Their week conſiſts of ſeven days, to each of which they have given the name of one of the planets, and arranged them exactly in the ſame order that has been adopted by Europeans:

| | | | | |
|---|---|---|---|---|
| Sunday | is | Additavaram | { or the day of the } | Sun |
| Monday | — | Somavaram | — | Moon |
| Tueſday | — | Mangalavaram | — | Mars |
| Wedneſday | — | Boutavaram | — | Mercury |
| Thurſday | — | Brahaſpativaram | — | Jupiter |
| Friday | — | Soucravaram | — | Venus |
| Saturday | — | Sanyvaram | — | Saturn. |

But their planets, like their gods, are frequently called by different names; or are variouſly pronounced in the different dialects, and parts of the empire.

Their year begins on the 11th day of our month of April. They divide it into two equal parts; the one compriſing the time the ſun is to the ſouth, the other to the north of the equator; and they cele-

brate his return to the north by an annual equinoctial feaſt.

To adjuſt the aſtronomical with the civil time, every fourth year is a leap year; in which the time exceeding the 365 days is thrown into one of the 12 months. The number of days in the months is unequal; and ſome are of opinion, that in eſtabliſhing the duration of each month, attention has been paid to the time required by the ſun to paſs through the different ſigns of the Zodiac *.

In

* Ces mois n'ont pas tous de la même durée, le mois de Juin eſt le plus long de tous, et le mois de Decembre le plus court. Cette difference ſuppoſe que les aſtronomes qui les premiers ont travaillé à cette methode Indienne ont connu l'apogée et le perigée du ſoleil; c'eſt à dire qu'ils ont remarqué que le ſoleil retardoit ſon mouvement dans le mois de Juin, et qu'il l'acceleroit pendant le mois de Decembre; qu'il employoit

In their tables they are put down in the following order:

| | Days. | Nas. | Vei. | Tai. |
|---|---|---|---|---|
| Sitterey, beginning the 11th of April, | 30 | 55 | 32 | 0 |
| Vayaſey - beginning in May | 31 | 24 | 12 | 0 |
| Any - - in June | 31 | 36 | 38 | 0 |
| Ady - in July | 31 | 28 | 12 | 0 |
| Avany - - in Auguſt | 31 | 2 | 10 | 0 |
| Pivataſſy - in Sept. | 30 | 27 | 22 | 0 |
| Arbaſſy - - in Oct. | 29 | 54 | 7 | 0 |
| Cartigey - in Nov. | 29 | 30 | 24 | 0 |
| Margaii - - in Dec. | 29 | 20 | 53 | 0 |
| Tay - in Jan. | 29 | 27 | 16 | 0 |
| Maſey - - in Feb. | 29 | 48 | 24 | 0 |
| Pangouney - in March | 30 | 20 | 21 | 15 |
| | 365 | 15 | 31 | 15 |

In the common time they are reckoned as follows:

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employoit par conſequent plus de temps à parcourir le ſigne des Gemeaux que celui du Sagittaire. La longueur des autres mois eſt comme le temps que le ſoleil met à parcourir les autres ſignes du zodiaque.

*Voy. dans les Mers de l'Inde.*

| | | | | |
|---|---|---|---|---|
| Bayſatch, | beginning | the 11th | of April, | has 31 Days |
| Taith, | - | - | - | 31 |
| Aſadeh, | - | - | - | 32 |
| Sanvon, | - | - | - | 31 |
| Bhadon, | - | - | - | 31 |
| Aſan, | - | - | - | 31 |
| Catuk, | - | - | - | 30 |
| Aghou, | - | - | - | 30 |
| Pous, | - | - | - | 29 |
| Magh, | - | - | - | 29 |
| Phagon, | - | - | - | 30 |
| Tchait, | - | - | - | 30 |
| | | | Days | 365 * |

The lunar month is divided into two parts; that from the new to the full moon, is called *Sood*, or increaſing; and that from the full to the change, *Bole*, or waning. The former is likewiſe ſometimes called *Sooklapakſha*, or the *light ſide*; and the other, *Kreeſhna-pakſha*, or the *dark ſide*.

* In the manner of writing the names of the months for the aſtronomical time, I have followed Monſieur le Gentil, and for the common time Colonel Polier. But it muſt always be remembered, that names are differently pronounced in different parts of India.

They reckon the duration of the world by four Yougs, but in the length aſcribed to them, they are extravagant; and notwithſtanding the endeavours of ſome ingenious men of ſcience, to adjuſt their chronology to that of other nations, I do not find, that it has yet been done in a manner by any means ſatisfactory.

| | YEARS. |
|---|---|
| The firſt, or the Sutty Youg, is ſaid to have laſted | 3,200,000 |
| The Tirtah Youg, or ſecond age | 2,400,000 |
| The Dwapaar Youg, or third age | 1,600,000 |
| And they pretend the Kaly Youg, or preſent age, will laſt | 400,000 |

Theſe ages correſpond, in their nature, to the golden, ſilver, brazen, and iron ages of the Greeks.

They repreſent the four ages under the emblem of a cow.—She denotes virtue, and originally ſtood on piety, truth, charity, and humility: but three legs are gone, and ſhe is ſaid to ſtand now only on one leg.

They tell us, that in the firſt ages men were greatly ſuperior to the preſent race, both in the length of their lives, and in the powers of their bodies and mental faculties; but that, in conſequence of vice, they gradually declined, and at laſt in this, the *earthen* age, degenerated to what we now ſee them.

At the end of each age, they ſuppoſe that this world is deſtroyed, and that a new creation ſucceeds.

They ſpeak of an author, named *Munnou*, or *Menu*, who, they ſay, flouriſhed in the Sutty Youg, or firſt age; of another, Jage Bulk, who is ſuppoſed to have lived in the Tirtah, or ſecond age; and their writings are ſaid to be ſtill extant, and to contain many of the Hindoo laws and cuſtoms. That theſe authors are of great antiquity, we may allow; but the wild date given to their works by the Brahmans, inſtead of increaſing our reſpect for them, makes us ſmile at their credulity: Or, when we conſider

ſider their uſual ingenuity, it leads us to imagine, that, like the ancient prieſts of Egypt, they have induſtriouſly wrapped up the origin of their ſpiritual authority in myſtery, and thrown it back to a remote period, with a view to ſhut out inveſtigation, and render inquiry fruitleſs. We ſhall therefore abandon theſe fabulous accounts to ſuch as may chooſe to amuſe themſelves with conjectures, and proceed to dates that ſeem to be ſupported by ſcience and hiſtory.

The beginning of the Kaly Youg, or preſent age, is reckoned from two hours twenty-ſeven minutes and thirty ſeconds of the morning of the 16th of February, three thouſand one hundred and two years before the Chriſtian æra; but the time for which moſt of their aſtronomical tables are conſtructed, is two days three hours thirty-two minutes and thirty ſeconds after that, or the 18th February, about ſix in the morning *.

* See Traité de l'Aſtronomie Indienne et Orientale, par Monſieur Bailly, publiſhed in 1787.

They

They ſay, that there was then a conjunction of the planets; and their tables ſhew that conjunction. Monſieur Bailly obſerves, that, by calculation, it appears, that Jupiter and Mercury were then in the ſame degree of the ecliptic; that Mars was diſtant about eight degrees, and Saturn ſeventeen; and it reſults from thence, that at the time of the date given by the Brahmans to the commencement of the Kaly Youg, they might have ſeen thoſe four planets ſucceſſively diſengage themſelves from the rays of the ſun; firſt Saturn, then Mars, then Jupiter, and then Mercury. Theſe four planets, therefore, ſhewed themſelves in conjunction, and though Venus could not have appeared, yet as they only ſpeak in general terms, it was natural enough to ſay, *there was then a conjunction of the planets.* The account given by the Brahmans is confirmed by the teſtimony of our European tables, which prove it to be the reſult of a true obſervation: but Monſieur

ſieur Bailly is of opinion, that their aſtronomical time is dated from an eclipſe of the moon, which appears then to have happened, and that the conjunction of the planets is only mentioned by the way. The cauſe of the date given to their civil time he does not explain, but ſuppoſes it to be ſome memorable occurrence that we are unacquainted with. We are by ſome told, that the circumſtance which marked that epoch, was the death of their hero Kriſhna, who, as we have already obſerved, was ſuppoſed to be the god Viſhnou in one of his incarnations. Others ſay, it was the death of a famous and beloved ſovereign, Rajah Judiſhter. But whichever of the two it may be, the Hindoos, conſidering the event as a great calamity, diſtinguiſhed it by beginning a new age, and expreſſed their feelings by its name, the Kaly Youg, *the age of unhappineſs or misfortune.*

But beſides the Kaly Youg, we are acquainted with two other epochs, from which the Hindoos, in ſome parts of India, reckon their

their civil time. The one commences from the year of the inauguration of a prince named Bickermajit, which happened in the year of the Kaly Youg 3044; and the other from the death of a prince, third in ſucceſſion from him, called Salbàhàm, who ſeems to be the Salivaganam of Monſieur le Gentil. The reign of Bickermajit was diſtinguiſhed by the ſtrict adminiſtration of juſtice, and the encouragement given by him to men of learning. The poet and philoſopher Kàldoſs was particularly protected by him. By that prince's deſire he is ſaid to have made a collection of the different parts of the Ramayan *, which was diſperſed in detached pieces; and he was conſidered as the chief of fourteen learned Brahmans, whom Bickermajit invited to his court from different parts of the empire, and diſtinguiſhed with the appellation *of the fourteen jewels of his crown.*

* A celebrated Epic Poem, containing the wars of Rama.

Monſieur

Monſieur Bailly informs us *, that Monſieur de la Loubére, who was ſent ambaſſador from Louis XIV. to Siam, brought home from thence in 1687, tables and rules for the calculation of eclipſes: and that he likewiſe found in the place, where the charts belonging to the navy are kept, two manuſcripts containing Hindoo aſtronomical tables, that were depoſited there by the late Monſieur de Liſle.

It appears that one ſet of the tables depoſited by M. de Liſle, and here mentioned by M. Bailly, had been given to him by father Patouillet, correſpondent of the miſſionaries in India; and that the other ſet had been ſent to Father Gaubil, by father Duchamp, who procured them from the Brahmans at Kriſhnàpouram †.

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* See Traité de l'Aſtronomie Indienne et Orientale, edition de Paris 1787.

† A town in the Carnatic.—It is written by M. Bailly, and by Mr. Playfair, in following him, *Chriſnabouram.*

The

The tables that were given by father Patouillet, are thought to have come from the neighbourhood of Narſapour *, as they contain a rule for determining the length of the day anſwering to lat. 16°, 16′. N.

Beſides theſe, M. le Gentil brought to Europe, in 1772, other tables and precepts of aſtronomy, that he got from the Brahmans at Tirvalore †.

Here then are four different ſets of tables and precepts of aſtronomy ‡, procured by different perſons, at different times, and from different places, ſome of which are extremely diſtant from the others; yet all, as M. Bailly obſerves, evidently came from the ſame original: all have the ſame motion of the Sun, the ſame duration of the

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* A town belonging to the Engliſh in the *Northern Circars*.

† A town in the Carnatic in lat. 10°, 44′.

‡ All theſe tables and precepts of aſtronomy are depoſited with the Academy of Sciences at Paris.

year,

year, and all are adapted to the ſame meridian, or to meridians at no great diſtance, paſſing near to Benares.—As for inſtance, the tables brought from Siam by M. de la Loubére, ſuppoſe a reduction of one hour and thirteen minutes of time, or eighteen degrees and fifteen minutes of longitude, weſt from the part of Siam to which thoſe tables had been adjuſted, and which evidently refers to the meridian of Benares.

The tables and precepts above mentioned, contain chiefly, tables and rules for calculating the places of the Sun and Moon, and of the planets; and rules for determining the phaſes of eclipſes *.

Monſieur le Gentil mentions, that the method deſcribed in the tables which he

* See Traité de l'Aſtronomie Indienne et Orientale, par M. Bailly.—And Voyage dans les Mers de l'Inde, par M. le Gentil, &c. tome i.

brought

brought home, is called *Fakiam*, or the new, to diſtinguiſh it from another eſtabliſhed at Benares, called *Siddantam*, or the ancient.—The Pere du Champ alſo ſays, that the Hindoos have a method called *Souria Siddantam*, which has ſerved as a rule for the conſtruction of all the tables now exiſting, and is ſuppoſed to be the original and primitive aſtronomy of the Brahmans: And he obſerves, that when the Brahmans at Kriſhnapouram were at a loſs in their aſtronomical calculations, or committed miſtakes, they uſed to ſay, *this would not have happened if we now underſtood the Souria Siddantam.*

The epoch of the tables brought from Tirvalore "coincides with the famous "æra of the Kaly-Youg; that is, with the "beginning of the year 3102 before Chriſt. "When the Brahmans at Tirvalore would "calculate the place of the Sun for a given "time, they begin by reducing into days "the

" the intervals between that time, and the " commencement of the Kaly-Youg, mul- " tiplying the years by $365^{d}$, $6^{h}$, $12'$, " $30''$, and taking away $2^{d}$, $3^{h}$, $32'$, $30''$, " the aſtronomical epoch having begun that " much later than the civil, &c.* "

" The Indian hour has been here reduced " to the European."

Monſieur Bailly, in treating of theſe tables, makes the following obſervations: " Le mouvement Indien dans ce long inter- " valle, de 4383 ans, ne differt pas d'une " minute de celui de Caſſini; il eſt egale- " ment conforme a celui des tables de " Mayer. Ainſi deux peuples, les Indiens " et les Européens, placés aux deux extré- " mités du monde, et par des inſtitutions " peut-etre auſſi eloignés dans le tems,

* See Tranſactions of the R. S. of Edin. vol. ii.

" ont obtenu précisement les mêmes ré-
" sultats, quant au mouvement de la lune,
" et une conformité qui ne seroit pas con-
" cevable, si elle n'etoit pas fondée sur
" l'observation, et sur une imitation réci-
" proque de la nature. Remarquons, que
" les quatres tables des Indiens sont toutes
" les copies d'une même astronomie. On
" ne peut nier que les tables de Siam, n'ex-
" istassent en 1687, dans le tems que Mon-
" sieur de la Loubère les rapporta de Siam.
" A cette époque les tables de Cassini et de
" Mayer n'existoient pas; les Indiens avoient
" deja le mouvement exact que renferment
" ces tables, et nous ne l'avions pas encore.
" Il faut donc convenir que l'exactitude de
" ce mouvement Indien est le fruit de l'ob-
" servation. Il est exact dans cette durée
" de 4383 ans, parce qu'il a été pris sur le
" ciel même; et si l'observation en a dé-
" terminé la fin, elle en a marqué egale-
" ment le commencement. C'est le plus
" long intervalle qui ait été observé et dont

" le

" le ſouvenir ſe ſoit conſervé dans les faſtes " de l'aſtronomie. Il a ſon origine dans " l'époque de 3102 ans avant J. C. et il eſt " une preuve démonſtrative de la realité de " cette époque *."

He ſays, that the Hindoo tables give an annual inequality to the moon, ſuch as was diſcovered by Tycho Brahé, and which was unknown to the Alexandrian ſchool, and to the Arabs who ſucceeded it.

In the Siameſe tables, " the motions of " the moon are deduced by certain interca- " lations, from a period of nineteen years, " in which ſhe makes nearly 235 revolu- " tions; and it is curious to find at Siam,

* See " Le Diſcours preliminaire du Traitè de " l'Aſtronomie Indienne et Orientale." Monſieur Bailly, in a note to pages 36 and 37, ſhews that they could not have received any inſtruction from any aſtronomer who preceded Caſſini, as all, except him, differ from them very conſiderably.

" the knowledge of that cycle, of which " the invention was thought to do ſo much " honour to the Athenian aſtronomer Meton, " and which makes ſo great a figure in our " modern kalendars *."

" Cette régle ſuppoſe donc une periode " de 19 années, ſemblable à celle de Méton " et du nombre d'or; et Dom. Caſſini " ajoute, que la période Indienne eſt plus " exacte que le cycle ancien du nombre " d'or †."

The Hindoos ſeem to have known the uſe of the gnomon at a very remote period; and at Benares, and other places, many ancient dials, of a very curious conſtruction and nice workmanſhip, are yet to be met with.

Their religion commands, that the four ſides of their temples ſhould front the car-

* Tranſ. of the R. S. of Edin. vol. ii. page 144.

† Aſtron. Indien. et Oriental. pages 4 and 5.

dinal

dinal points, and they are all ſo conſtructed. Monſieur le Gentil obſerves:

" Le gnomon ſert aux Brames a trouver " la ligne meridienne, a orienter leur pa- " godes, et a trouver combien la longueur " d'un jour quelconque de l'année pris hors " des equinoxes, excede la durée du jour " de l'equinoxe, ou eſt plus petit que ce " meme jour.

" L'uſage du gnomon chez eux remonte " a une tres grande antiquitè, s'ils s'en " ſont toujours ſervis, pour orienter leurs " pagodes, comme il y a lieu à le pre- " ſumer *."

" The rule by which the phænomena of " eclipſes are deduced from the places of " the ſun and moon, have the moſt imme- " diate reference to geometry; and of theſe

* Voyage dans les Mers de l'Inde, par M. le Gentil.

" rules, as found among the Brahmans at " Tirvalore, M. le Gentil has given a full " account. ——We have alſo an account " by Father du Champ of the method of " calculation uſed at Kriſhnapouram.

" It is a neceſſary preparation, in both " of theſe, to find the time of the ſun's " continuance above the horizon at the " place and the day for which the calcu- " lation of an eclipſe is made; and the " rule by which the Brahmans reſolve this " problem is extremely ſimple and inge- " nious. At the place for which they cal- " culate, they obſerve the ſhadow of a " gnomon on the day of the equinox, at " noon, when the ſun, as they expreſs it, " is in the middle of the world. The " height of the gnomon is divided into " 720 equal parts, in which parts the " length of the ſhadow is alſo meaſured. " One-third of this meaſure is the number " of minutes by which the day, at the end

" of

" of the firſt month after the equinox, ex-
" ceeds twelve hours; four-fifths of this
" exceſs, is the increaſe of the day dur-
" ing the ſecond month; and one-third
" is the increaſe of the day during the
" third month.

" It is plain that this rule involves the
" ſuppoſition, that when the ſun's decli-
" nation is given, the ſame ratio every-
" where exiſts between the arch which
" meaſures the increaſe of the day at any
" place, and the tangent of the latitude;
" for that tangent is the quotient which
" ariſes from dividing the length of the
" ſhadow by the height of the gnomon.
" Now, this is not ſtrictly true; for ſuch a
" ratio only ſubſiſts between the chord of
" the arch, and the tangent above men-
" tioned. The rule is therefore but an ap-
" proximation of the truth, as it neceſſarily
" ſuppoſes the arch in queſtion to be ſo
" ſmall as to coincide nearly with its chord.

" *This ſuppoſition holds only for places in*
" *low latitudes; and the rule which is founded*
" *on it, though it may ſafely be applied in*
" *countries between the tropics, in thoſe that*
" *are more remote from the equator, would*
" *lead into errors too conſiderable to eſcape*
" *obſervation.*

" *As ſome of the former rules have ſerved*
" *to fix the time, ſo does this, in ſome mea-*
" *ſure, to aſcertain the place, of its invention.*
" *It is the ſimplification of a general rule,*
" *adapted to the circumſtances of the torrid*
" *zone, and ſuggeſted to the aſtronomers of*
" *Hindoſtan by their peculiar ſituation* *."

The Zodiac, or Sodi-Mandalam, is divided into twelve parts or ſigns, each of which has its particular name.

" The names and emblems by which
" thoſe ſigns are expreſſed, are nearly the

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* See Tranſ. of the R. S. of Edin. vol. ii. p. 170.

" ſame

" ſame as with us; and as there is nothing
" in the nature of things to have determined
" this coincidence, it muſt, like the arrange-
" ment of the days of the week, be the
" reſult of ſome ancient and unknown
" communication *."

Each ſign contains thirty degrees; but the Hindoos alſo divide the twelve ſigns into twenty-ſeven parts †, which they call *conſtellations*, or *places of the moon reckoned in the twelve ſigns*; every ſign is equal to two conſtellations and a quarter, each conſtellation conſiſts of thirteen degrees twenty minutes, and has its particular name ‡.

" This

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* See Tranſ. of the R. S. of Edin. vol. ii. p. 141.

† Vid. Voyages dans les Mers de l'Inde, par M. le Gentil.—Aſtr. Ind. et Orientale, par M. Bailly;—& la Croze, vol. ii. liv. 6.

‡ " Ces 27 conſtellations ſont en effet marquées dans
" le ciel par des etoiles. J'emportai avec moi le nom
" de chaque conſtellation en particulier, et le nombre
" des

" This diviſion of the zodiac is extremely " natural in the infancy of aſtronomical " obſervation, becauſe the moon completes " her circle among the fixed ſtars nearly in " twenty-ſeven days, and ſo makes an actual " diviſion of that circle into twenty-ſeven " equal parts.

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" des etoiles qu'il renferme; mais je ne peux pas aſſurer " les avoir bien reconnues, parceque beaucoup de ces " conſtellations ſortent du cours de notre zodiaque.

" Dans les regles de l'aſtronomie Indienne des " Siamois, que Dominique Caſſini nous a données, tome " viii. des Anciens Mémoires de l'Academie Royale " des Sciences, p. 234, 235, & 239, il eſt dit, que les " ſtations de la lune ſont les vingtſeptiémes parties du " zodiaque: les Siamois admettent donc vingt ſept " conſtellations, comme les Indiens de la preſqu' iſle " en deça du Gange; mais il ne paroît pas que les " Siamois faſſent aucune attention aux étoiles, qui re- " pondent à ces vingtſeptiémes parties du zodiaque. " On ne trouve ces vingt-ſept conſtellations du zo- " diaque chez aucune autre nation Orientale; elles " ſont donc un ancien monument bien précieux pour " l'hiſtoire de l'aſtronomie." Voyage dans les Mers de l'Inde, par Monſieur le Gentil, de l'Academie des Sciences, p. 256, 257, &c.

" Theſe

"Theſe *conſtellations* are far from in-
"cluding all the ſtars in the Zodiac. M.
"le Gentil obſerves, that thoſe ſtars
"ſeem to have been ſelected, which are
"beſt adapted for marking out, by lines
"drawn between them, the places of the
"moon in her progreſs through the hea-
"vens *."

The preceſſion of the equinoxes is reckoned in their tables at fifty-four ſeconds in the year: the motion of the ſtars from weſt to eaſt is found to be at preſent only about fifty ſeconds in the year: but from this motion of fifty-four ſeconds, they have evidently formed many of their calculations. They have a cycle or period of ſixty years, each of which has its particular name; another of 3,600 years, and one of 24,000. From the annual motion given by them to the ſtars, of 54 ſeconds

* See Tranſ. of the R. S. of Edin. vol. ii. p. 140.

of

of longitude in the year, 54 minutes of longitude make ſixty years, 54 degrees 3,600, and the entire revolution of 360 degrees makes their great period, or *annus magnus*, of 24,000 years, which is often mentioned by them.

Their rules of aſtronomy are written in enigmas and in verſe; in verſe, perhaps, to facilitate the retention of them in the memory; and in enigmas, to render them unintelligible to all but thoſe who are regularly inſtructed, a privilege which is denied both to the Bhyſe and the Soodra.

Monſieur le Gentil obſerves, that the Brahmans in general make their calculations with a great degree of quickneſs. He gives an account of a viſit he received ſoon after his arrival at Pondicherry from a Hindoo, named Nana Moodoo, who, though not a Brahman, had found means, through the ſecret protection of perſons in power, to learn ſome of the principles of aſtro-

aſtronomy. Monſieur le Gentil, to try the extent of his knowledge, gave him ſome examples of eclipſes to calculate, and amongſt others, one of a total eclipſe of the moon, of the 23d December 1768. Seating himſelf on the floor, he began his work with a parcel of ſmall ſhells, named Cowries, which he employed to reckon with; and looking occaſionally at a book of palm leaves, that contained his rules, he gave the reſult of his calculation, with all the different phaſes of the eclipſe, in leſs than three quarters of an hour, which, on confronting it with an Ephemeris, Monſieur le Gentil found ſufficiently exact, to excite his aſtoniſhment at the time and manner in which the calculation had been performed. Yet the education of Nana Moodoo, by his own account, muſt have been very confined; and Monſieur le Gentil takes notice, that he ſeemed entirely unacquainted with the meaning

meaning of many terms, being unable to explain them.

" Pour la facilité de leurs operations " aſtronomiques, les Brames les ont miſes " en vers ; chaque terme eſt un terme com- " poſé, et a beſoin d'explication pour etre " compris : par ce moyen les Brames ne ſont " entendus de perſonne, ou au moins ne le " ſont que de très peu de monde.

" Le Brame, qui avoit enſeigné cet In- " dien, s'etoit donc reſervé le ſecret des " termes, de façon que celuici faiſoit " machinalement ſes calculs ſans les enten- " dre ; il trouvoit des reſultats, et ne ſavoit " point ce qu'ils ſignifioient.

" Par exemple ; dans les éclipſes de lune, " les Brames ont donné à l'argument de " latitude, le nom de *Patona Chandara*, " c'eſt à dire, la lune offenſée par le " dragon :

" dragon : Or, le probleme conſiſte à " trouver ce Patona Chandara ; l'Indien en " queſtion le trouvoit tres bien, mais il " n'entendoit point le mot Patona Chan- " dara, bien loin, qu'il ſut, que ce fut la " diſtance de la lune à ſon nœud, et ainſi " du reſte *."

In

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* The *Patona Chandara* accounts for the vulgar idea among the Hindoos, that the eclipſes are occaſioned by a conteſt between the ſun, or the moon, and *the great ſerpent.*

Eclipſes are always obſerved with ſuperſtitious ceremonies. The following account is given by Bernier of thoſe he ſaw on occaſion of an eclipſe of the ſun.

" Celle que je vis à Delhi me ſembla auſſi tres " remarquable pour les ridicules erreurs et ſuperſti- " tions des Indiens. Au temps qu'elle devoit arriver " je montai ſur la terraſſe de ma maiſon, qui etoit " ſituée ſur le bord de Gemna. De là je vis les deux " côtés de ce fleuve près d'une lieue de long, couverts " de gentils, ou idolatres, qui etoient dans l'eau " juſqu'à la ceinture, regardant attentivement vers le " ciel, pour ſe plonger et ſe laver dans le moment " que

In addition to what has been already ſaid, tending to ſhew the ſuperior antiquity of

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" que l'eclipſe commenceroit. Les petits garçons et " les petites filles etoient tout nuds, comme la main. " Les hommes l'etoient auſſi, hormis qu'ils avoient " une eſpèce d'écharpe bridée à l'entour des cuiſſes " pour les couvrir; et les femmes mariées et les filles " qui ne paſſoient pas ſix ou ſept ans étoient couvertes " d'une ſimple drap. Les perſonnes de condition, " comme les rajahs, ou princes ſouverains gentils, " qui ſont ordinairement à la cour au ſervice et à la " paye du roi, et les ſerrafs, ou changeurs, banquiers, " jouaillers, et autres gros marchands, avoient la plû- " part paſſé de l'autre côté de l'eau avec toute leur fa- " mille, et y avoient dreſſé leurs tentes, et plante dans " la riviere des Kanates, qui ſont une eſpece de par- " avent pour faire leurs ceremonies, et ſe laver à leur " aiſe avec leurs femmes, ſans être vus de perſonne. " Ces idolatres ne ſe furent pas plutot apperçus que " le ſoleil commençoit de s'eclipſer, que j'entendis " un grand cri qui s'eleva, et que tout d'un coup ils " ſe plongerent tous dans l'eau, je ne ſais combien de " fois de ſuite, ſe tenant par après debout dans cette " eau, les yeux et les mains elevées vers le ſoleil, " marmotant tous et priant comme on diroit en grande

of the aſtronomy of the Brahmans, to any other that Europeans are acquainted with, I ſhall take the liberty to make a few more

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" devotion, prenant de temps en temps de l'eau avec " les mains, la jettant vers le ſoleil, s'inclinant la " tête profondement, remuant et tournant les bras et " les mains, tantôt d'une façon, et tantôt d'une autre, " et continuant ainſi leurs plongemens, leurs prieres, " et leurs ſingeries juſqu'à la fin de l'eclipſe, quand " chacun ſe retira en jettant des pieces d'argent bien " avant dans l'eau, et faiſant l'aumone aux Brames, " qui n'avoient pas manqué de ſe trouver à cette ce- " remonie. Je remarquai qu'au ſortir de cette ri- " viere ils prirent tous de vêtemens nouveaux, qui les " attendoient tout plier ſur le ſable, et que pluſieurs " des plus devots laiſſerent là leur anciens habits pour " les Brames. C'eſt ainſi, que de ma terraſſe je vis " celebrer cette grande fête de l'eclipſe, qui fût " chommée de la même façon dans l'Indus, dans le " Gange, et dans tous les autres fleuves et talabs, ou " reſervoirs des Indes; mais ſurtout dans celui de " Tanaiſer, ou il ſe trouva plus de cent et cinquante " mille perſonnes aſſemblées de tous les côtes des " Indes, parceque ſon eau eſt ce jour-la reputée plus " ſainte, et plus meritoire qu'aucune autre."

quotations from the learned and ingenious remarks of Mr. Playfair.

" The moon's mean place, for the beginning of the Kaly-Youg, (that is, for midnight between the 17th and 18th of February, 3102 A. C. at Benares,) calculated from Mayer's tables, on the ſuppoſition that her motion has always been at the ſame rate as at the beginning of the preſent century, is $10^s\ 0^\circ\ 51'\ 16''$—But, according to the ſame aſtronomer, the moon is ſubject to a ſmall, but uniform acceleration, ſuch that her angular motion, in any one age, is $9''$ greater than in the preceding, which, in an interval of 4,801 years, muſt have amounted to $5^\circ, 45', 44''$. This muſt be added, to give the real mean place of the moon at the aſtronomical epoch of the Kaly-Youg, which is therefore $10^s, 6^\circ, 37'$. —Now, the ſame, by the tables of Tirvalore, is $10^s, 6^\circ, 0'$; the difference is leſs than two-thirds of a degree, which, for ſo remote

remote a period, and conſidering the acceleration of the moon's motion, for which no allowance could be made in an Indian calculation, is a degree of accuracy that nothing but actual obſervation could have produced.

" To confirm this concluſion, M. Bailly computes the place of the moon for the ſame epoch, by all the tables to which the Indian aſtronomers can be ſuppoſed to have ever had acceſs. He begins with the tables of Ptolemy; and if, by help of them, we go back from the æra of Nabonaſſar to the epoch of the Kaly-Youg, taking into account the comparative length of the Egyptian and Indian years, together with the difference of meridians between Alexandria and Tirvalore, we ſhall find the longitude of the ſun, 10°, 21′, 15″ greater, and that of the moon 11°, 52′, 7″ greater, than has juſt been found from the Indian tables. At the ſame time that this ſhews

how difficult it is to go back, even for a leſs period than that of 3000 years, in an aſtronomical computation, it affords a proof altogether demonſtrative, *that the Indian aſtronomy is not derived from that of Ptolemy.*

" The tables of Ulugh Beig are more accurate than thoſe of the Egyptian aſtronomer. They were conſtructed in a country not far from India, and but a few years earlier than 1491, the epoch of the tables at Kriſhnapouram. Their date is July the 4th, at noon, 1437, at Samarcand; and yet they do not agree with the Indian tables, even at the above-mentioned epoch of 1491. But for the year 3102 before Chriſt, their difference from them in the place of the ſun is 1°, 30′, and in that of the moon 6°; which, though much leſs than the former differences, are ſufficient to ſhow, *that the tables of India are not borrowed from thoſe of Tartary.*

" The

" The Arabians employed in their tables the mean motions of Ptolemy; the Perſians did the ſame, both in the more ancient tables of Chryſococca, and the later ones of Naſſireddin. *It is therefore certain, that the aſtronomy of the Brahmans is neither derived from that of the Greeks, the Arabians, the Perſians, or the Tartars.* This appeared ſo clear to Caſſini, though he had only examined the tables of Siam, and knew nothing of many of the great points which diſtinguiſh the Indian aſtronomy from that of all other nations, that he gives it as his opinion, that theſe tables are neither derived from the Perſian aſtronomy of Chryſococca, nor from the Greek aſtronomy of Ptolemy; the places they give at their epoch to the apogee of the ſun, and of the moon, and their equation for the ſun's centre, being very different from both *."

* See Tranſ. of the R. S. of Edin. vol. ii. p. 155, &c.

" * A formula for computing this inequality" (in the moon's motion) " has been given by M. de la Place, which though only an approximation, being derived from theory, is more accurate than that which Mayer deduced entirely from obſervation; and if it be taken inſtead of Mayer's, which laſt, on account of its ſimplicity, I have employed in the preceding calculations, it will give a quantity ſomewhat different, though not ſuch as to affect the general reſult. It makes the acceleration for 4383 years, dated from the beginning of the Kaly-Youg, to be greater by 17′, 39″ than was found from Mayer's rule, and greater, conſequently, by 16′, 32″, than was deduced from the tables of Kriſhnapouram. It is plain, that this coincidence is ſtill near enough to leave the argument that is founded on it in poſſeſſion of all its force, and to afford a ſtrong confirma-

* See Tranſ. of the R. S. of Edin. vol. ii. p. 160.

tion

tion of the accuracy of the theory and the authenticity of the tables.

" That obſervations made in India, when all Europe was barbarous or uninhabited, and inveſtigations into the moſt ſubtle effects of gravitation, made in Europe near five thouſand years afterwards, ſhould thus come in mutual ſupport of one another, is perhaps the moſt ſtriking example of the progreſs and viciſſitude of ſcience, which the hiſtory of mankind has yet exhibited.

" This, however, is not the only inſtance of the ſame kind that will occur, if, from examining the radical places and mean motions in the Indian aſtronomy, we proceed to conſider ſome other of its elements; ſuch as, the length of the year, the inequality of the ſun's motion, and the obliquity of the ecliptic, and compare them with the concluſions deduced from the

theory of gravity by M. de la Grange. To that geometer, phyſical aſtronomy is indebted for one of the moſt beautiful of its diſcoveries, viz.—That all the variations in our ſyſtem are periodical; ſo that though every thing, almoſt without exception, be ſubject to change, it will, after a certain interval, return to the ſame ſtate in which it is at preſent, and leave no room for the introduction of diſorder, or of any irregularity that might conſtantly increaſe. Many of theſe periods, however, are of vaſt duration. A great number of ages, for inſtance, muſt elapſe, before the year be again exactly of the ſame length, or the ſun's equation of the ſame magnitude, as at preſent. An aſtronomy, therefore, which profeſſes to be ſo ancient as the Indian, ought to differ conſiderably from ours in many of its elements. If, indeed, theſe differences are irregular, they are the effects of chance, and muſt be accounted errors; but if they obſerve the laws,

laws, which theory informs us that the variations in our ſyſtem do actually obſerve, they muſt be held as the moſt undoubted marks of authenticity *."

Mr. Playfair then goes on to examine this queſtion, as M. Bailly has done; and we are perſuaded, if the reader will *impartially* peruſe the inveſtigations of theſe learned men, he will be ſatisfied, that the differences alluded to, are neither the effects of chance, nor to be accounted errors.

After examining the duration given to the year by the Brahmans at the period of the Kaly-Youg, Mr. Playfair proceeds:

"The equation of the ſun's centre is an element in the Indian aſtronomy, which has a more unequivocal appearance *of belonging to an earlier period than the Kaly-*

* See Tranſ. of the R. S. of Edin. vol. ii. p. 160, &c.

*Youg.*

*Youg* *. The maximum of *that equation is fixed, in theſe tables, at* 2°, 10′, 32″. It is at preſent, according to M. de la Caille, 1°, 55′ ½, that is 15′ leſs than with the Brahmans. Now, M. de la Grange has ſhewn, that the ſun's equation, together with the eccentricity of the earth's orbit, on which it depends, is ſubject to alternate diminution and increaſe, and accordingly has been diminiſhing for many ages. In the year 3102 before our æra, that equation was 2°, 6′, 28″ ½; leſs only by 4′, than in the tables of the Brahmans. But if we ſuppoſe the Indian aſtronomy to be founded on obſervations that preceded the Kaly-Youg, the determination of this equation

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* M. Bailly, in his remarks on the length of the years, ſuppoſes ſome of the obſervations of the Brahmans to have been made during a period often mentioned by them, of 2400 years before the Kaly-Youg, or, 7,292 years ago.—He takes the medium of that period 1200 years before the Kaly-Youg, or 6090 years ago.

will

will be found to be ſtill more exact.—Twelve hundred years before the commencement of that period, or about 4300 before our æra, it appears, by computing from M. de la Grange's formula, that the equation of the ſun's centre was actually 2°, 8′, 16″; ſo that if the Indian aſtronomy be as old as that period, its error with reſpect to this equation is but 2′*.

" The obliquity of the ecliptic is another element in which the Indian aſtronomy and the European do not agree, but where their difference is exactly ſuch as the high antiquity of the former is found to require. The Brahmans make the obliquity of the ecliptic 24°.—Now M. de la Grange's formula for the variation of the obliquity, gives 22′, 32″, to be added to its obliquity in 1700, that is, to 23°, 28′, 41″, in order to have that which took place in

* See Tranſ. of the R. S. of Edin. p. 163.

the

the year 3,102 before our æra. This gives us 23°, 51′, 13″, which is 8′, 47″ ſhort of the determination of the Indian aſtronomers.—But if we ſuppoſe, as in the caſe of the ſun's equation, that the obſervations on which this determination is founded, were made 1200 years before the Kaly-Youg, we ſhall find that the obliquity of the ecliptic was 23°, 57′, 45″, and that the error of the tables did not much exceed 2′.

" Thus do the meaſures which the Brahmans aſſign to theſe three quantities, the length of the tropical year, the equation of the ſun's centre, and the obliquity of the ecliptic, all agree, in referring the epoch of their determination to the year 3102 before our æra, *or to a period ſtill more ancient.* This coincidence in three elements, altogether independent of one another, cannot be the effect of chance. The difference, with reſpect to each of them, be-

tween their aſtronomy and ours, might ſingly perhaps be aſcribed to inaccuracy; but that three errors, which chance had introduced, ſhould be all of ſuch magnitude as to ſuit exactly the ſame hypotheſis concerning their origin, is hardly to be conceived.—Yet there is no other alternative, but to admit this very improbable ſuppoſition, or to acknowledge, that the Indian aſtronomy is as ancient as one or other of the periods abovementioned *.

" In ſeeking for the cauſe of the ſecular equations, which modern aſtronomers have found it neceſſary to apply to the mean motion of Jupiter and Saturn, M. de la Place has diſcovered, that there are inequalities belonging to both theſe planets,

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* See Tranſ. of the R. S. of Edin. p. 164.

In ſuppoſing the time neceſſary for the progreſs of knowledge in that ſcience, we muſt look to periods much beyond thoſe.

ariſing

ariſing from their mutual action on one another, which have long periods, one of them no leſs than 877 years; ſo that the mean motion muſt appear different, if it be determined from obſervations made in different parts of thoſe periods. "Now I "find," ſays he, "by my theory, that at "the Indian epoch of 3102 years before "Chriſt, the apparent and annual mean "motion of Saturn was 12°, 13′, 14″, and "the Indian tables make it 12°, 13′, 13″.

"In like manner, I find, that the annual "and apparent mean motion of Jupiter at "that epoch, was 30°, 20′, 42″, preciſely as "in the Indian aſtronomy."

"Thus have we enumerated no leſs than nine aſtronomical elements *, to which the tables

* "The inequality or the preceſſion of the equinoxes; the acceleration of the moon; the length of the ſolar year;

tables of India affign ſuch values as do by no means belong to them in theſe later ages, but ſuch as the theory of gravity proves to have belonged to them three thouſand years before the Chriſtian æra. At that time, therefore, or *in the ages preceding it*, the obſervations muſt have been made from which theſe elements were deduced. For it is abundantly evident, that the Brahmans of later times, however willing they might be to adapt their tables to ſo remarkable an epoch as the Kaly-Youg, could never think of doing ſo, by ſubſtituting, inſtead of quantities which they had obſerved, others which they had no reaſon to believe had ever exiſted. The elements in queſtion are preciſely what theſe aſtronomers muſt have ſuppoſed in-

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year; the equation of the ſun's centre; the obliquity of the ecliptic; the place of Jupiter's aphelion; the equation of Saturn's centre; and the inequalities in the mean motion of both theſe planets."

variable,

variable, and of which, had they ſuppoſed them to change, they had no rules to go by for aſcertaining the variations; ſince to the diſcovery of theſe rules is required, not only all the perfection to which aſtronomy is at this day brought in Europe, but all that which the ſciences of motion and of extenſion have likewiſe attained. It is no leſs clear that theſe coincidences are not the work of accident; for it will ſcarcely be ſuppoſed that chance has adjuſted the errors of the Indian aſtronomy with ſuch ſingular felicity, that obſervers, who could not diſcover the true ſtate of the heavens, at the age in which they lived, have ſucceeded in deſcribing one which took place ſeveral thouſand years before they were born *.

" The preceding calculations muſt have required the aſſiſtance of many ſubſidiary

* See Tranſ. of the R. S. of Edin. vol. ii. p. 169.

tables,

tables, of which no trace has yet been found in India. Beſides many other geometrical propoſitions, ſome of them alſo involve the ratio which the diameter of a circle was ſuppoſed to bear to its circumference, but which we would find it impoſſible to diſcover from them exactly, on account of the ſmall quantities that may have been neglected in their calculations. Fortunately, we can arrive at this knowledge, which is very material when the progreſs of geometry is to be eſtimated, from a paſſage in the *Ayin Akbaree* *, where we are told that the Hindoos ſuppoſe the diameter of a circle to be to its circumference as 1250 to 3927; and where the author, *who believed it to be perfectly exact*, expreſſes his aſtoniſhment, that, among ſo ſimple a people, there ſhould be found a truth, which among the wiſeſt and moſt learned nations had been ſought for in vain.

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* See SKETCH III. p. 94.

"The proportion of 1250 to 3927, is indeed a near approach to the quadrature of the circle; it differs little from that of Metius, 113 to 355, and is the ſame with one equally well known, that of 1 to 3.1416. When found in the ſimpleſt and moſt elementary way, it requires a polygon of 768 ſides to be inſcribed in a circle; an operation which cannot be arithmetically performed without the knowledge of ſome very curious properties of that curve, and at leaſt nine extractions of the ſquare root, each as far as ten places of decimals. All this muſt have been accompliſhed in India; for, it is to be obſerved, that the above-mentioned proportion cannot have been received from the mathematicians of the weſt. The Greeks left nothing on this ſubject more accurate than the theorem of Archimedes; and the Arabian mathematicians ſeem not to have attempted any nearer approximation. The geometry of modern Europe can much leſs be regarded

garded as the ſource of this knowledge. Metius and Vieta were the firſt who, in the quadrature of the circle, ſurpaſſed the accuracy of Archimedes; they flouriſhed at the very time when the Inſtitutes of Akbar were collected in India *."—But the ſcience of the Brahmans was then buried under the ruins of the Hindoo empire.

" On the grounds which have now been explained the following general concluſions appear to be eſtabliſhed.

" 1ſt, The obſervations on which the aſtronomy of India is founded, were made more than three thouſand years before the Chriſtian æra; and, in particular, the places of the ſun and moon, at the beginning of the Kaly-Youg, were determined by actual obſervation.

* See Tranſ. of the R. S. of Edin. vol. ii. p. 185.

" This follows from the exact agreement of the radical places in the tables of Tirvalore, with thoſe deduced for the ſame epoch from the tables of De la Caille and Mayer, and eſpecially in the caſe of the moon when regard is had to her acceleration. It follows, too, from the poſition of the fixed ſtars in reſpect of the equinox, as repreſented in the Indian zodiac; from the length of the ſolar year; and laſtly, from the poſition and form of the orbits of Jupiter and Saturn, as well as their mean motions; in all of which, the tables of the Brahmans, compared with ours, give the quantity of the change that has taken place, juſt equal to that which the action of the planets on one another may be ſhewn to have produced, in the ſpace of forty-eight centuries, reckoned back from the beginning of the preſent.

" Two other of the elements of this aſtronomy, the equation of the ſun's centre, and

and the obliquity of the ecliptic, when compared with thoſe of the preſent time, ſeem to point to a period ſtill more remote, and to fix the origin of this aſtronomy 1,000 or 1200 years earlier; that is, 4,300 years before the Chriſtian æra*: and the time neceſſary to have brought the arts of calculating and obſerving to ſuch perfection as they muſt have attained at the beginning

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* That they point to a period more remote than the beginning of the Kaly-Youg, I imagine that the impartial reader will not now deny; but I hope to be excuſed in ſaying, that I cannot ſee any reaſon for dating the *origin* of the Indian aſtronomy, at 1000 or 1200 years before that. Perhaps it ſhould rather be ſaid, that the Brahmans, 4,300 years before the Chriſtian æra, muſt have been in poſſeſſion of ſuch or ſuch parts of their aſtronomy. It is poſſible that materials may yet be found, to enable Mr. Playfair to carry his reſearches ſtill farther back into antiquity; but probably never to aſcertain the origin of a ſcience, which was not delivered ready written, like a book of laws, but begun by looking at the heavens, and improved, through the courſe, perhaps, of many ages, by obſervation and experience.

of the Kaly-Youg, comes in ſupport of the ſame concluſion.

" Of ſuch high antiquity, therefore, muſt we ſuppoſe the origin of this aſtronomy, unleſs we can believe, that all the coincidences which have been enumerated are but the effects of chance; or, what indeed were ſtill more wonderful, that, ſome years ago, there had ariſen a Newton among the Brahmans, to diſcover that univerſal principle, which connects, not only the moſt diſtant regions of ſpace, but the moſt remote periods of duration; and a De la Grange, to trace, through the immenſity of both, its moſt ſubtle and complicated operations.

" 2dly, Though the aſtronomy that is now in the hands of the Brahmans is ſo ancient in its origin, yet it contains many rules and tables that are of later conſtruction.

" The

" The firſt operation for computing the moon's place from the tables of Tirvalore, requires that 1,600,984 days ſhould be ſubtracted from the time that has elapſed ſince the beginning of the Kaly-Youg, which brings down the date of the rule to the year 1282 of our æra. At this time, too, the place of the moon, and of her apogee, are determined with ſo much exactneſs, that it muſt have been done by obſervation, either at the inſtant referred to, or a few days before or after it. At this time, therefore, it is certain, that aſtronomical obſervations were made in India, and that the Brahmans were not, as they are now, without any knowledge of the principles on which their rules were founded. When that knowledge was loſt, will not perhaps be eaſily aſcertained *; but there are, I think, no

* It appears to have been loſt, only ſince the conqueſt of their country by ſtrangers; from the want of protection

no circumſtances in the tables from which we can certainly infer the exiſtence of it at a later period than what has juſt been mentioned; for though there are more modern epochs to be found in them, they are ſuch as may have been derived from the moſt ancient of all, by help of the mean motions in the tables of Kriſhna-pouram, without any other ſkill than is required to an ordinary calculation. Of theſe epochs, beſide what have been occaſionally mentioned in the courſe of our remarks, there is one involved in the tables of Narſapour as late as the year 1656, and another as early as the year 78 of our æra, which marks the death of Salivaganam, one of their princes, in whoſe reign a reform is ſaid to have taken place in the methods of their aſtronomy. There is no reference

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protection and encouragement, and the effects of perſecution and violence. The date ſeems to prove this.

to

to any intermediate date from that time to the beginning of the Kaly-Youg.

" The parts of this aſtronomy, therefore, are not all of the ſame antiquity; nor can we judge, merely from the epoch to which the tables refer, of the age to which they were originally adapted. We have ſeen that the tables of Kriſhnapouram, though they profeſs to be no older than the year 1491 of our æra, are in reality more ancient than the tables of Tirvalore, which are dated from the Kaly-Youg, or at leaſt have undergone fewer alterations. This we concluded from the ſlow motion given to the moon in the former of theſe tables, which agreed, with ſuch wonderful preciſion, with the ſecular equation applied to that planet by Mayer, and explained by M. de la Place.

" But it appears that neither the tables of Tirvalore or Kriſhnapouram, nor any with

with which we are yet acquainted, are the moſt ancient to be found in India. The Brahmans conſtantly refer to an aſtronomy at Benares, which they emphatically ſtyle *the ancient*, and which, they ſay, is not now underſtood by them, though they believe it to be much more accurate than that by which they now calculate. That it is more accurate, is improbable; that it may be more ancient, no one who has duly attended to the foregoing facts and reaſonings, will think impoſſible; and every one, I believe, will acknowledge, that no greater ſervice could be rendered to the learned world, than to reſcue this precious fragment from obſcurity. If that is ever to be expected, it is when the zeal for knowledge has formed a literary ſociety among our countrymen at Bengal *, and while

* I am ſorry to find, that, ſo laudable an example has not yet been followed by our countrymen at Madras;

while that ſociety is directed by the learning and abilities of Sir William Jones.—Indeed, the further diſcoveries that may be made with reſpect to this ſcience, do not intereſt merely the aſtronomer and mathematician, but every one who delights to mark the progreſs of mankind, or is curious to look back on the ancient inhabitants of the globe. It is through the medium of aſtronomy alone, that a few rays from thoſe diſtant objects can be conveyed in ſafety to the eye of a modern obſerver, ſo as to afford him a light, which, though it be ſcanty, is pure and unbroken, and free from the falſe colourings of vanity and ſuperſtition.

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Madras; for though Mr. Playfair has emphatically, and perhaps properly, called the ſites of Benares, and Palibothra, &c. *the claſſic ground of India*, yet, as the Southern provinces have been leſs diſturbed by foreigners, than the northern countries of Hindoſtan, were due enquiry to be made, I doubt not but many curious materials would be found in them.

" 3dly,

" 3dly, The baſis of the four ſyſtems of aſtronomical tables we have examined, is evidently the ſame.

" Though theſe tables are ſcattered over an extenſive country, they ſeem to have been all originally adapted to the ſame meridian, or to meridians at no great diſtance, which traverſe what we may call the claſſical ground of India, marked by the ruins of Canoge *, Palibothra, and Benares. *They contain rules that have originated between the tropics;* whatever be their epoch, they are all, by their mean motions, connected with that of the Kaly-Youg; and they have beſides one uniform character, which it is perhaps not eaſy to deſcribe. Great ingenuity has been exerted to ſimplify their rules, yet in no inſtance, almoſt, are they reduced to the utmoſt ſimplicity: and when it happens that the operations to which

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* Canoge and Palibothra are the ſame.

they

they lead are extremely obvious, these are often involved in an artificial obscurity. A Brahman frequently multiplies by a greater number than is necessary, where he seems to gain nothing but the trouble of dividing by one that is greater in the same proportion; and he calculates the æra of Salivaganam, with the formality of as many distinct operations, as if he were going to determine the moon's motion since the beginning of the Kaly-Youg. The same spirit of exclusion, the same fear of communicating his knowledge, seems to direct the *calculus* which pervades the religion of the Brahman; and in neither of them is he willing to receive or impart instruction. With all these circumstances of resemblance, the methods of this astronomy are as much diversified as we can suppose the same system to be, by passing through the hands of a succession of ingenious men, fertile in resources, and acquainted with the variety and extent of the science which they cultivated.

tivated.—A ſyſtem of knowledge which is thus aſſimilated to the genius of the people, that is diffuſed ſo widely among them, and diverſified ſo much, has a right to be regarded, either as a native, or a very ancient inhabitant of the country where it is found.

" 4thly, The conſtruction of theſe tables implies a great knowledge of geometry, arithmetic, and even of the *theoretical part* of aſtronomy, &c.

" But what, without doubt, is to be accounted the greateſt refinement, is the hypotheſis employed in calculating the equations of the centre for the ſun, moon, and planets; that, viz. of a circular orbit having a double eccentricity, or having its centre in the middle between the earth and the point about which the angular motion is uniform. If to this we add the great extent of geometrical knowledge requiſite to combine this, and the other principles of

of their aſtronomy together, and to deduce from them the juſt concluſions, the poſſeſſion of a calculus equivalent to trigonometry; and laſtly, their approximation to the quadrature of the circle; we ſhall be aſtoniſhed at the magnitude of that body of ſcience, which muſt have enlightened the inhabitants of India in ſome remote age, and which, whatever it may have communicated to the weſtern nations, appears to have received nothing from them."

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If, therefore, after what has been ſaid, we are obliged to allow that the Hindoos were ſo far advanced in the ſcience of aſtronomy, as to make the obſervations, which they appear to have made, even at the beginning of the Kaly-Youg, about four thouſand eight hundred and ninety years ago; or, according to what has been alledged by M. Bailly and Mr. Playfair, 2400, or 1200 years before that period;

riod; we muſt neceſſarily ſuppoſe many previous ages, in which they might gradually proceed to that degree of knowledge and refinement, which they muſt have then enjoyed. The country ſeems to have been as populous, the nation as powerful, the people as much poliſhed, and arts and learning as far advanced at the *beginning of the Kaly-Youg*, as 4000 years afterwards. But theſe reflections lead us ſo far back into the abyſs of time, that whilſt we are loſt in contemplating the paſt duration of our ſyſtem, we may be apt to forget the generally received opinions with reſpect to the creation of the world, and the hiſtory of mankind.

I ſhall conclude this imperfect ſketch of the aſtronomy of the Brahmans, with an extract of a letter from Sir Robert Barker, to the Preſident of the Royal Society of London, read before the Society the 29th

of May 1777, giving a deſcription of the obſervatory at Benares *.

However much that ancient and celebrated ſeminary may have declined from its former ſplendour, he informs us, that there are ſtill many public foundations and temples, where ſome thouſands of Brahmans yet conſtantly reſide.

" Having frequently heard that the Brah-
" mans had a knowledge of aſtronomy,
" and being confirmed in this by their
" information of an approaching eclipſe,
" both of the ſun and moon, I made in-
" quiry, when at that place in the year
" 1772, amongſt the principal Brahmans, to
" endeavour to get ſome information rela-
" tive to the manner in which they were
" acquainted with approaching eclipſes;
" but they gave me but little ſatisfaction.

* See page 94.

" I was told, that thoſe matters were con-
" fined to a few, who were in poſſeſſion of
" certain books and records, ſome contain-
" ing the myſteries of their religion, and
" others aſtronomical tables, written in the
" Sanſkrit language, which ſcarcely any
" but thoſe few underſtand; that they
" would, however, take me to a place
" which had been conſtructed for the pur-
" poſe of making obſervations, and from
" whence they ſuppoſed the learned Brah-
" mans made theirs. I was conducted to
" an ancient building of ſtone, the lower
" part of which, in its preſent ſtate, ſerved
" as a ſtable for horſes, and a receptacle
" for lumber, but, by the number of courts
" and apartments, it appeared that it muſt
" once have been an edifice for the uſe
" of ſome public body. We entered this
" building, and went up a ſtair which led
" to a large terrace on the top of a part of
" it near to the river Ganges, where, to
" my ſurpriſe and ſatisfaction, I ſaw a
" number

" number of inſtruments yet remaining in " the greateſt preſervation, ſtupendouſly " large, immovable from the ſpot, and con- " ſtructed of ſtone, ſome of them being " upwards of twenty feet in height. The " execution in the conſtruction of theſe " inſtruments exhibited a mathematical ex- " actneſs in the fixing, bearing, and fitting, " of the ſeveral parts. The ſituation of " the two large quadrants of the inſtru- " ments marked A *, whoſe radius is nine " feet two inches, by being at right angles " with a gnomon at 25 degrees elevation, " are thrown into ſuch an oblique ſitua- " tion, as to render them the moſt difficult, " not only to conſtruct of ſuch a magni- " tude, but to ſecure in their poſition, " and affords a ſtrong proof of the ability " of the architect; for by the ſhadow of " the gnomon thrown on the quadrants, " they do not ſeem to have in the leaſt al-

* See the Plate.

 " tered

" tered from their original poſition; and " ſo true is the line of the gnomon, that, " by applying the eye to a ſmall iron ring " of an inch diameter at one end, the ſight " is carried through three others of the " ſame dimenſion to the extremity at the " other end, thirty-eight feet eight inches " diſtant from it, without any obſtruc- " tion.

" Lieutenant Colonel Archibald Camp- " bell, at that time chief engineer in the " Eaſt India Company's ſervice at Bengal, " a gentleman whoſe abilities do honour to " his profeſſion, made a perſpective draw- " ing of the whole of the apparatus that " could be brought within his eye at one " view; but I lament that he could not re- " preſent ſome very large quadrants, whoſe " radii were about twenty feet, they being " on the ſide from whence he took his " drawing. They are exact quarters of " circles of different radii, the largeſt of

" which I judged to be twenty feet, con-
" ſtructed very exactly on the ſides of
" ſtone walls built perpendicular, and ſitu-
" ated, I ſuppoſe, in the meridian of the
" place; a braſs pin is fixed at the centre,
" or angle, of the quadrant, from whence,
" a Brahman informed me, they ſtretched a
" wire to the circumference when an ob-
" ſervation was to be made; from which
" it occurred to me, the obſerver muſt
" have moved his eye up or down the cir-
" cumference by means of a ladder, or
" ſome ſuch contrivance, to raiſe and lower
" himſelf until he had diſcovered the alti-
" tude of the heavenly bodies in their paſ-
" ſage over the meridian, ſo expreſſed on
" the arcs of thoſe quadrants; theſe arcs
" are very exactly divided into nine large
" ſections, each of them is again divided
" into ten, making ninety leſſer diviſions,
" or degrees, and theſe into twenty, ex-
" preſſing three minutes each, of about
" two tenths of an inch aſunder; ſo it is

" poſſible they had ſome method of again
" dividing theſe into more minute parts at
" the time of obſervation.

" My time would only permit me to
" take down the particular dimenſions of
" the moſt capital inſtrument, or the
" greater equinoctial ſun-dial, repreſented by
" figure A, (ſee the Plate,) which appears to
" be an inſtrument to expreſs ſolar time
" by the ſhadow of a gnomon upon two
" quadrants, one ſituated to the eaſt, and
" the other to the weſt of it; and indeed
" the chief part of their inſtruments at this
" place appear to be conſtructed for the
" ſame purpoſe, except the quadrants and
" an inſtrument in braſs, that will be de-
" ſcribed hereafter.

" Figure B is another inſtrument for de-
" termining the exact hour of the day, by
" the ſhadow of a gnomon, which ſtands
" perpendicular to, and in the centre of,
" a flat

" a flat circular ſtone, ſupported in an " oblique ſituation by means of four up- " right ſtones and a croſs-piece; ſo that " the ſhadow of the gnomon, which is a " perpendicular iron rod, is thrown upon " the diviſions of the circle deſcribed on " the face of the flat circular ſtone.

" Figure C is a braſs circle, about two " feet diameter, moving vertically upon " two pivots between two ſtone pillars, " having an index, or hand, turning round " horizontally on the centre of this circle, " which is divided into three hundred and " ſixty parts; but there are no counter- " diviſions on the index to ſubdivide thoſe " on the circle. The inſtrument appears " to be made for taking the angle of a " ſtar at ſetting or riſing, or for taking the " azimuth or amplitude of the ſun at ſet- " ting or riſing.

" The uſe of the inſtrument, figure D, " I was at a loſs to account for. It conſiſts " of

" of two circular walls, the outer of which " is about forty feet diameter and eight " high, the wall within about half that " height, and appears intended as a place " to ſtand on to obſerve the diviſions on " the upper circle of the outer wall, rather " than for any other purpoſe; and yet " both circles are divided into three hun- " dred and ſixty degrees, each degree being " ſubdivided into twenty leſſer diviſions, " the ſame as the quadrants. There is a " door-way to paſs into the inner circle, " and a pillar in the centre of that, of the " ſame height with the lower circle, and " having a hole in it which ſeems to be a " ſocket for an iron rod to be placed per- " pendicular. The diviſions on theſe circles, " as well as on all the other inſtruments, " will bear a nice examination with a pair " of compaſſes.

" Figure E is a ſmall equinoctial ſun- " dial, conſtructed on the ſame principle as " the large one A."

Mr.

Mr. Call, member of the Royal Society, and formerly chief engineer on the coaſt of Coromandel, in a letter to the Aſtronomer Royal, to be found in the Philoſophical Tranſactions of 1772, ſays, that he diſcovered the ſigns of the zodiac on the cieling of a choultery at Verdapetah, in the province of Madura, near Cape Comorin; that he found them on the cieling of a temple that ſtands in the middle of a tank, before the pagoda of Teppicolum; and that he had often met with ſeveral parts of the zodiac in detached pieces.

END OF THE FIRST VOLUME.