of its basis." Herbert Spencer says: "The neglect of science is irreligious. Devotion to science is a tacit worship—a tacit recognition of worth in the thing studied. It is not a mere lip homage, but a homage expressed in actions—not a mere professed respect, but a respect proved by the sacrifice of time, thought and labour." In another place Spencer says: "Science makes a constant appeal to individual reason—the student is required to think out his own conclusions. Every step in a scientific investigation is submitted to his

judgment. He is not asked to admit it without seeing it to be true. And the trust in his own powers thus produced is further increased by the uniformity with which Nature justifies his inferences when they are correctly drawn. From which there flows that independence which is a most valuable element in character." He adds: "Under the form of original research it exercises perseverance and sincerity." Professor J. Arthur Thomson says:—"We heartily agree with Agassiz that a training in natural science is one of the best preparations a man can have for work in any department of life where accurate carefulness, and adherence to the facts of the case are of indispensable importance." And in what department of life can these be dispensed with? Surely confidence in one's self and one's powers; independence of character; discipline; self-effacement; the development of perseverance and of sincerity; carefulness in work; these are things which establish beyond all doubt, or cavil the utility of science!

A brief, final word as to the influences which scientific societies should have upon national character. Karl Pearson in his "Grammar of Science" says:—"Modern Science as training the mind to an exact and impartial analysis of facts, is an education specially fitted to promote sound citizenship." He proceeds to lay down that a man with such a training "will scarcely be content with mere superficial statement, with mere appeal to the imagination, to the emotions, to individual prejudices. He will demand a high standard of reasoning, a clear insight into facts and their results, and his demand cannot fail to be beneficial to the community at large." Another writer has sagely observed that national character itself depends upon what the individuals composing a community do in their recreative hours. It will be the task of some historian in the future to estimate the influence which has been, and is being exercised by Scientific Societies in making our age what it is. The members of our Society are not leisured men. It is only as a recreation that we can work at astronomy; and we have come together because we have arrived, individually, at a stage in our recreative studies at which we are no longer able to get on without company; because, also we seek each, along his own humble lines, to popularize and advance the branch of science with which we are concerned. At our meetings there is a unity of purpose and of general amity; "party is a word unknown amongst us, sect is out of the question; rich and poor know no distinction." Surely an Association like ours, if it is worked honestly and perseveringly, must from the points of view I have just indicated, help to the formation and attainment of a higher individual, and, therefore, of a higher national character. I

leave you to work out the thoughts I have all too briefly put before you, and I trust, that in doing so, I have also answered my friend's question, "What is the use of it?"

W. J. SIMMONS.

20th November 1912.

The Determination of Ancient Dates from Astronomical Data.

T. ROYDS, D.Sc., AND S. SITARAMAIIYA, B.A.

Kodaikanal Observatory, September 3rd, 1912.

IN some of the ancient Sanskrit writings statements of the positions of the planets at the time of notable occurrences have sometimes been given. If these data are reliable we have at once a means of determining the dates of those events at any subsequent time, since the motions of the planets are now known with sufficient accuracy, and the number of planets observed makes up for the inexactness of the observations.

We have examined the data quoted in the "Mahabharat," verses 14 to 17 of Chapter III of Bhishmaparva (Bombay Edition), referring to the first day of the Mahabharat war. The (geocentric) positions are defined by the lunar asterism (nakshatra) which each planet occupied. In order to be able to convert these into angular heliocentric positions we must know two things—

- (1) The system of asterisms in use at that time.
- (2) The initial point of the zodiac from which the asterisms were counted.

With regard to the initial point of the zodiac, we have a means of confirming any value we adopt by an additional statement given later in the book fixing the vernal equinox of that period. Knowing the rate of precession of the equinoxes the distance of the initial point from the present vernal equinox could then be confirmed.

The first difficulty is, however, a serious one if the system of asterisms is not identical with the one at present in use. We have assumed that the asterisms mentioned in the Mahabharat were those to which the same names now apply, and