In the Ordnance survey, all the bases, excepting the re­cent one in Ireland, were measured with a steel chain, which was compared from time to time, generally before and after the operation, with a similar steel chain of 100 feet, which was not otherwise used in the measurement. The primary measure in this case was a brass standard forty-inch scale, belonging to Mr Ramsden, and not Ge­neral Roy’s. From this standard, six lengths of forty inches were transferred, by means of the beam-compass, to a prismatic bar of cast iron, into which brass points were inserted at the proper distances, so that the bar formed a measure of twenty feet. In order to transfer this to the steel chain, a portion of the chain was placed on rollers exactly parallel to the iron bar, and stretched, as in the measurement of the several bases, with a weight of fifty-six pounds. From the extreme points on the edge of the bar, marking the distance of twenty feet, fine wire plummets were suspended, so as nearly to touch the chain. One end of the chain, determined by a fine line drawn on the brass handle, being then brought under the wire by means of an adjusting screw, a point coinciding with the other wire was made in the chain. This part of the chain was then shift­ed, and another twenty feet measured in the same manner ; and thus the whole chain was determined at five successive operations.

The brass scale which was used in this operation is sup­posed to be lost, but the prismatic bar is still in existence, and forms, therefore, the only authentic standard of the sur­vey, the standard steel chain being probably liable to some alteration from rust or wear at the joints. This bar was also examined by Captain Kater, who found the mean yard on it to be equal to 36·00254 inches of Shuckburgh’s scale. Assuming this determination to be correct, it follows that every distance given in the Ordnance survey, in order to be expressed in terms of Shuckburgh’s scale, must be multi­plied by ∙9999694. Now the Hounslow Heath base was found by the measurement with the steel chains to be 27,404·3165 feet of Ramsden’s standard scale. The length, therefore, in terms of Sir George Shuckburgh’s scale, is 27,402∙38 feet.

It thus appears that the two measurements of this im­portant base, when reduced to the same standard, give the following results :

with the glass rods 27,403∙38 feet,

with the steel chain 27,402∙38 feet.

The difference is one foot, which is larger than can well be considered probable, supposing the steel measuring chain to have been exactly five times the length of each of the glass rods. In the account of the survey, the difference is stated to be 2¾ inches ; but this was on the supposition that the two standards were precisely of the same length.

Prior to Captain Kater's experiments, it had been assumed, from some comparisons with an intermediate scale belong­ing to the Royal Society, that Ramsden’s scale exactly agreed with General Roy's. The latter states (Trigono­metrical Survey, vol. i. p. 16), that he placed the two scales (his own and the Society’s) together on a table with thermometers alongside, and that after they had remained in this position two days, Mr Ramsden carefully took a lengtl) of three feet from the Royal Society's standard with his beam-compasses, and applied it to the other scale, and it was found to reach *exactly* to thirty-six inches, the temperature being 65°. In like manner, when the length

of the steel chains was determined, Mr Ramsden com­pared his own brass standard with that of the Royal So­ciety, “ and after the two standards had been allowed to remain together about twenty-four hours, they were found to be *precisely* of the same length.” The temperature is not stated. Now this perfect agreement leads to the in­ference that the comparisons were not made with the re­quisite care, or that the means employed were insufficient,@@1 In fact, it was found by Captain Kater, that the difference between General Roy’s scale and that of the Royal Society amounted to ·00047 of an inch ; a quantity, however, with­in the limits of the distance measurable with the beam-compasses. The principal cause of the difference between the two determinations of the base may probably be ascrib­ed to errors committed in transferring the length of the scale to the twenty-feet iron prism ; and perhaps also in part to an erroneous comparison of this rod with Shuck­burgh’s scale ; for it is said that the points on the brass pins inserted in the rod are so worn and enlarged by the appli­cation of the beam-compass as to render any exact com­parison impossible.

the standard measure of the Irish base is a distance of ten feet, defined by two fine points on a bar of cast. iron. We arc not acquainted with the length of the mean foot in terms of Shuckburgh’s scale ; but as none of the results yet published are given in terms of this base, its accurate length, in relation to other standards, is at present unim­portant.@@5

*Of the Selection of the Stations tend the Signals.*

In conducting a survey over an extensive country, the choice of stations must in a great measure be determined by the nature of the ground ; for it Is obvious that sig­nals can only be erected at places mutually visible from each other. But although the natural irregularities of the surface of the ground render an entirely arbitrary dispo­sition of the signals impracticable, there will frequently be room for a choice between two or more points ; and it is therefore important to determine the conditions which must be fulfilled, in order that the inevitable errors of ob­servation may have the least effect on the measured dis­tances.

Let A, B, C be the three angles of a triangle, and *a, b, c* the sides respectively opposite. In each case the data are the three angles, and one of the sides, as *a ;* and the ele­ments to be calculated are *b* and *c,* the remaining Sides. the question therefore is to determine the species of tri­angle, in order that the computed lengths of *b* and *c* may be the least affected by small indeterminate errors in the measurement of the angles. Suppose each of the angles to have been observed, and let the errors of observation be respectively *α*, *β, γ.* When the sum of the observed angles differs from 180°, or rather from 180° + the spherical excess, each angle is corrected by applying to it one third of the excess or defect. After the angles have thus been corrected, they still remain affected with the errors of ob­servation ; but as the sum is now correct, it is plain that the sum of the errors is nothing, or that *α* + *β* + *γ =* 0, and consequently *α = —* (*β* + *γ*). Now, putting the given side *a* = 1, the side *c* is found in parts of *a* from the for-

,\*\*\*\*\* sin. (C -fr 7) sin. C cos. y -fr cos. C sin. *y* mula *c = . ; 1 = -,—-* <—J- —.... ' ∙ and

sin. (A -fr α) sin. A cos. a -fr cos. A sin. a

@@@1 On this subject, see an excellent paper by Mr Baily in the ninth volume of the Memoirs of the Royal Astronomical Society.

@@@\* In the article Figure of the Earth, the lengths of the English arcs of meridian are copied from the Trig. Survey, and are conse­quently expressed in feet of Ramsden's standard scale, while all the foreign measurements, as well as those of the Indian arcs, are in feet of Shuckburgh’s scale reduced according to the comparative values of the different standards given by Captain Kater. This inadvertence does not affect the values there given of the earth's axes, and the lengths of the equatorial and meridional degrees, all of which are understood u» be expressed in feet of Shuckburgh's scale