THURSDAY, DECEMBER 31, 1914.

CALCULATING DEVICES.

Modern Instruments and Methods of Calculation. A handbook of the Napier Tercentenary Exhibition. Edited by E. M. Horsburgh. Pp. vii + 343. (London: G. Bell and Sons, Ltd., and The Royal Society of Edinburgh, n.d.) Price 6*s*. net.

ALL who are interested in the history or the methods of calculation owe a debt of gratitude to the editor and the committee who have produced this valuable book. It is in the recollection of everyone concerned in mathematical operations that the Royal Society of Edinburgh held a great celebration in July last, three hundred years after the publication, by John Napier, of his admirable Canon of Logarithms. This was attended by learned delegates from many distant countries, as well as by a number of our own countrymen. Greatly as many must have regretted their inability to be present on account of duties elsewhere, this regret will not be lessened by a perusal of the book now under review, for from it they will learn what a magnificent collection was available for inspection and discussion. This collection of tables, books, portraits, and instruments of various kinds, which must have appealed to the historic as well as the utilitarian and mechanical instincts of those who were fortunate to be able to attend the celebration, form the basis upon which the present work is constructed, for it is in minor part catalogue and in major part a series of descriptive articles by experts in the several branches.

Seeing that the price asked for a large octavo book of 343 pages and containing a very large number of excellent illustrations is only six shillings, those who are interested should feel that, like the Nautical Almanack, the work is in effect a gift, the price doubtfully covering the cost of production.

The first section, by Prof. G. A. Gibson, deals with the life of Napier, of his great invention of logarithms, of his meeting with Briggs, and matters mainly of personal and historical interest. Here we read how Napier formulated his ideas of the logarithm which was derived, not from algebraic methods, as is now found to be most convenient, but upon the relative values of the portions of two lines determined by the motion of two points, one moving uniformly and the other, starting at the same, but moving with diminishing velocity such as to be proportional in amount to the length of the part untraversed. He thus made his logarithms without reference to a base, and the logarithm of "the whole sine" (the sine of 90°) becomes zero, the logarithm of positive quantities less than unity is positive, and of quantities greater than unity is negative. Curiously, hyperbolic logarithms to the base *e* are not those that Napier calculated, but logarithms to the base $1/e$. It is difficult to realise now that highly convergent series for logarithms are universally understood how Napier could have calculated as he did the logarithmic series and tangents of all angles from 0° to 90° by intervals of one minute of arc, and this long before the days of the binomial theorem. In this chapter we learn incidentally that Napier invented the decimal point, and we find also a description of the well-known "bones."

The next two sections are very largely in the nature of catalogues of the articles in the loan collection and of the collection of mathematical tables, but descriptive articles are included, of which one on portable sun-dials, by J. R. Findlay, and an account, written by Dr. Knott, of the great manuscripts by Dr. Sang, given by his daughters to the Royal Society of Edinburgh, may in particular be mentioned, as also the concluding article, by W. G. Smith, on the special development of calculating ability in prodigies or "calculating boys."

The further chapters are as follows: "Calculating Machines," by F. J. W. Whipple, but including special articles by P. E. Ludgate and T. C. Hudson; "The Abacus," by Dr. Knott; "Slide Rules," by G. D. C. Stokes; "Other Mathematical Laboratory Instruments," by a number of specialists. As this chapter includes such varied and elaborate instruments as integraphs, planimeters and their use in naval architecture, harmonic analysers, tide predictors, machines for drawing conic sections, for solving equations and precision plotting, many of which are well illustrated and explained by a number of authors having special knowledge, it will be evident that this is one of the most technically difficult and illuminating in the book. Among remaining chapters may be mentioned that on ruled papers and nomograms, which latter are graphical devices by means of which numerical solutions may be found for equations involving several variables. For instance, in the general equation for a spherical triangle showing the relationship between any angle and the three sides, Prof. D'Ocagne has given a nomogram from which, if three of the six quantities are given, the other three can be determined by the aid of a stretched thread.

The chapters relating to calculating mechanism contain descriptions of numerous recent additions

to our resources in this direction which as yet are but little known, and interesting to many as a discussion of the novelty and advantages of these would be, it would be impossible to do justice to the subject without occupying far more space than is available. Dr. Knott's chapter on the abacus, also, is one which it would be delightful to follow if only space allowed, for the description of the mental process followed by the Japanese when making their lightning speed calculations with the abacus, of their inverse way of effecting division, and, in general, of the manner in which they work off figure by figure the problem set upon the abacus as it is done with to make room for the new figure in the result; all are full of interest, and a careful study of this chapter would be likely to modify the complacency with which the European in general contemplates the Asiatic as a computer with wires and beads.

C. V. BOYS.

OIL OF VITRIOL AS AN AGENT OF "CULTURE."

The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches: a Theoretical and Practical Treatise. By Prof. G. Lunge. Fourth edition. Vol. i.: Sulphuric Acid. Part i., pp. xxiv + 582. Part ii., pp. xii + 583–1078. Part iii., pp. xii + 1079–1617. (Gurney and Jackson, 1913.) Price, vol. i. (in 3 parts), 3*l.* 3*s.* net.

PROF. LUNGE'S monumental work on the manufacture of sulphuric acid is one of the acknowledged classics of chemical technology, and the soundest proof of its continued merit and widespread appreciation is seen in the circumstance that it has now reached its fourth edition. The subject is admittedly of great complexity. The manufacture is one of the great staples of chemical industry, and lies, in fact, at the basis of that industry in general.

Indeed, it is impossible to conceive of the position of chemical industry, and of the industries dependent upon it, if the world were suddenly bereft of sulphuric acid. If we could deprive Germany, for example, of all means of manufacturing or otherwise procuring oil of vitriol, not only would her chemical industries languish, but even her capacity for military offence or defence would be effectually checked since the use of this acid is indirectly, but nevertheless absolutely, necessary for the manufacture of those high explosives upon which her artillery, the strongest arm of her service, wholly depends. She has, of course, internal means of supply, but these are by no means limitless, and there are already signs that she is within measurable distance of the end of her resources as regards the provision of the raw materials needed for the manufacture. Liebig once said that we might gauge the civilisation of a country by the amount of this acid it consumed. It would appear, therefore, that the continued forcible dissemination of German "culture" is largely dependent upon a German supply of oil of vitriol.

But, of course, it is the arts of peace that mainly consume the oil of vitriol the world requires, and there is scarcely a process of manufacture that could be named that does not need it either directly or indirectly.

It is difficult to obtain a trustworthy estimate of the aggregate output at the present time, but from the statistics referred to by Dr. Lunge it is probably not fewer than five million tons, of which not less than a fifth, and probably more, were, prior to the outbreak of war, made in Germany, mainly from imported iron pyrites.

In addition, Germany has hitherto imported a gradually increasing quantity of oil of vitriol, amounting in 1911 to 99,653 tons. At the present time, therefore, she is almost wholly dependent upon the employment of zinc-blende, the relatively poor German pyrites, the mixed ores from Freiberg, and Mansfeld, and the small quantity from gas-oxide. It may be anticipated, therefore, that the serious economic disturbance consequent upon the invasion of her eastern frontier will very largely affect her ability to maintain her supply.

In the case of a substance of such world-wide application as sulphuric acid it need scarcely be said that there is a very strenuous industrial competition, and there is probably no branch of chemical technology which has been more thoroughly developed than its manufacture, and to-day its production is studied, watched, and controlled with all the precision of a vast scientific experiment in which all the resources of modern chemical, physical, mechanical, and engineering knowledge are brought to bear. The main principles of its manufacture are in all probability definitely established, but so fierce is the competition and so bountiful the trained skill and intelligence concentrated upon its economic production, that each succeeding decade sees some new departure, often of fundamental or far-reaching importance. It is a duty which the veteran author has imposed upon himself in the days of his retirement from the active work of his professorship, to take note of these changes, and to embody them in successive editions of the great work with which his memory will always be associated. That he may long be spared to continue this self-imposed task is the sincere hope of every well-wisher to the progress of that great branch of technology of which Dr. Lunge has been for so many years so distinguished an exponent.

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