

circular and hyperbolic functions in both differentiation and integration. The gain is for mathematicians; its use to practical men may be doubted, as the numerical calculation of these functions is (at present) best done by the familiar logarithms. In the older treatises the applications were chiefly algebraic and geometric; the author's system is to introduce the student at once to a wide scope of applications in both geometry and physics, including some of the higher branches (*e.g.* central orbits, harmonic vibration, Fourier's and Green's theorems, &c.). It is clear that the account of each must be very brief. In some cases (*e.g.* the article on "Curve-Tracing," Art. 127) it amounts to merely a sketch of procedure and results with scarcely any proof. In an "introductory" work this seems a defect. It is, however, a masterly introduction to the subject, and the wide scope of the applications is well fitted to interest the student.

It remains to notice some defects (in our judgment). About ten pages are devoted to *ordinary* trigonometric relations and tables of mere trigonometric formulæ. This seems too much space (being 4 per cent. of the whole) to such elements. No definition is given of a maximum or minimum, and the treatment of maxima and minima is made to depend wholly on geometry.

On p. 189 it is stated that Taylor's theorem is one "by means of which any function whatever can be expanded"—an obvious slip, corrected lower down (pp. 193, 201). The necessity for the subject-functions, and in many cases also their differential coefficients, being continuous and generally also finite within the limits of any question is not stated. This is, unfortunately, a not uncommon omission in elementary works. ALLAN CUNNINGHAM

*Elementary Algebra.* By Charles Smith, M.A., Fellow and Tutor of Sidney Sussex College, Cambridge. (London: Macmillan and Co., 1886.)

IT is a pleasure to come across an algebra-book which has manifestly not been written in order merely to prepare students to pass an examination. Not that we think Mr. Smith's book unsuitable for this purpose; indeed, with its carefully-worked examples, graduated sets of exercises, and regularly-recurring miscellaneous examination-papers, it compares favourably with the most approved "grinders" books. The real want of the present day is a text-book logically arranged and logically written. Apparently no author cares to risk the chance of the financial ruin of his book by going thoroughly to the root of the evil. A policy of "safety" is the most we can expect. This is Mr. Smith's policy, and although we think he might have made fewer concessions to custom and yet have been safe, we welcome his effort very cordially, trusting that, when his book has gained the success which it well deserves, he will see his way to introduce further improvements. He shows to great advantage as a teacher, his style of exposition being most lucid: the average student ought to find the book easy and pleasant reading. The second set of exercises on the binomial theorem is worth specially noting; in many other mathematical books the sets of exercises proposed to the student might well be, as in this instance, *collections of really useful theorems.*

#### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

#### The Pleomorphism of the Schizophyta

SOME students of natural history are content, when the explanations of phenomena which they have advanced and the

arguments by which they have supported those explanations are appropriated by other observers, to remain silent, trusting to the justice of future generations for the vindication of their claims. So far as my own experience goes, an active observer who should trouble himself to obtain honest treatment from all his contemporaries in regard to the significance of his published writings, might abundantly employ the latter half of his life in struggling with new writers for that just recognition of his efforts in earlier years in advancing the knowledge of this or that subject, which is the one reward desired above all others by most men who have not attained to the heights of philosophic contempt for the regard and sympathy of fellow-labourers. I do not intend to largely employ my leisure in this pursuit, but there is one subject on which I am anxious once for all to establish the significance of my observations and reasonings published twelve years ago in relation to similar views advanced and accepted at this moment.

That subject is what is now spoken of as the pleomorphism of the Schizophyta or Bacteria.

The view that the genera then recently established by Cohn, viz. *Micrococcus*, *Bacterium*, *Bacillus*, *Vibrio*, *Spirillum*, and *Leptothrix*, are form-phases, or variations of growth of a number of "Protean" species of Bacteria, each of which may exhibit, according to undetermined conditions, all or some of these forms, was definitely and precisely formulated by me in my memoir on "A Peach-coloured Bacterium," published in the *Quart. Journ. of Microscop. Science* in 1873. I distinctly recognised the existence of true species of Bacteria or Schizophyta, but I pointed out that these must be characterised, not by the simple form-features used by Cohn, but by the *ensemble* of their morphological and physiological properties as exhibited in their complete life-histories. I illustrated my conception of the Protean or pleomorphic character of Bacterian species by a reference to the similar character of the species of Calcareous Sponges, and I had in my mind also the closely parallel facts established by Carpenter in relation to the endless variety of forms of the Protozoic Foraminifera.

My view was no merely speculative suggestion, but was based upon a careful study of a remarkable peach-coloured Bacterium, which exhibited a wide range of forms, connected by intermediate forms, growing together in the same vessel, and linked to one another most unmistakably by the fact that they all were coloured by a special pigment which I studied with the spectroscope, and to which I gave the name "Bacterio-purpurin." I observed this organism on many different occasions from various localities; I figured and described its various form-phases; I obtained some modifications of form by cultivation, but chiefly depended upon the association of the different forms, the presence of completely transitional forms, and the common bond of the pigment, for the view as to their nature which I put forward. I gave the name *Bacterium rubescens* to this pleomorphic, or, as I termed it, "Protean," species. I gave an account of further observations on this organism in the *Quart. Journ. Mic. Sci.*, 1876, pp. 27-40.

Cohn opposed my view as to the genetic connection of the various forms associated by me under this name, and, contrary to the established laws of nomenclature, substituted a manuscript name in one of Rabenhorst's collections (viz. "*roseo-persicina*"), for the duly-published name applied by me to this organism. He further described some of its form-phases, already figured by me, as *Monas okeni*, *Monas vinosa*, and *Rhabdomonas warmingii*.

On the other hand, two years later, Dr. Warming of Copenhagen (*Vidensk. Meddelelser. naturhist. For. i. Kjöbenhavn*, 1875), after studying the same organism and figuring many of its form-phases, adopted my view as to their nature, and the extension of that view to the Schizophyta generally. He says: "Les bactéries sont douées en réalité d'une plasticité illimitée, et je crois qu'il faudra renoncer au système de M. Cohn." In 1883 Dr. Neelsen, in his "Studien über die blaue Milch" (Cohn's *Beiträge*, vol. iii. p. 241) cites my views and their confirmation by Warming, and rightly contrasts them with the later views of Nägeli and Billroth, and with that of Lister, who conceived that certain Bacteria were developed from a filamentous fungus (*Dematium fuscisporum*). As the result of his investigation of the *Bacterium cyanogenum* of blue milk, Neelsen says: "Viel eher würde für unsern Fall der Ausspruch Lankesters zutreffend erscheinen, von dem Proteus-ähnlichen Organismus, dessen einzelne Erscheinungs-formen eine Serie von Adaptationen vorstellen."

In 1884 Prof. de Bary of Strasburg, in his "Vergleichende