CLASSICS OF SCIENCE: Stonehenge as an Observatory

Astronomy-Archæology

You can construct a primitive observatory by setting up sight-lines to mark the place where you observe the sun to rise on June 21, December 21, and the points half-way between, where the sun rises at the times of the equinox.

STONEHENGE and Other British Stone Monuments Astronomically Considered, by Sir Norman Lockyer, K. C. B., F. R. S. London, 1906.

The Agricultural Year

The early peoples have been very much misrepresented, and held to have been uninstructed, by several writers who have not considered what they were really driving at. It was absolutely essential for early man, including the inhabitants of Britain as it was then—townless, uncivilized—that the people should know something about the proper time for performing their agricultural operations. We now go into a shop and for a penny buy an almanack which gives us everything we want to know about the year, the month and the day, and that is the reason why so few of us care about astronomy; we can get all we want from astronomy for a penny or twopence. But these poor people, unless they found out the time of the year and the month and the day for themselves, or got some one to tell them—and their priests were the men who knew, and they were priests because they knew—had absolutely no means of determining when their various agricultural operations should take place. So that we find all over the world temples erected in the very first flash of civilisation.

On this a point comes in of very considerable interest. If we study the civilisations in Egypt, we find that, so far as we know, one of the first peoples who used this principle of orientation for agricultural purposes was some tribe that came down the Nile about 6400 years B. C. They used the star Canopus, and their determination was that of the autumnal equinox, which practically was the time when the Nile began to go down, and when their sowing might begin. There was another race who, instead of being interested in the sun, and therefore in agriculture, at the time of autumnal equinox, were interested in the year about the time of Easter as well. This race built the Pyramids about four thousand years B. C. There was an interval of about two or three thousand years between these races. As we shall see there were others, who at Thebes started the solstitial worship—that is to say, the worship of the sun at midsummer—and at Memphis in May, so as to enable them to go on with their agricultural operations with greater certainty.

TRILITHONS AT STONEHENGE. Although used for observing the summer solstice, Lockyer found indications that the inner ring of stones was set up for marking the farmers' year beginning with May

When we study the history of our own country—when we come back from Egypt to Britain, leaving alone Greece and Rome—we find that in various times in our country we have had a year, a farmer's year, beginning in the month of May; we have had another farmer's year beginning in the month of August; we have had another farmer's year beginning at the longest day; and it appears that the year beginning at the longest day was really the last year to be introduced. So that while we have in Stonehenge a solstitial temple—that is to say, a temple to make observations of the length of the year by observing the rise of the sun on the longest day of the year—in other parts of England there were other temples observing the sun, not on the 21st of June, but early in May and early in August.

Horizon for Reference

After Mr. Penrose, by his admirable observations in Greece, had shown that the orientation theory accounted as satisfactorily for the directions in which the chief temples in Greece had been built as I had shown it did for some in Egypt, it seemed important to apply the same methods of inquiry with all available accuracy to some example, at all events, of the various stone circles in Britain which have so far escaped destruction. Many attempts had been previously made to secure data, but the instruments and methods employed did not seem to be sufficient.

Much time has, indeed, been lost in the investigation of a great many of these circles, for the reason that in many cases the relations of the monuments to the chief points of the horizon have not been considered; and when they were, the observations were made only with reference to the magnetic north, which is different at different places, and besides is always varying; few indeed have tried to get at the astronomical conditions of the problem. . . .

In order to obtain some measurements to test the orientation theory in Britain, I found that Stonehenge is the ancient monument in this country which lends itself to accurate theodolite work better than any other.

Acting on a very old tradition, some people from Salisbury and other surrounding places go to observe the sunrise on the longest day of the year at Stonehenge. We therefore are (*Turn to next page*)

Stonehenge as an Observatory—*Continued*

perfectly justified in assuming that it was a solar temple used for observation in the height of midsummer. But at dawn in midsummer in these latitudes the sky is so bright that it is not easy to see stars even if we get up in the morning to look for them; stars, therefore, were not in question, so that some other principle had to be adopted, and that was to point the temple directly to the position on the horizon at which the sun rose on that particular day of the year, and no other.

Now, if there were no change in the position of the sun, that, of course, would go on for ever and ever; but, fortunately for archæologists, there is a slight change in the position of the sun, as there is in the case of a star, but for a different reason; the planes of the ecliptic and of the equator undergo a slight change in the angle included between them. So far as we know, that angle has been gradually getting less for many thousands of years, so that, in the case of Stonehenge, if we wish to determine the date, having no stars to help us, the only thing that we can hope to get any information from is the very slow change of this angle; that, therefore, was the special point which Mr. Penrose and I were anxious to study at Stonehenge, for the reason that we seemed in a position to do it there more conveniently than anywhere else in Britain.

But while the astronomical conditions are better at Stonehenge than elsewhere, the ruined state of the monument makes accurate measurements very difficult.

Economical Temples

Although I have before hinted that the astronomical use of the Egyptian temples and British circles was the same, there is at first sight a vast difference in the general plan of structure.

This has chiefly depended upon the fact that the riches and population of ancient Egypt were so great that the people could afford to build a temple to a particular star, or to the sun's position on any particular day of the year. The temple axis along the line pointing to the celestial body involved, then became the chief feature, and tens of years were spent in lengthening, constricting and embellishing it.

In Britain the case was different, there was neither skill nor workers sufficient to erect such stately piles, and as a consequence one structure had to do the work of several and it had to be done in the most economical way. Hence the circle with the observer at the centre and practically a temple axis in every direction among which could be chosen the chief directions required, each alignment being defined by stones, more or less distant, or openings in the circle itself.

Now for some particulars with regard to those parts of Stonehenge which lend themselves to the inquiry.

The main architecture of Stonehenge consisted of an external circle of about 100 feet in diameter, composed of thirty large upright stones, named sarsens, connected by continuous lintels. The upright stones formerly stood 14 feet above the surface of the ground. They have nobs or tenons on the top which fit into mortice holes in the lintels. Within this peristyle there was originally an inner structure of ten still larger upright stones, arranged in the shape of a horseshoe, formed by five isolated trilithons which rose progressively from N. E. to S. W., the loftiest stones being 25 feet above the ground. About one-half of these uprights have fallen, and a still greater number of the imposts which they originally carried.

There is also another circle of smaller upright stones, respecting which the only point requiring notice now is that none of them would have interrupted the line of the axis of the avenue. The circular temple was also surrounded by the earthen bank . . .of about 300 feet in diameter, interrupted towards the northeast by receiving into itself the banks forming the avenue before mentioned, which is about 50 feet across. Within this avenue, no doubt an old *via sacra,* and looking northeast from the center of the temple, at about 250 feet distance and considerably to the right hand of the axis, stands an isolated stone, which from a medieval legend has been named the Friar's Heel.

The axis passes very nearly centrally through an intercolumniation (so to call it) between two uprights of the westernmost trilithon as it originally stood. . . .

These earthen banks defining the avenue do not exist alone. . . . There is a general common line of direction for the avenue and the principal axis of the structure; and the general design of the building, together with the position and shape of the naos, indicates a close connection of the whole temple structure with the direction of the avenue. There may have been other pylon and screen equivalents as in other ancient temples, which have disappeared, the object being to confine the illumination to a small part of the naos. There can be little doubt, also, that the temple was originally roofed in, and that the sun's first ray, suddenly shining into the darkness, formed a fundamental part of the cultus. . . .

Date of Construction

There is a difference in treatment between the observations required for Stonehenge and those which are available for Greek or Egyptian solar temples. In the case of the latter, the effect of the precession of the equinoxes upon the stars, which as warning clock stars were almost invariably connected with those temples, offers the best measure of the dates of foundation; but in Britain, owing to the brightness of the dawn at the summer solstice, such a star could not have been employed, so that we rely only on the secular change of the obliquity as affecting the azimuth of the point of sunrise. . . .

It is to be understood that on account of the slight uncertainty as to the original line of observation and the very slow rate of change in the obliquity of the ecliptic, the date thus derived may possibly be in error by 200 years more or less; this gives us a date of construction lying between say 1900 and 1500 B. C.

Sir Joseph Norman Lockyer was born at Rugby, England, May 17, 1836, and died at Sidmouth in Devonshire, August 16, 1920. He was educated on the continent, and at 21 became a clerk in the War Office. He studied astronomy in his spare time, and at the age of 30 began to study sunspots with the spectroscope. This soon led him to the discovery of the method of studying solar prominences in full daylight with the same instrument. In the same year Lockyer discovered a bright yellow spectral line of an unknown element in the sun, and named the element "helium." In 1887, Lockyer published the results of his spectroscopic researches as "The Chemistry of the Sun," and in 1897 he published "The Sun's Place in Nature," which classifies the stars on the basis of the light they emit. In 1894, Lockyer turned his astronomical knowledge to the interpretation of archæology in his "Dawn of Astronomy." "Stonehenge," from which the accompanying classic is gleaned, is its sequel, in which the laws of orientation of the elaborate temples of Greece and Egypt are found to apply no less to the rude stone circles of primitive England.