SURVEYING.

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HE system of rules and operations by which the rela­tive position of any number of points in a tract of country may be determined, so that it may be delineated on a plane surface, is called surveying. When the extent of country is not great, the subject involves little difficulty ; but when a kingdom, such as Britain or France, is to be sur­veyed, in addition to some of the more profound theories of pure mathematics, the aid of astronomy, and other branches of natural philosophy, is required ; but such an extensive view of the subject will not be expected in this work.

As a surveyor has perpetual occasion for calculation, it is necessary that he be thoroughly master of arithmetic, and understand the nature of logarithms, the use of logarithmic tables, and algebraic notation. As it is his business to in­vestigate and measure lines and angles, and to describe them on paper, he should be well acquainted with the ele­ments of geometry and trigonometry, and with the applica­tion of their principles to the mensuration of heights, dis­tances, and surfaces. In particular, he should be familiar with the best practical methods of solving the ordinary geo­metrical problems, and should be expert in drawing lines and describing figures. He should know something of the principles of geology, optics, and magnetism, and possess some skill in drawing and painting.

In a survey, the most remarkable objects, such as the summits of hills, spires, towers, &c. must be chosen as sta­tions, and, if necessary, marked by signals. These must be considered as joined by straight lines forming a chain of triangles, each connected with all the others. Thc angles of the triangles should neither be very acute nor very ob­tuse ; their sides should be as long as possible, so as to ad­mit of two of the stations, at the angles, being seen from the third: the nearer each triangle approaches to the equi­lateral form, the better. The three angles of each triangle should be measured, if possible, for although two of them be sufficient to determine the third, yet it will conduce to accuracy if all the three be taken ; and if their sum hardly differ from 180°, it may be supposed that they have been correctly determined. The principal points should also be intersected as much as possible by lines from different sta­tions, to ascertain whether different data give the same po­sition.

A theodolite is the most convenient instrument for mea­suring thc angles, because it gives them at once reduced to the plane of the horizon. When a sextant is used, the angles, if out of that plane, must be reduced to it by cal­culation.

Supposing a proper disposition of the triangles to have been made, when their angles are known, if a side of any one of them were also known, then the sides of all the others might be found by calculation, and a plan of the country constructed. Therefore, a side of one of the triangles must be taken as a base, and measured with great care, for upon this the just determination of the absolute length of all the other lines depends ; and if the survey be extensive, it will be proper to assume another base, called a base of verification, and compare its measured with its calculated length. The base should be as long as possible, and lie on a flat surface; if it is not perfectly level, its slope must be measured, and its horizontal length calculated. In ordinary cases, the base may be measured by a chain or tape, but more accu­rately by stretching a rope, 100 yards or more, tight in its direction, and applying repeatedly to it a twenty-feet deal-rod. A pin may be stuck in the rope at the fore-end of the rod, each time it is removed, and before the rope is removed to a new position : a point directly under the end of the last rod may be marked on the top of a peg fixed in the ground. In the trigonometrical survey of Britain, which has been going on ever since 1784, under the direc­tion of the Board of Ordnance, an original base of about five miles was measured three times over, first with twenty-feet deal-rods, then with glass rods of the same length, and at a later period by a hundred feet steel chain of a particular construction. Several bases of verification have