

being caused to move in a larger orbit than that described by it while still a part of the sun's mass," and the author suggests the action of comets carrying off portions of the nebulous border of a sun, as they struck it in the direction of its motion at a suitable moment.

The fifth and last article, in the results of which Dr. Smith expresses confidence other than he shows in respect of his earlier excursions into heterodox and quasi-heterodox physics, is devoted to "the laws of river-flow." Residence on the banks of the Mississippi enabled him to discover the formula of a double spiral action, by which to explain the elevation of the middle of a stream, the drift of floating material from the sides and of sunken material to the sides, the shape and depth of the eroded channels, the different speed of diverse portions of the current. This piece of at any rate unborrowed speculation appears not unworthy of consideration.

H. W. B.

*Das Heidelberger Schloss und Seine Gärten in alter und neuer Zeit und der Schlossgarten zu Schwetzingen.* By H. R. Jung and W. Schröder. Pp. 74. (Berlin: G. Schmidt, 1898.)

IN this work we have an historical account of the gardens and castles of Heidelberg—the famous German university town, and its less well-known neighbour Schwetzingen. The authors are both gardeners, and, although the book is written chiefly from a garden point of view, a good deal of space is given to purely historical matter. Judging from the photographs, the gardens at Schwetzingen seem to be far more beautiful and natural than those of Heidelberg, where grottoes, shrines, and various other architectural devices appear to be the leading feature, and not always ornamental ones either. To those interested in the history of very old and famous gardens, this treatise may be of use; and it will not take up much space on the library shelf, being only about a quarter of an inch in thickness. It is well printed and illustrated, and is practically free from misprints; the only one of any importance being at p. 47, where *Azalea* appears as *Aralea*. Were it not that there is a genus *Aralia*, this slip would not be worth mention.

JOHN WEATHERS.

*Graduated Test-papers in Elementary Mathematics.* By Walter J. Wood, B.A. Pp. 71. (London: Macmillan and Co., Ltd., 1899.)

THERE are forty test-papers in this collection, each containing questions in arithmetic, Euclid, and algebra. At the head of each test are notes stating the parts of the subjects required in order to solve the questions. The papers are primarily intended to test the progress of students preparing themselves for the examination in first stage mathematics of the Department of Science and Art, and Departmental teachers will find them of real value for that purpose. In the lower mathematical forms of secondary schools, also, the papers should be of service, as many of the questions have been selected from the papers of public examining bodies mostly favoured by such schools. Care appears to have been taken in selecting and arranging the questions, and answers are given to all the questions in arithmetic and algebra.

*The Story of the British Race.* By John Munro. Pp. 242. (London: George Newnes, Ltd., 1899.)

SOME time ago Mr. Munro wrote "The Story of Electricity" for this library of useful stories. In this volume he transfers his attentions to the science of anthropology, and expresses in his preface the hope that his book will "tend to destroy some errors regarding the origin and pedigree of the nation which have infected life and literature for ages." The volume should be the means of creating an interest in the study of mankind, in addition to imparting a knowledge of the nature of the races in the British Islands.

NO. 1542, VOL. 60]

#### LETTERS TO THE EDITOR.

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#### Fourier's Series.

I HAVE M. Poincaré's authority to publish the accompanying note regarding the applicability of Fourier's series to discontinuous functions, and send it accordingly for publication in NATURE.

A. A. MICHELSON.

MON CHER COLLÈGUE,—Comme je l'avais prévenu vous avez, tout à fait raison. Prenons d'abord l'intégrale  $\int_0^y \frac{\sin xz}{x} dx$ , dont la limite pour  $y = \infty$  est  $\pi/4$ , 0,  $-\pi/4$  selon que  $z$  est positif, nul ou négatif.

Faisons maintenant tendre simultanément  $z$  vers 0 et  $y$  vers l'infini de telle façon que  $zy$  tende vers  $a$ . La limite sera  $\int_0^a \frac{\sin x}{x} dx$  qui peut prendre toutes les valeurs possibles depuis 0 jusqu'à  $\int_0^\pi \frac{\sin x}{x} dx$ .

Si nous prenons maintenant  $n$  termes dans la série  $\sum \frac{\sin kz}{z}$  en faisant tendre simultanément  $z$  vers 0 et  $n$  vers l'infini de telle façon que le produit  $nz$  tende vers  $a$ , cela sera évidemment la même chose; et la différence entre la somme et l'intégrale sera d'autant plus petite que  $z$  sera plus petit. Cela se voit aisément.

Tout à vous,

(Signed) POINCARÉ.

#### A Note upon Phosphorescent Earthworms.

IT has been long known that earthworms may be phosphorescent. So long ago as 1836 Prof. Dugès described, under the name of *Lumbricus phosphoreus*, a worm which showed this peculiarity. In 1887 Prof. Giard showed that a worm probably identical with this, and, if so, not a *Lumbricus* at all, was marked luminous, especially when the soil was disturbed in the vicinity. Giard named the species *Photodrilus phosphoreus*. It has been met with and noticed to be luminous by two other observers. Quite recently (*Zoolog. Jahrbücher*, xii., 1899, p. 216) Dr. Michaelsen, of Hamburg, ascertained that this species of Giard is really identical with *Microscolex modestus* of Rosa. The multiplication of names is hardly the fault of Prof. Giard, since the genus *Microscolex* had only been instituted a few months before his genus *Photodrilus*. This species, unlike the majority of its congeners, which are chiefly congregated in Patagonia, and there very abundant, is not only European, but also occurs in England. It seems also to be, at least usually, phosphorescent. I received some time since, through the kindness of Mr. Carleton Rea, a few small earthworms from the neighbourhood of Worcester, which were undoubtedly a *Microscolex*, and at least not much different from *M. modestus*. Mr. Rea informed me that they were phosphorescent, with a "light emitted exactly similar to that of the glow-worm." They could be stimulated to show this light by "stamping the lawn." It has been suggested that this phosphorescence in earthworms is really due to photogenic bacteria entangled in the slime upon the skin. Possibly such an explanation may account for the occasional phosphorescence of *Allolobophora foetida* (the "Brandling"), observed by Vejdovsky. But the regularity, and the mode of excitation, of the luminosity seems to show that *Microscolex* is phosphorescent in its own right.

FRANK E. BEDDARD.

#### ON THE CHEMICAL CLASSIFICATION OF THE STARS.<sup>1</sup>

IN the attempts made to classify the stars by means of their spectra, from Rutherford's time to quite recently, the various criteria selected were necessarily for the most part of unknown origin; with the exception of hydrogen, calcium, iron, and carbon, in the main chemical origins could not be assigned with certainty to

<sup>1</sup> By Sir Norman Lockyer, K.C.B., F.R.S. A paper read at the Royal Society, May 4.