is mounted on a forked piece or other similar contrivance attached to a prolongation of the upper pivot of the polar axis ; the tele­scope is mounted between the pivots of the declination axis. (E) The eye-piece of the telescope is placed in the upper pivot of the polar axis ; a portion or the whole of the axis of the telescope tube coincides with the polar axis. Mountings of types A and B —that is, with a long polar axis supported at both ends—are often called the “English mounting,” and types C and D, in which the declination axis is placed on the extension of the upper pivot of the polar axis, are called the “German mounting,” from the first employment of type C by Fraunhofer. A description of some of the best examples of each type will illustrate their relative advan­tages or peculiarities.

Fig. 15 may be taken as a practical example of the earlier equa- torials as made by Troughton in England and afterwards by Gambey for various Continental observatories. In the *Phil. Trans.* for 1824 (part 3, pp. 1-412) will be found a description by Sir John Herschel and Sir James South of the equatorial telescope which they em­ployed in their measurements of double stars. The polar axis was similar in shape to that of fig. 15 and was composed of sheets of tinned iron. In Smyth’s celebrated Bedford telescope the polar axis was of mahogany. Probably the best example of this type of mounting applied to a refractor is that made by the elder Cooke of York for Mr Fletcher of Tarnbank ; the polar axis is of cast iron and the mounting very satisfactory and convenient, but unfortunately no detailed description has been pub­lished. In recent years no noteworthy refractors have been mounted on this plan ; but type A has been chosen by Grubb for the great Mel­bourne reflector, with marked ingenuity of adaptation to the peculiar requirements of the case. Fig. 16 shows the whole instrument on a small scale, and fig.

17 represents part of it on a larger scale, the upper part of the tube and polar axis being omitted. The figures show the telescope directed to the pole, the hour circle being set 6h from the meridian. The polar axis consists of a hollow cone C (fig. 17) of cast iron bolted to a hollow cast-iron cube H, to the lower side of which is attached a short steel axis carrying the driving sector EF and the hour circle R, and terminating in the lower pivot of the polar axis. This pivot *a* is terminated by a piece of chilled cast iron polished flat on its lower face, which face re­volves in contact with a piece of bell metal, flat on its upper and partly spherical on its lower side, bearing in a correspondingly shaped annulus, formed to receive it in the cast-iron block which is attached to the pier. This arrangement enables the bell-metal cushion to take its own position when the direc­tion of the polar axis is slightly changed in pro­cess of adjustment. The pressure of the pivot on tion axis. The counterpoise U is attached to the other extremity. There is an elegant ar­rangement for diminishing the friction of the declination axis, which our limits do not per­mit us to describe, and the means for clamping and giving slow motion in declination do not require special notice. The reader is referred for a fuller description to *Phil. Trans.,* 1869, pp. 127-161. The telescope is of the Cassegrain form, the mirror having a 4-feet aperture and 30½-feet focal length.

The best existing examples of type B are Airy’s equatorial at Greenwich, the equatorial at Liverpool (also designed by Airy), and the photographic equatorial recently erected at the Paris observatory. The polar axis of the Greenwich equatorial consists of six iron tubes arranged so as to form two triangular braced beams connected by very strong elliptical wheels of cast iron, which carry the upper and lower pivots of the polar axis. These tubes are shown in sec­tion at the points T, fig. 18, which represents a section through the declination axis in the plane of the equator when the tele­scope is directed to a star at the equator (for the general arrange­ment of the mounting, see fig. 19). The driving circle is 6 feet in diameter, and turns freely on the lower pivot of the polar axis, under the action of the driving clock. The hour circle is graduated on the driving circle, and may be set to show sidereal time during its bearings, in the direction at right angles to the polar axis, is relieved by the sector A, whieh is forced up by the screw *d* acting through laminæ of steel springs. The end pressure of *a* upon its

bearings is relieved by a weight. The friction of the upper pivot is re­lieved by a sector pressed up against it by the action of two weights. In this way, although the moving part of the telescope weighs 18,170 lb, it can be turned with a pressure of 12½ lb, acting at a radius of

20 feet. The driving sector EF is 5 feet in radius ; its circular rim is accurately toothed to fit a square threaded endless screw E, which is turned by the driving clock. A toothed wheel attached to H and acted on by a pinion connected with a hand-wheel affords an easy means of setting the instrument in hour angle, or moving the telescope quickly in right ascen­sion. The telescope is clamped by iron bands to the strong cast-iron cradle, which is cast with and forms one extremity of the declina-

the whole of a night’s work ; thus the observer, in order to direct the instrument on a parti­cular object, has only to set an index connected with the polar axis to the star’s right ascension

upon the hour circle, without the trouble of computing the hour angle at the instant of observation. This convenient arrangement was first introduced by Airy. The whole mounting is very massive, but very incon­venient to use when a great many different objects have to be examined on the same night ; but on ac­count of its freedom from tremor and the excellence of its driving clock it should be very suitable for pro­longed study of a single object or for long photo­graphic exposures.@@1 Quite recently Sir Howard Grubb has signed a contract to make a telescope of 28-inches aperture and 28-feet focal length,@@2 which is to be substituted for the present tele­scope by Merz & Son of 12¾-inches aperture and 18-feet focus. Fig. 19 is engraved from a photograph of the model of the original polar axis. The model was prepared to illustrate the manner in which the new telescope is to be mounted, and we are indebted for the picture

@@@1 See the detailed account in *Greenwich Observations,* 1868.

@@@2 This object-glass will have the shortest proportional focal length of any yet constructed of aperture exceeding 16 inches. The following table gives the focal length in apertures of the largest existing refractors :—

Vienna telescope (Grubb) 27-inches aperture, focal length 15∙5 apertures Washington „ (Clark) 26 ,, ,, 15∙0 „

Pulkowa „ (Clark) 30 „ „ 18∙0 „