dismantled walls, being content to pay tribute to each in turn and sometimes to more than one simultaneously, for which it indemnifies itself by peaceful intervals of trade whenever the land routes are open and the upper and lower reaches of the Niger are clear of pirates. But at times even the short tract separating it from Kabara is so beset with marauders that it bears the ominous name of “Ur-immandess,” that is, “He (God) hears not.” Recently, however, it has enjoyed a considerable interval of peace, and the population, estimated by Barth at 11,000 in 1853, had risen to 20,000 in 1880 (Lenz). These form a motley group of Sonrhais, Tuaregs, Mandingoes, Arabs from Mor­occo, Berabish Arabs, Bambaras, Fulahs, and since 1850 a few Jewish traders. Apart from some Christian captives, the place was reached during the 19th century by only four Europeans—Laing from Tripolitana (1826), who was murdered on his return journey, Caillié from the north (1828), Barth from central Sudan (1853), and Lenz from Morocco (1880). Since 1884, however, regular relations have been opened with the French on the upper Niger.

From the ruins covering extensive tracts on the north and west sides, it is evident that Timbuktu was formerly a much larger place than at present. Even the great mosque, which must at one time have stood in the centre, now lies near the outskirts, where its high but unsightly earth tower forms a striking landmark. The aggregate of mean hovels or mud houses of which the place consists is only relieved by a few structures of a better class. As in former times, a great staple of trade is salt from Taudeni and other parts of the Sahara, here exchanged with gold dust for kola nuts from the south, Manchester goods, and some other European wares, which with tea are imported from Morocco or penetrate from the British protected territories along the lower Niger. Cowries, slowly yielding to European moneys, are the chief currency. The local industries are mainly confined to some fancy and other leatherwork prepared by the Tuareg women. The local adminis­tration is in the hands of an hereditary kahia, a kind of mayor, descended from one of the Ruma families. The kahia is himself more or less under the control of a neighbouring Tuareg chief and of the powerful Bakhai family, who, as “sherífs” and marabouts, are revered throughout the western Sahara. Timbuktu, which possesses some valuable Arabic manuscripts and is still a centre of Moslem teaching, is a converging point of the chief west Sudanese and Saharan races—Arabs or Arabized Berbers to the west ; Sonrhais in the immediate vicinity, and thence south-eastwards along the Niger ; Ireghenaten or “ mixed ” Tuaregs southwards across the Niger as far as the Hombori Hills and in the fertile Libbako plains beyond them ; Fulahs, Mandingoes, and Bambaras in and about the city ; and Imóhag or Imósharh Tuaregs belonging to the Awellimiden confederation mainly to the north and east.

TIME, Measurement of. Time is measured by suc­cessive phenomena recurring at regular intervals. The only astronomical phenomenon which rigorously fulfils this condition, and the most striking one,—the apparent daily revolution of the celestial sphere caused by the rotation of the earth,—has from the remotest antiquity been employed as a measure of time. The interval between two successive returns of a fixed point on the sphere to the meridian is called the sidereal day; and sidereal time is reckoned from the moment when the “first point of Aries” (the vernal equinox) passes the meridian, the hours being counted from 0 to 24. Clocks and chrono­meters regulated to sidereal time are only used by astro­nomers, to whom they are indispensable, as the sidereal time at any moment is equal to the right ascension of any star just then passing the meridian. For ordinary pur­poses solar time is used. In the article Astronomy (vol. ii. p. 771) it is shown that the solar day, as defined by the successive returns of the sun to the meridian, does not furnish a uniform measure of time, owing to the slightly variable velocity of the sun’s motion and the inclination of its orbit to the equator, so that it becomes necessary to introduce an imaginary mean sun moving in the equator with uniform velocity. The equation of time *(loc. cit.,* pp. 772-773) is the difference between apparent (or true) solar time and mean solar time. The latter is that shown by clocks and watches used for ordinary pur­poses. Mean time is converted into apparent time by applying the equation of time with its proper sign, as given in the *Nautical Almanac* and other ephemerides for every day at noon. As the equation varies from day to day, it is necessary to take this into account, if the appar­ent time is required for any moment different from noon. The ephemerides also give the sidereal time at mean noon, from which it is easy to find the sidereal time at any moment, as 24 hours of mean solar time are equal to 24h 3m 56s∙5554 of sidereal time. About 21st March of each year a sidereal clock agrees with a mean-time clock, but it gains on the latter 3m 56s⋅5 every day, so that in the course of a year it has gained a whole day. For a place not on the meridian of Greenwich the sidereal time at noon must be corrected by the addition or subtraction of 9s∙8565 for each hour of longitude, according as the place is west or east of Greenwich.

While it has for obvious reasons become customary in all civilized countries to commence the ordinary or civil day at midnight, astronomers count the day from noon, being the transit of the mean sun across the meridian, in strict conformity with the rule as to the beginning of the sidereal day. The hours of the astronomical day are also counted from 0 to 24. An international conference which met in the autumn of 1884 at Washington, to con­sider the question of introducing a universal day (see below), has recommended that the astronomical day should commence at midnight, to make it coincide with the civil day. The great majority of American and Continental astronomers have, however, expressed themselves very strongly against this change; and, even if it should be made in the *British Nautical Almanac,* it appears very doubtful whether the other great ephemerides will adopt it, the more so as astronomers have hitherto felt no in­convenience from the difference between the astronomical and the civil day.

*Determination of Time.—*The problem of determining the exact time at any moment is practically identical with that of determining the apparent position of any known point on the celestial sphere with regard to one of the fixed (imaginary) great circles appertaining to the observer’s station, the meridian or the horizon. The point selected is either the sun or one of the standard stars, the places of which are accurately determined and given for every tenth day in the modern ephemerides. The time thus determined furnishes the *error* of the clock, chronometer, or watch employed, and a second determination of time after an interval gives a new value of the error and thereby the *rate* of the timekeeper.

The ancient astronomers, although they have left us very ample information about their dials, water or sand clocks *(clepsydræ),* and similar timekeepers, are very re­ticent as to how these were controlled. Ptolemy, in his *Almagest,* states nothing whatever as to how the time was found when the numerous astronomical phenomena which he records took place ; but Hipparchus in the only book we possess from his hand gives a list of forty-four stars scattered over the sky at intervals of right ascension equal to exactly one hour, so that one or more of them would be on the meridian at the commencement of every sidereal hour. In a very valuable paper@@1 Schjellerup has shown that the right ascensions assumed by Hipparchus agree within about 15' or one minute of time with those calculated back to the year 140 b.c. from modern star-places and pro­per motions. The accuracy which, it thus appears, could be attained by the ancients in their determinations of time

@@@1 “ Recherches sur l’Astronomie des Anciens : I. Sur le chronomètre céleste d’Hipparque,” in *Copernicus: An International Journal of Astronomy,* i. p. 25.