

worn out by age, and otherwise unsuitable, as the height of the Pole differed by  $4^{\circ}$ ; and so he constructed four instruments, of which three now remain. In the east end of the court is the equatorial armillary, which is made of bronze, and consists of (1) a massive horizontal circle, held up at four corners by four dragons, each of which with one upraised palm supports the bronze circle, while round the other palm a chain is passed and fastened behind to a small bronze pillar,—the dragons are themselves works of art; (2) a double vertical circle firmly connected with the horizontal circle at its north and south points, and supported at its lowest point by a bronze pillar. On the vertical circle, which, like the other, is fixed, at a distance equal to the latitude of Peking, that is  $40^{\circ}$ , are two pivots corresponding to the North and South Poles. Revolving round these pivots are two circles, one double, corresponding to the solstitial colure—that is, the great circle passing through the Poles and the solstices; the other single, corresponding to the equinoctial colure—that is, the great circle through the Poles and the equinoxes. Half-way between the Poles is another circle, which corresponds to the equator, the rim of which is let into the two colure circles. There is also another circle, making with the latter an angle of  $23\frac{1}{2}^{\circ}$ , and corresponding to the ecliptic. Finally, inside these circles, all of which revolve together round the polar axis, there is another double circle, representing the polar circle or declination, and between the rims of this double circle revolves the hollow tube through which observations were made. It is probable that there were originally threads across the tube to define the line of sight. There are in the circles  $365\frac{1}{4}^{\circ}$ —that is, a degree for each day in the year—and each degree is subdivided into divisions of  $10'$  each. When using this instrument the observer turned round the inner circle till the heavenly body was sighted in the centre of the tube, and then the distance of the star was read from the Pole on the polar circle, and its position on the equator by the equatorial circle. The complex construction was in some particulars of no use whatever: the ecliptic and one of the colures were useless. At the west end of the court are the other two instruments, the equatorial, or astrolabe, and the altitude and azimuth instrument. The former is remarkably simple in its construction. There is a fixed bronze circle placed parallel to the equator, and there is another double circle perpendicular to it, which moves round an axis passing through the centre of and perpendicular to the equatorial circle. Of course there is also the hollow tube for observation. This instrument is free from the clumsiness and complexity of the first-named instrument, and in the form of its mounting much more closely resembles those in use at present in all Observatories than the other instruments. The altitude and azimuth instrument consists of two circles, one horizontal and fixed, the other vertical and movable round an axis passing through the centre of the horizontal circle, and was used to observe the altitudes of the heavenly bodies and their distances from the north and south points. It is curious to observe that all these instruments are exactly similar to those constructed by Tycho Brahé, the great Danish astronomer, who was the first European to make astronomical instruments of metal. And thus we see that the Chinese anticipated European astronomers by at least three centuries, and that the former had at that very early date attained great proficiency both in the science of astronomy and the art of metal-carving. Verbiest, the Jesuit father, says that these instruments had, at the beginning of the present dynasty, fallen into disrepair. The truth was that they were far too clumsy, and were so heavy that it took several men to move them; and in some positions, from the profuseness of ornament, the stars could not be observed at all. Besides they had got out of position, and there were no appliances for righting them. It is more than probable that during the latter part of the Ming dynasty astronomy had been neglected, and so the old instruments fell into disuse. In the year 1670, so bad were the old instruments, that Verbiest was ordered to make six new instruments. It appears that when the high Ministers of State were ordered to go to the Observatory, and make certain observations, the calculations of Verbiest were verified as correct, while those of Wu Ming Hsuen, the Chinese astronomer, were proved to be wrong. And so Verbiest was intrusted with the calculation of the calendar and the construction of these instruments, which were of the same general character as the old instruments, but much more accurate, and more easily adjustable. The circles are divided into  $360^{\circ}$ , and each degree into six parts of  $10'$  each. By means of the diagonal scale and a movable divided scale, the observer could, on the new instruments of Verbiest, read to  $15''$ , instead of  $10'$  as in the old instruments. Since the time of Verbiest two more instruments have been added—namely, an

altitude and azimuth instrument, in the fifty-fourth year of Kang Hsi (1715), the other an equatorial armillary in the ninth year of Khien-Lung (1745). The former is said to have been a present from Louis XIV. to the emperor, but by some it is attributed to a German Jesuit, named in Chinese Kilian, and is remarkable for the total absence of ornamentation, and for the degrees being marked in foreign numerals. One of the most curious objects in the Observatory is the Qw'ei Ying T'ang, a three-roomed building lying a few yards to the south of the steps. It is evidently very old. In it is a stone slab 16 feet 2 inches long and 2 feet 7 inches broad, with a groove on both sides, and raised about 3 feet above the ground. At the south end of the slab is a brass pillar, which was formerly 8 feet high, but to which the present dynasty have added 2 feet more, extending to the roof, and at its summit is a small circular hole  $\frac{1}{8}$  inch in diameter. Another brass pillar 3 feet 5 inches high stands at the north end of the slab. At noon the sun shines through the little hole in the roof, and throws an elliptical shadow of the sun on the slab, or on the brass pillar at the north end about the winter solstice. By observing the distance of the sun's image from the foot of the south brass pillar the solstices and equinoxes were determined. For instance, at the summer solstice the distance should be 2 feet 9 inches. The instruments of Verbiest are almost perfect of their kind, and will remain a lasting memorial of the industry and genius of the devoted missionary. At the time that he made them they were growing out of date in Europe. The telescope had already begun to be used largely in astronomical observations, and Verbiest must have known of it. The question arises, How does it happen that the Chinese, who in the thirteenth century were far ahead of Europe in the construction of these instruments, seem to have made no headway since? Many reasons can be given, but the chief one is that with them the main object of making astronomical observations was to regulate the calendar, and to give the time to the people; and for this accurate instruments were not needed, and their want was never felt. The greater problems of the heavens never seriously attracted the attention of the Chinese astronomers. The Astronomical Board consists of eighteen officials, with the fifth prince, an uncle of the emperor, at their head. There are, including students, altogether 196 persons attached to the Board. The privilege of becoming a member of this Board has become hereditary, though it is not of necessity so. The policy, however, pursued by the Board, of keeping secret the book tables of the sun and moon, and everything used in regulating the almanac, tends to encourage the hereditary principle. No one can see them but the relatives of the Board; and so vacancy after vacancy is filled up by members of the same family as the predecessor, and as the office is an honorary, and not a lucrative, one, the people do not grumble at their exclusion. The principal duty of this Board is to prepare the calendar, the most important book published in China. Besides astronomical facts, it gives the lucky and unlucky days, on the latter of which no Chinese will transact the least business. Another duty is to observe eclipses, and this appears to be the only occasion on which the instruments are still used. On every New Year's Eve, at midnight, astronomers from the Board seat themselves in the Observatory, and watch the way in which the wind blows a number of banners which are hung around. As the wind blows, so will the new year be. This year the wind blew from the north-east, the fortunate direction, and therefore it will be a year of long life and plenty.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following were elected Fellows of St. John's College at the annual election on November 5: W. N. Roseveare, B.A. (mathematics), Master at Westminster; E. H. Acton, B.A. (botany and chemistry); F. W. Hill, B.A. (mathematics); T. Darlington, B.A. (philology), University Scholar, London, Head Master of Queen's College, Taunton, author of "The Folk-Speech of South Cheshire"; H. F. Baker, B.A. (mathematics), bracketed Senior Wrangler in 1887.

#### SOCIETIES AND ACADEMIES.

LONDON.

Mineralogical Society, October 30.—Anniversary Meeting.—Mr. L. Fletcher, President, in the chair.—The Hon. Secretary, Mr. Scott, read the Annual Report, which showed that the