book was published in four volumes, the first of which appeared in 1816, and the last in 1840, after the author’s death. The work contains a large amount of genealogical and antiquarian infor­mation; it is written in a readable style, and its learning is enlivened by humour. Surtees had also a gift for ballad writing, and he was so successful in imitating the style of old ballads that he managed to deceive Sir Walter Scott himself, who gave a place in his *Minstrelsy of the Scottish Border* to a piece by Surtees called “ the Death of Featherstonehaugh,” under thc impression that it was ancient. Surtees, who in 1807 married Anne Robinson, died at Mainsforth on the 11th of February 1834. As a memorial of him the “ Surtees Society ” was founded in 1834 for the purpose of publishing ancient unedited manuscripts bearing on the history of the border country.

See G. Taylor, *Memoir of Robert Surtees,* with additions by J. Raine (Surtees Society, London, 1852).

**SURTEES, ROBERT SMITH** (1803-1864), English novelist and sporting writer, was the second son of Anthony Surtees of Hamsterley Hall, a member of an old Durham family. Educated to be a solicitor, Surtees soon began to contribute to the *Sporting Magazine,* and in 1831 he published a treatise on the law relating to horses and particularly the law of warranty, entitled *The Horseman’s Manual.* In the following year he helped to found the *New Sporting Magazine,* of which he was the editor for the next five years. To this periodical he contributed between 1832 and 1834 the papers which were afterwards collected and published in 1838 as *Jorrocks’s Jaunts and Jollities.* This humorous narrative of the sporting experiences of a cockney grocer, which suggested the more famous *Pickwick Papers* of Charles Dickens, is the work by which Surtees is chiefly re­membered, though his novel *Handley Cross,* published in 1843, in which the character of “ Jorrocks ” is reintroduced as a master of fox-hounds, also enjoyed a wide popularity. The former of these two books was illustrated by “Phiz” (H. K. Browne), and the latter, as well as most of Surtees’s subsequent novels, by John Leech, whose pictures of “ Jorrocks ” are everywhere familiar and were the chief means of ensuring the lasting popu­larity of that humorous creation. In 1838, on the death of his father, Surtees, whose elder brother had died in 1831, inherited the family property of Hamsterley Hall, where he lived for the rest of his life. The later novels by Surtees included *Hillingdon Hall* (1845), in which “Jorrocks” again appears; *Hawbuck Grange* (1847); *Mr Sponge’s Sporting Tour* (1853); *Ask Mamma* (1858); *Plain or Ringlets?* (1860); *Mr Pacey Romford’s Hounds* (1865). The last of these novels appeared after the author’s death, which occurred on the 16th of March 1864. In 1841 he married Elizabeth Jane, daughter of Addison Fenwick of Bishop­wearmouth, by whom he had one son and two daughters, the younger of whom, Eleanor, in 1885 married John Prendergast Vereker, afterwards 5th Viscount Gort.

See R. S. Surtees, *Jorrocks’s Jaunts and Jollities* (London, 1869), containing a biographical memoir of the author; W. P. Frith, *John Leech, His Life and Work* (2 vols., London, 1891); Samuel Halkett and J. Laing, *Dictionary of Anonymous and Pseudonymous Literature of Great Britain* (4 vols., Edinburgh, 1882-1888).

**SURVEYING,** the technical term for the art of determining the position of prominent points and other objects on the surface of the ground, for the purpose of making therefrom a graphic representation of the area surveyed. The general principles on which surveys are conducted and maps computed from such data are in all instances the same; certain measures are made on the ground, and corresponding measures are protracted on paper on whatever scale may be a convenient fraction of the natural scale. The method of surveying varies with the magnitude of the survey, which may embrace an empire or represent a small plot of land. All surveys rest primarily on linear measurements for the direct determination of distances; but linear measure­ment is often supplemented by angular measurement which enables distances to be determined by principles of geometry over areas which cannot be conveniently measured directly, such, for instance, as hilly or broken ground. The nature of the survey depends on the proportion which the linear and angular measures bear to one another and is almost always a combination of both.

*History.—*The art of surveying, *i.e.* the primary art of map-making from linear measurements, has no historical beginning. The first rude attempts at the representation of natural and artificial features on a ground plan based on actual measurements of which any record is obtainable were those of the Romans, who certainly made use of an instrument not unlike the plane-table for determining the alignment of their roads. Instruments adapted to surveying purposes were in use many centuries earlier than the Roman period. The Greeks used a form of log line for recording the distances run from point to point along the coast whilst making their slow voyage from the Indus to the Persian Gulf three centuries b.c.; and it is improbable that the adaptation of this form of linear measurement was confined to the sea alone. Still earlier (as early as 1600 b.c.) it is said that the Chinese knew the value of the loadstone and possessed some form of magnetic compass. But there is no record of their methods of linear measurements, or that the distances and angles measured were applied to the purpose of map-making (see Compass and Map). The earliest maps of which we have any record were based on inaccurate astronomical determinations, and it was not till medieval times, when the Arabs made use of the Astrolabe *(q.v.'),* that nautical surveying (the earliest form of the art) could really be said to begin. In 1450 the Arabs were acquainted with the use of the compass, and could make charts of the coast-line of those countries which they visited. In 1498 Vasco da Gama saw a chart of the coast-line of India, which was shown him by a Gujarati, and there can be little doubt that he benefited largely by information obtained from charts which were of the nature of practical coast surveys. The beginning of land surveying (apart from small plan-making) was probably coincident with the earliest attempts to discover the size and figure of the earth by means of exact measurements, *i.e.* with the inauguration of geodesy (see Geodesy and Earth, Figure of the), which is the fundamental basis of all scientific surveying.

*Classification.—*For convenience of reference surveying may be considered under the following heads—involving very distinct branches of the art dependent on different methods and instru­ments@@1:—

1. Geodetic triangulation. 5. Traversing, and fiscal or revenue

2. Levelling. surveys.

3. Topographical surveys. 6. Nautical surveys.

4. Geographical surveys.

I. Geodetic Triangulation

Geodesy, as an abstract science dealing primarily with the dimensions and figure of the earth, may be found fully discussed in the articles Geodesy and Earth, Figure of the; but, as furnishing the basis for the construction of the first framework of triangulation on which all further surveys depend (which may be described as its second but most important function), geodesy is an integral part of the art of surveying, and its relation to subsequent processes requires separate consideration. The part which geodetic triangulation plays in the general surveys of civilized countries which require closely accurate and various forms of mapping to illustrate their physical features for military, political or fiscal purposes is best exemplified by reference to some completed system which has already served its purpose over a large area. That of India will serve as an example.

The great triangulation of India was, at its inception, calculated to satisfy the requirements of geodesy as well as geography, because the latitudes and longitudes of the points of the triangulation had to *be* determined for future reference by process of calculation combining the results of the triangulation with the elements of the earth's figure. The latter were not then known with much accuracy, for so far geodetic operations had been mainly carried on in Europe, and additional operations nearer the equator were much wanted; the survey was conducted with a view to supply this want. Thus high accuracy was aimed at from the first.

Primarily a network was thrown over the southern peninsula. Thc triangles on the central meridian were measured with extra care and checked by base-lines at distances of about 2° apart in

@@@1 The subject of tacheometry is treated under its own heading.