

fractional powers; in the algebraic theory it is almost impossible to avoid this, except by tedious divagations, but in the theory of numbers such symbols ought to be avoided if possible, and their occurrence here may cause some readers a shade of regret. G. B. M.

LISSAJOUS'S FIGURES.

Harmonic Vibrations and Vibration Figures. By J. Goold, C. E. Benham, R. Kerr, and Prof. L. R. Wilberforce. Edited by H. C. Newton. (London: Newton and Co., n.d.) Price 6s. net.

THE four authors of this book have each contributed an account of the construction and use of apparatus which they have invented or brought to perfection, the several parts of the book being independent of one another, but related by the similarity of the subject-matter. Lissajous's figures were originally introduced as a convenient method of illustrating optically or mechanically acoustic phenomena, but the beauty and perfection of the results obtained by the compound pendulum of Tisley, and later by the twin elliptic pendulum of Goold, have made the subject sufficiently attractive to be pursued for its own sake. As two leading scientific publishers declined to take the book on the ground that it could not pay, we are indebted to Messrs. Newton and Co. for rescuing and producing a book which will be valued in many quarters.

Mr. Benham writes the history of the harmonograph; and describes his own triple pendulum and his own modification of Goold's twin elliptic pendulum. He also gives valuable information to anyone who would construct his apparatus as to the details which are necessary for success. The construction of the ruling pen, choice of inks or dyes, the selection of suitable paper, interesting dodges with photographic plates or with successive chemicals, are a few only of the tips or dodges described. The extremely beautiful stereoscopic effects obtained by viewing two nearly identical harmonograph figures with a stereoscope are described and illustrated, as is the curious change which occurs when such a pair of figures are slowly turned round at the same time, so as to change their relative aspect, the series of lines all appearing on the surface of a cylinder in the one position, and gradually merging into a series, each of which lies between the last one and the axis in the other position. In the case of figures drawn by the twin elliptic pendulum, where it would be next to impossible to draw two successive figures which should be sufficiently alike, the ingenious plan is adopted of selecting those which have a two-fold symmetry, but in which the two halves on opposite sides of the centre are not quite identical, and then simply turning one upside down, in order to obtain stereoscopic shell-like structures of wonderful beauty. Several examples of the marvellous beauty of the twin elliptic pendulum's work are given, in which it is difficult to know whether the forms of the curves or the water-mark patterns are the more to be admired.

Visitors at soirées of the Royal Society will remember the curves drawn by Mr. Goold's big twin elliptic pendulum, as also that queer vibrating and droning

steel plate, which gave rise to so many curious phenomena. One passage from Mr. Goold's description may here be quoted.

"If . . . a small chain be thrown on the vibrating plate, it will immediately settle itself on the curved line between the vortices and . . . will crawl away to the nearest vortex, and there coil itself up like a serpent, continuing to rotate as long as the plate remains sufficiently excited."

This is one only of a number of curious results obtained by Mr. Goold.

Mr. Richard Kerr describes a form of geometric pen, capable of producing very beautiful patterns. This is followed by an account of Mr. Lewis Wright's method of projecting Lissajous's figures on a screen, using reeds in the place of tuning forks, and Prof. Wilberforce describes his well-known sympathetic vibrations obtained by the aid of one or two torsion springs.

This is an excellent book for the Christmas holidays.
C. V. Boys.

OUR BOOK SHELF.

Cattle of Southern India. By Lieut.-Col. W. D. Gunn. Department of Agriculture, Vol. III., Bulletin No. 60. Pp. 65; plates. (Madras: 1909.) Price 3s.

ALTHOUGH the existence of a number of local breeds and sub-breeds of Indian humped cattle (*Bos indicus*) is familiar to Anglo-Indians, comparatively little is known about them in this country, and it is, therefore, highly satisfactory that Col. Gunn, Superintendent of the Indian Civil Veterinary Department at Madras, has furnished us with this elaborately illustrated account of the various types to be met with in southern India. It is, however, a matter for regret that the author did not see his way to make his work complete by including the breeds found in other parts of India. As to the origin of humped cattle, the author is silent, and perhaps wisely so, since, so far as we are aware, nothing definite has hitherto been ascertained with regard to this subject.

If we rightly understand him—and his classification is by no means so clear and unmistakable as it might be—the author considers that there are two main types of large-humped cattle in southern India, namely, the Mysore and the Ongole, or Nellore. The former, which are characterised by the long, more or less upwardly directed, slightly tapering horns, and generally iron-grey or bluish colour, are, however, divisible into a number of sub-breeds, such as the Amrat Mahal, Hallikar, Alumbadi, &c., all of which come under the native designation of Doddadana, or large cattle, in contradistinction to the Nadudana, or ordinary small village cattle. The finest of all are the cattle of the Amrat Mahal breed, which were formerly owned by Tippu Sultan, but became the property of the British Government after the fall of Seringapatam, although the management of the herds remained for a time under the control of the Maharaja of Mysore, on condition of his supplying a specified number of bullocks. In the old days of Indian warfare these cattle were of the greatest value for transport-purposes on account of their rapid pace.

The Nellore, or Ongole, cattle, on the other hand, carry short and somewhat stumpy horns, which are, however, longer in cows than in bulls, and have an outward and slightly backward direction. Formerly black-and-white was in fashion, but white is