As in the case of aqueous solutions, the solubility of the precipitate is diminished by adding excess of the precipitant. When dry hydrogen sulphide is passed into benzene solutions of the oleate of copper, nickel or cobalt, the sulphides of the metals are at once thrown down. If these solutions are first saturated with hydrochloric acid so as to precipitate the chlorides and then saturated with dry hydrogen sulphide, the sulphides do not form. Stannic chloride dissolved in benzene was treated with dry hydrogen sulphide in large excess without any visible formation of sulphide; but on standing overnight there was a copious precipitate. Arsenic trichloride in benzene showed a similar reluctance to form sulphide, but when petroleum ether was used as a solvent the formation was almost instantaneous.

Hughes has found that dry hydrochloric acid will not react with dry ammonia, a fact which the author has confirmed. Yet when anhydrous benzene is treated with hydrochloric acid dried over sulphuric acid and phosphorus pentoxide, and then ammonia (evolved by heating lime mixed with ammonium chloride and dried by passing through a tower of lime and one of dry pumice covered with phosphorus pentoxide) is passed into the solution, a white, bulky precipitate of ammonium chloride at once forms; the benzene vapours are enough to cause the reaction to take place. Neither of the solutions, nor the mixture, conduct better than benzene itself, nor is there any change of conductivity at the instant of mixing. Similarly, when anhydrous pyridine is mixed with benzene, the solution is a non-conductor. But when such a solution is mixed with a solution of hydrochloric acid in benzene there is at once formed a heavy precipitate of the hydrochloride.

We must therefore conclude that instantaneous chemical reactions are possible with non-conducting solutions as well as with electrolytes. W. R. C.

A MEDIÆVAL TREATISE ON SURVEYING.

PROF. HAMMER, of Stuttgart, who has from time to time published interesting contributions to the history of geodesy and of surveying instruments, has given in a recent number of the *Zeitschrift für Vermessungswesen* a detailed account of Reinhold's treatise on surveying and mine surveying, a little-known work that enjoyed great popularity in Germany in the Middle Ages. In the bibliography appended to Brough's "Mine Surveying" (ninth edition, 1902, p. 360), Reinhold's book appears as the earliest independent treatise on the subject. In view of the far-reaching influence exercised by the work, a brief analysis of the contents may not be without interest.

The title of the book is "Gründlicher und warer Bericht vom Feldmessen." It was published at Saalfeld in 1574 by his son, Erasmus Reinhold. Reinhold senior was born at Saalfeld in 1511 and died there of the plague in 1553. From 1536 until his death he was professor at Wittenberg. The main contents of the book would appear, therefore, to have been written in the middle of the sixteenth century. The preface, written by Erasmus Reinhold junior, a physician, gives examples of errors made in surveying. Thus, a large forest was measured thrice; the first determination gave an area of 26,000 acres, the second 36,000 acres, and the last 27,000 acres. The author divides his "Bericht" on surveying into five sections. The first deals with the four rules of arithmetic, the extraction of square roots, &c.; the second deals with the calculation of areas; the third with the dividing up of land; the fourth shows how the rules given may be applied in districts where other measures of area are in use; and, lastly, the fifth section enumerates the rules of surveying so as to enable, as the author puts it, a common man of sufficient intelligence to carry out his own measurements without further great ado. The second part of the work is devoted to an account of the quadrants and of the compass, and to a treatise in nineteen chapters on mine surveying.

In the first part of his book Reinhold complains that it is rare to find a town which uses the same names and sizes for field surveying as its neighbours. Morgen, Juchart, Tagwerk, Mannsmahd, Hufe, Hufacker, Artacker, &c., are among the units of area met with. He therefore carefully enumerates his measures of length and area, with the symbols used for them throughout the book. The unit of length is the rod (*Ruthe*) of 16 feet (*Werkschuh*), each of which is again divided into 16 finger-breadths (*Fingerbreit*). The unit of area is the acre (*Acker*) of 150 square rods (*gevierdt Ruthen*). The Werkschuh, on which his whole system of measures is based, is dealt with by Reinhold in a peculiar manner, very characteristic of the period. He says in effect: how long, however, a Werkschuh is, is known to everyone, or can easily be ascertained from any carpenter, mason or cabinet-maker. Later on in the volume he gives a woodcut showing the length of a third of this foot, from which it is evident that the Werkschuh was 281 millimetres long, and consequently the Ruthe was 4·50 metres long, which is in close accord with the old Brunswick rod of 16 feet (4·566 metres). A square rod would represent 20¼ square metres, and the unit of area, the Acker, would contain about 3040 square metres, which is in fair accord with several of the Morgen in use in Germany before the introduction of the metric system. For the measurement of lengths, Reinhold advocates the use of a cord or rods. A wire cord is preferred to a hemp one, as not being affected by weather or by varying tension. For setting out a right angle the author makes use of the right-angled triangle with the sides 3, 4 and 5. He also recommends the numbers 20, 21 and 29, as well as the approximation with the numbers 12, 12 and 17 ($12^2 + 12^2 = 288$, whereas $17^2 = 289$). In reference to the latter method, he reminds the reader that he writes for the common man who does not require everything to be weighed on a gold-balance. Areas are calculated by means of rectangles, trapezoids and triangles, attention being given to the measurement of lakes and woods and other polygonal figures in which diagonals cannot be measured. For the measurement of angles the compass is used. It is graduated into single degrees, each 5 degrees being numbered consecutively from 0 to 360°. The direction of the pointer in the illustration given represents a westerly declination of about 6°. Lastly, the trigonometrical solution of triangles by the aid of a table of natural sines is explained. The next section of the work deals exhaustively with the division of land. Errors, it is pointed out, frequently occur which a good surveyor could easily prevent. Every prince and town, therefore, should, as the author quaintly puts it, have a licensed, but nevertheless competent, surveyor. The second division of the whole work is devoted to mine surveying. The instruments described include the compass, a good quadrant, a water-level and a hanging clinometer. The unit of length in mine measurements was the *Lachter* (fathom) of 6 shoes, and the technical terms then used were much the same as those now in vogue in German mines.

Such in brief are the contents of this remarkable treatise written 350 years ago. Comparing it with some of the most recently published text-books on surveying, it is depressing to find how little is the progress that has been made in the instruction in this important branch of engineering. In a large treatise on the subject published this year the statement is made that a slight knowledge of geometry is necessary, and consequently a chapter is inserted in the middle of the book dealing with geometry, trigonometry and logarithms. The development of the theory of measurements and the mathematical principles on which it is based are neglected, and the author confines himself to enunciating mechanical rules for the testing of surveying instruments and for carrying out surveys. This rule-of-thumb method of education was not enough for Reinhold in 1550, whilst in 1782 Prof. Lempe, in his lectures at the Freiberg School of Mines and in his text-book, went still further by urging the necessity of learning and applying arithmetic, geometry, plane and spherical trigonometry, and even analytical geometry and the elements of the differential and integral calculus, as the surest basis of a successful study of mine surveying. B. H. B.

DYNAMIC INTERPRETATION OF CELL-DIVISION.[1]

THE author came to the study of biology possessing, as a civil engineer, an equipment rare among the disciples of this science. Some years ago he interpreted the phenomena of cell-division and karyokinesis as due to the play of Newtonian forces of equal potential but opposite sign, rather than to the gross actions of pull or push performed by ordinary mechanical forces; and was able to reproduce the spindle-figure and centrosomes by a trough full of spirits of turpentine in which were suspended crystals of sulphate of quinine, and into which were introduced a pair of wires joined to the poles of an electric machine. After continued study under such masters as Giard, he now develops

1. "Interpretacion Dinamica de la division Cellular." By A. Gallardo. Pp. 101. (Buenos Aires, 1902.)