V. *Further Particulars respecting the Observatory at* Benares, *of which an Account, with Plates, is given by Sir* Robert Barker, *in the LXVIIth Vol. of the Philosophical Transactions. In a Letter to* William Marsden, *Esq. F. R. S. from* John Lloyd Williams, *Esq. of* Benares.

Read January 31, 1793.

DEAR SIR,

In conformity with your request, I have now the pleasure of sending you an account of the measurement of the different parts of the Benares observatory, called *maun-mundel*, as taken by myself, with a two-foot rule, and a rod of ten feet very exactly divided. An account of the use of the different instruments, though very imperfect, was given me on the spot, by several learned Brahmins who attended me; one of whom is professor of astronomy in the new founded college at Benares. They all agreed that this observatory never was used, nor did they think it capable of being used, for any nice observations; and believe that it was built more for ostentation, than the promotion of useful knowledge.

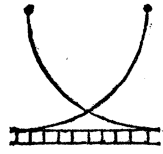
In my inquiry into the particulars of the building, I have been assisted by my friend the Nabob Ali Ibrahim Kaun, and I believe this account may be relied on.

A.* The large quadrant, called in Arabic, *kootoop-bede*; in Hindoo, *droop*, the name of the north polar star. This instrument is built of stone, fixed in mortar, and clamped with iron in a very clumsy manner; between most of the stones are spaces of $\frac{1}{16}$ part of an inch. The stile, in its length from north to south, measured 39 feet $6\frac{1}{2}$ inches; the height of the south end, 5 feet $4\frac{1}{4}$ inches; height of the north end, 22 feet 3 inches. This stile consists of two walls $11\frac{1}{2}$ inches thick, with a flight of 27 steps between; and on the outer edge of each of these walls are fixed two iron rings. The distance between the two rings is 5 feet $8\frac{1}{2}$ inches; from the uppermost to the top, 18 feet 8 inches; from the lower one to the bottom, 15 feet and $\frac{1}{2}$ an inch; both sides are nearly alike. The rings are, each of them, $\frac{3}{4}$ of an inch in thickness, and they are let into the wall between two stones; the holes through which the object is to be viewed are $\frac{5}{16}$ths of an inch in diameter, $\frac{5}{8}$ths of which space, in each, is covered by the projection of the stone. The radius of one of the quadrants, on which the hour lines are marked, from the outer part of the wall of the stile to the inner edge of the arc, is 9 feet and $\frac{3}{4}$ths of an inch; that of the other, 9 feet one inch. The width of the rim of the quadrants, which are inclined to a line perpendicular to the shadow falling from the gnomon, is 5 feet $10\frac{1}{4}$ inches. The quadrant is divided into 6 *gurries*, and each *gurry* into 10 *pulls*.

On the outer wall of the stile, fronting the east, at the

* The references are to the plates annexed to Sir ROBERT BARKER's account.

height of 10 feet and 10 inches from the base, are fixed two iron pins, each forming a centre, from which circular lines are drawn, intersecting each other, as in the annexed representation ;



with a parallel line drawn underneath, which has the hour, or *gurry* and *pull* lines marked on it. The wall is plastered ; and there are, on other edifices fronting the east, similar lines drawn ; the use of which, I understood, was to ascertain the time of the day.

B. An equinoctial dial, called *gentu-raje*.—It is a circular stone, fronting north and south, but inclining towards the south. The diameter of the south face is 2 feet $2\frac{3}{4}$ inches, a perpendicular line falling from the top will give one foot distance from the bottom of the inclined plane. In the south front of this stands a small stone pillar, distance 3 feet 8 inches ; a line drawn from the centre of this dial to the point on the top of the pillar, will, by its shadow, give the time of the day. On the *nadir* side of this dial, the stone is 4 feet 7 inches diameter ; on the centre of which is a small iron stile, with a hole in it, perpendicular to its plane ; and in the perpendicular line of the chord are placed two small irons. A line passing through the hole in the stile, and each end applied to the forementioned irons, gives a shadow, which denotes the hour, &c.

C. A brass circle in the line of the equator, facing north

and south. It has a moveable index, turning on a pivot in the centre; the circle is divided into 360 degrees, or *unse*, subdivided again into 60′, and again into 6″, and into $\frac{1}{4}$ths. This instrument is called *cund-brit*, or *cranti-brit*, but I could not learn the use of it.

D. A double circular wall, with a round pillar in the centre, as described by Sir ROBERT BARKER. The floor being broken, and uneven, renders the height of the outer wall irregular, but it measured from 8 feet 1 inch, to 8 feet 3 inches; diameter inside, 27 feet $6\frac{1}{2}$ inches; thickness of the wall, 2 feet. The inner wall is 18 feet within; thickness of this wall, 1 foot $5\frac{1}{2}$ inches. The diameter of the centre pillar, 3 feet $7\frac{1}{2}$ inches.

At the four cardinal points, on the top of the outer wall, are four iron pins, with small holes in them, through which, the Pundits say, wires are designed to be drawn at the time of observation, which wires intersect each other at the centre of the pillar. The tops of both the walls are graduated, or divided into degrees; and it is said, that by the shadow of these wires falling on the walls, the sun's declination is found.

In addition to the foregoing, which are described in the plates alluded to, on the south-east quarter of the building is a large black stone, 6 feet 2 inches diameter, fronting the west; it stands on an inclined plane. I could not learn the use of this instrument; but was informed that it never had been completed. There is no other building of any consequence, nor does it appear there ever was.

I fear, that from the want of sufficient knowledge of the science of astronomy, I have not been able to describe the

different instruments, and their uses, satisfactorily; however, you may rely on the measurements being taken with the greatest exactness.

For the following description I am indebted to our chief magistrate, the Nabob ALI IBRAHIM KAUN.

"The area, or space comprising the whole of the buildings and instruments, is called in Hindoo, *maun-mundel*; the cells, and all the lower part of the area, were built many years ago, of which there remains no chronological account, by the Rajah MAUNSING, for the repose of holy men, and pilgrims, who come to perform their ablutions in the Ganges, on the banks of which the building stands.

"On the top of this the observatory was built, by the Rajah JEYSING, for observing the stars, and other heavenly bodies; it was begun in 1794 Sumbut, and, it is said, was finished in two years. The Rajah died in 1800 Sumbut.

"The design was drawn by JAGGERNAUT, and executed under the direction of SADASHU MAHAJIN; but the head workman was MAHON, the son of MAHON a pot-maker of Jeypoor. The pundit's pay was five rupees per day; the workmen's two rupees, besides presents; some got lands, or villages, worth 3 or 400 rupees yearly value; others money."

I am, &c.

Benares
March 25, 1792.

J. LL. WILLIAMS.