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DUFINE TODAY'S TRAINING, I FTRST FELT TMAT TME ETTE MAD MOTION, MOVENENT, AND MOETLITY, I FELT A FAST MOTTON. I FELT THAT THE SITE WAS AIFY AND LIGHT. I FELT SFACIOLENESS AND VASTNESE. I ASSOCTATED ELACK AND NAVY BLUE WTTH THE GTTE: I ALSO ASSOCTATED WHITE AND TWTNFLTNG WITH THE STTE THE STTE HAD A VACLUM SOLIND, THE STTE WAS HAFD AND IT FEIT SMOGTH. I COULD ALSO FEEL SLTDTNG AND GLIDTNG. THE OVERALI FEELINE WAB CLEAN AND 1 COULD HEAR MUSTC SOLNDG: I FELT THAT THEFE WEFE OCOUFENOES HEFE, IN TWO AL BE'S, I OEJECTTFTED KUXUFTOUS AND WONDEFWUL.

THE STTE CONSTSTS OF A STFUOTUFE OR SEVERAL STFUCTUFES.
THE ETRUCTUFE WAS ROUND, HAFD, AND CUFVING. THE STRURTUFE WAS SCIENTIFTC AND A MUSEUM. I OEJETVIFIED ASTFONOMY " IN AN ADL BK, I DEJEWTTFTED BTG DTFPER,

I THEN OETERTTFIED BTG WHITE FTLIAFS.
I THEN OEJELTTFIED FEOFLE TN A LAFGE TOWN.
GOING BACK TO THE STFUOTUFE, $I$ OBUEGTFTED STUAYTNG, LEAFNTNG, KNDWILEDGE. AN TNSTTTUTE FACTUAL, TNFOFMATVE, HELPINE, WATCHTNG, TAKING NOTES, OESEFVTNG, FESEAFCHTNE, SUESTDTZING, HEAL TNE,

WHEN OEJEGTIFYING THE FEDFIE, I EATD THAT THEY WEFE TALKINE, WALKING, AND THEY WERE NICE AND CAFTNG. FEOFLEE BELIEVING. I OBJEGTTFTED YOUNE MEN.
$I$ ALSO DBJECTIFIED FEOFLE WOFEING, VTSTTTNG, HEFE ON VACATTON, AND FEOFLE WITH THETF FMMILTES, I COULD ALEO SMELI.

FGOD AND THE GTRLCTUFE WAS CLEAN. I mATD THAT THE ETTE WAS NOT AS PUCH FUN AS DTENEYLAND BUT NOT AS SERTOUS AS A SFACE MLSEUM.

I THEN OBAECTIFIED WHAT THE STFUCTURE LOOKGD LIKE. I GALD THAT THERE WERE TWD FOUND DF CTRCULAR FOFTIONE THAT WEFE LTNEED, LOCFED, FINGED OF TTED TOGETHER GTTMTNE ON A HABD GTFAIEMT, AND THICE BASE M THEFE WEFE WTNDOWS" THE STRUOTURE IS EASILY GEEN. IN AN AT EF, I SAID THAT THE STHUCTUFE WAS VEFY DECORATIVE AND VEFY AFTFUL. THE STRUCTUFE FEMTNDED ME OF NEW, MODEFN ARTn

I COULD THEN SEE FEOFLE OUTSTME THE STRUCTURE THEFE WAS A LDT OF ACTIVITY FEDFLE WEFE WITH CHILDREN ENJOYING THEMSEVEE AND THEY WEFE HAVING FUN. IT WAS WAFM AND HUMID AND HOT. THEFE IS WATEF NEAFBY, FEOFLE CDME HEFE ON VACATION: IN AN AOL BE: I DEJECTTF TED BALIOONS.

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THEFE AFE ANTVALS HERE TT IS VERY PLEMSANT HERE.

THE FILLAFS FEMINDED ME OF HTSTGFY MND THE STRUGTUFE RENTNDED ME OF A BCTENCE.

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## CPYRGHT <br> WHTO) RANSEDTHHEMBGAULIHS?



One of the mysteries of Slonebenge is bou' the buge stones were placed in position. The dranings belou' explain a possible method of ereciting atrilithon. For each of the uprights a bole is dug; then the slone is bauled into position on rollers, the boitom end is tipped into the bole.
and the stone is beated into rertical position by bundreds of men on long ropes. The lintel stone is iwen raised by levers, in small siages, as a platform is buili up under it; finally it is moved sideuays unilil morlises on its underside fit into the tenons on the tops of uprights.

The total lack of agreement among the experts hardly inspires confidence: if Stonehenge was so manifestly a structure designed for predicting eclipses, there should be at least some meeting of minds on how it was done. In 1857, in order to setcle whether cuneiform had really been deciphered, the Royal Asiatic Society challenged scholars to submit translations of a newly discovered inscription; four did so, the results were found so alike that there could no longer be room for doubr, and the issue was declared sertled. When the astronomers who have been studying Stonehenge come up with at least convergent ideas, then we may be readier to believe that its priests knew how to predict eclipses.
its original position, one is fallen flat, and two have disappeared.) Newham and Hawkins point out that the short sides of the rectangle are parallel with Stonehenge's main axis. So, when one looks along them to the northeast, one sights, just as along the axis, upon the point of midsummer sunrise. If one looks along them in the opposite direction, toward the southwest, one sights upon the point of midwinter sunset. And the line of the long sides marks, in the southeast direction, the southernmost point at which the full moon rises at midsummer, and, in the northwest direction, the northernmost point at which it sets at midwinter. Borh men were struck by the same idea as to why Salisbury Plain was chosen for

## veloped the skill to id

 erable accuracy.If, then, this uniqueOneqaii number of specific asगbo was set on a site deliberat tions, what of its humखer rel and alignments, even ta objects of veneration and astronomically useful? dropped by a Scot piofessor makes Hawkins' seem ©xe stream of articles bulk ander Thom has tried hirs and cromlechs of

tion to whatever religious p instruments for determining tings not only of the sun and 111. ?
conducted subsequently by such British antiquaries as John Aubrey, Sir Richard Colt Hoare, and William M. Flinders Petrie. The numbers ansigned by Petrie to the various holes and stones are still employed in identifying them.

Archaeological research has provided the most trustworthy evidence concerning not only the several phases of construction and their dates. bit also the cultures to which they belong. Interpreting the original function of Stonchenge is partly an archaeological matter and partly an astronomical problem. Scientific excavation and restoration began in the 20th century, especially with the work of William Hawley from 1919 to 1926. The most meticulous investigations were conducted jointly by Richard J. C. Atkinson, Stuart Piggott, and John F. S. Stone from 1950 to 1954. The result of these excavations was an extremely complicated picture of successive perods of construction.

Construction. The history of Stonehenge may be, divided into three main periods. The first major construction, or Period 1 , took place between 1900 and $1700 \mathrm{~B} . \mathrm{C}$. It was accomplished by people belonging to the secondary Neolithic culture, a blend of carlier hunting and gathering peoples and the first groups with an agricultural cconomy to appear in the British Isles. This construction consisted of a circular ditch and hank about 320 feet ( 97 meters) in diameter. broken by an entrance causeway from the northcast. Just inside the bank and concentric with it was lang a circle of 56 equally spaced holescalled the Aubrey holes for their 17 th centurs discoverer John Aubrey. The holes were filled with chalk rubble and, in some instances, with cremated human bones. Charcoal from one hole. yielded a radiocarlon date of 1548 a. C. 275 years. The 16 -foot ( 4.9 -meter) tall Heel Stome was erected at this time or earlier, a hort dis-

## stonehenge

tance outssde the ditch to the nortlacrast. The Heel Stone is a block of sarsen stome, a type of sandstone used for many of the larger stone elements in the monumen.

The structure of Period 11 (about 1700-1500 b. c.) does not now exist but can be inferred from the existence within the ditch and the Aubrey; hole circle of the " Q " and " R " hules. These holes form a double circle, 86 feet ( 26.2 meters) and 74 feet ( 22.5 meters) in diameter, each circle originally containing about 38 bluestones. Many of these stones were removed and used for later constructions. Two parallel ditches were dug outward from the main entrance, forming an avenue rumning northeast toward the point on the horizon at which the sum rises on midsummer day, or the summer solstice. Because of the absence of holes in the western part of the double circle, it would appear that Stonehenge II was never completed. The architects must have belonged to the Beaker culture, colonizers who came from the Europcan continent at the end of the Neolithic Period, for shards of Beaker pottery have been found in association with the traces of this structure.

Period III (about 1500-1400 в. c.) wituessed the final and most spectacular phases of construction. Once of the principal features is the $100-$ frot ( 30.5 -meter) circle of 30 sarsen stone columns. Each column weighs about 25 toms; measures absent 3 to 4 feet ( $0.9-1.2$ meters) thick. 7 feet ( 2.1 meters) wide, and 13 feet ( 4 meters) high; and is capped by a contimous circle of herizontal lintels held in position by mortise and tenon
joints. Within this circke so the central honvesthen of five sarsen trilithoms referect to previmuth, Other features, such as the circless of "Y"m and " $Z$ " toles outside the sarsen circle and a smith horsesslere of buestones within the trilithenn aniel appear to represent later modifications of at the plan. The largest of the bluestones, called thin Altar-Stome, now lies under two fallen trilitho.. stones. Its miginal location and function an unk nown. The builders of Stonchenge In wrill almost certainly members of the Early Broman Age Wessex culture, at the time one of the mond advanced European cultures outside of the Me Mo terranean arca. Other sites of this culture large ly graves, have produced bromze ax lilades ang other artifacts resembling strikingly in detail many objects from central Europe and M: cenaean Grecce. In 1953 a carving of a bromat dagger similar in form to those used at Myceran during the period of the shaft graves was fonnt on one of the sarsen stunes.

As for the construction techmiques of Stonir henge, much practical experimentation has bore done with simple equipment to determine pon sible metheds of transport and the size of than labor force needed to move and erect the lares sarsens. Geetogical studies have shown that thit sarsens came from Marlherough Downs. sante 24 miles ( 32 km ) north of Stonchenge. Thic hhoc stones were brought from the Prescelly Monn lains of southwestem H alcs, probably by sea and then overland by sledges rumning on rollers. I has been estimated that it might reguire upward of 500 mien to pull a 50 -ton stone up the steepes

outral homedne to premmens les of ". and le and a shall - trilithem are"a ications of the nes, called the. fallen trilithen 1 function are ronge In were Early Bronze oue of the most dar of the Medi. sculture largax blades and agly in detail. rope and My. ing of a bronze. aed at Mycomae aves was found igues of Stometation has beca deteminine pos. the size of the crect the large. shown that the Dowas, shue 20 nge. The blucrescelly Manably by sea and z on rollers. It teguire upwards up the steepest
slone along the ronte. Timber cribwork, lesers, and ropes were considered adeguate for raising stomes to rertical positions and placing lintels on the ir tops.

Function. The original function of this extrandinary momment has been the subject of much speculation. It has been thought of as a momment, fumeral or otherwise, to various legandary or historic personages. it hat also been considered to be the center of a religions cult. Becanse of it. orientation toward the rising sun, sciontists have scem it as an astronomical observatory of some kind. Archacologists are in general agreement that the site had both a religious and an astronomical function. It is likely that the monmment at Stonchenge, hallowed by its early use as a purcly religious structure, became modified gradually in its carly phases to perform astronomical functions as well-first to retord the advent of the summer solstice, then to predict sumrise, moonrise, and probably eclipses, all as part of a religions and agricultural ritual.

In 1963, Gerald Hawkins, an astronomer, used a computer to work out all obserations that could be made by sighting along and through the various markers, stone posts, and openings between uprights, including four "station" stone jocations that form a rectangle on the line of the Aubrey holes. His calculations indicated with almost perfect probability that Stonehenge carn be used as an astronomical instrument to predict accurately, with adjustment of movable marking stones once a year, the movements of both sum and moon as well as eclipses. Varions objections to the theory and its implications have been raised by atchacologists. One of the important ones is the unlikelihood of the existence of such a suplisticated device, requiring the passing on of accumulated obsenational data never a long period of time, in a culture that was otherwise on a considerably lower level of development than the heart of Bronze Age culture in the eastem Mediterrancan.

Donald F. Brown
Boston University
Further Feading: Atkinson, Richard J. C., Stonehenge (Macmillan 1956): Hawhins Gerald S. and White, John B., Stonelirnge Docuded (Doubleday 1965): Petre, William Flinders, Stonehcige (1881); Stone Toth F. S., Wessex Before the Celts (Praeger 1958)

STONE'S RIVER, Battle of, in the Amcrican Civil War, fought Dec. 31, J862-Jan. 2, 1863, about 30 miles ( 48 km ) sontheast of Nashville, Tenn. lt is often called the Battle of Murfreesboro. A hajd-fought but indecisive conflict, it had no apparent influence on the strategic situation, but President Abraham Lincoln observed that if the Union Ammy had been defeated, "the nation could scarcely have lived over it."

After Gen. Braxton Bragg led an unsuccessful invasion of Kentucky in the autumn of 1862, he retired to Murfreesboro, in southeastem Temnessee. Maj. Gen. W'illiam S. Rosecrans, the new commander of the Union Army of the Cumberland, was hased at Nashville. Eastem Temessee was favorably inclined to the Union, and the high command in Washington was determined to drive the Confederates from the region.

Guder strong pressure for action, Rosecrans led his army out of Nashville on Dec. 26, 1862. Rain, fog, and Confederate cavalry patrols hindered lis advance, and his leading elements did not approach Murfreesboro until the evening of the 29 th. The next day, the two amies con-
fronted cach other in strength. Renecrans had about 45.(K) ment Mrage a little less than 40.000.

Bragy deploved his forces astride the west fork of Stome's Rjecr, a few mikes mortherest of the town. The bulk of them were on the west bank, but one division, alkout 5,000 men, was on the east. Rosecrans concentrated entirely on the west side of the river.

The battle plans of the opposing commanders were identical in principle. Each planned to hold with his right wing and attack with his left wing, secking an envelopment of the enemy.

Brage struck first, about 6 A. M. on Der. 31 . Ile surprised the Union troops at the right end of the line; many were cooking breakfast. Hiw assault gathered momentum as reinforcements arrived. The Union right was bent back at right angles to the left, and by midaftermoon the Union army was compressed into a tight horseslioe with its back to the river.

But stout resistance and minor counterattacks had jolted the Confederates. Bragg called for the division on the east bank of the river to strengthen a last blow, but its commander did not move, fearing a Union attack. At a council that right, some Union generals wished to retreat to Nashville, but Rosecrans decided to hold.

On Jan. 1, there was little fighting. Both anmies were exhausted and bad suffered heavy losses. The next day, the only mportant action was east of the river, where a Enion force that had crossed there repulsed a Comfederate attack.

Bragg realized that Rosecrans had rexeived ammunition and supplies, and on Jar. 3 he withdrew through Murfreesh aro and pracerded south. Rosecrans cocupied the town but did not parsue his foe. The situation in Tomessee remained static for six months, but by holding fast Rosccrans had averted what would have been a serious defeat for the Union at that stage of the war.

The Union losses were about 12,800 men killed wounded, and missing. The Confederate casualties totaled about 11,600 . The Stones River National Battlefield now ocupies part of the battle site. In the Stones River (or Murfreeslome) National Cemetery are graves of soldiers of both amies.

STONEWARE is a hard, nonporous ceramic. It is made of a highly siliceors pacte, either a special clay or clay' mixed with other materials, such as ground fint, feldspar, or marble. The paste is fired at a high temperature urtil it vitrifies (fuses) to form a nomporous, glasss substance that gives a ringing somod when struck. Stoneware thus differs from soft. low-fired porous earthenware. It closely resembles hard, highfired, nowporons poncelain and is uftern called porcelanems ware. However, licause stoneware is usually heavy and opaque, with a bluish gray or reddish brown color, Westem authorities have tended to distinguish, if from porcelain, which they characterize as thin, translucent, and white.

Stoncuare may have incised impressed, or applied relief decorations. It may be unglazed, or it may be glazed to resist acidic liquids or for decoration. A thin, slightly pitted salt glaze is common. Thicker, colored lead glazes are also found.

Stonewares were made in Shang China before $1000 \mathrm{B}$. . Heavy, porcelancous stonewares of the Han, Tang, Sung, and Yuan dymasties had black or brown painted decoration or relief decoration with celadon green glaze. In the Ming period,

