

mastered) will find himself put to serious inconvenience in reading many a recent German memoir. The present edition has been extensively revised and altered by the author, so that it is better than the German original—not to speak of the comfort of reading mathematics in our clear and concise language.

We may also call attention to the second edition of Joseph Edwards' 'Elementary Treatise on the Differential Calculus' (Macmillan), a sensible and useful treatise, including everything necessary, and excluding subtleties not called for. The examples are specially copious and well chosen, and in general the treatise has the best qualities of the English text-books, without their worst defects. Still, we cannot help thinking that the examination of such Continental treatises as those of Schlömilch and of Jordan would have led to some improvements. However, the student will find the presentation easy, interesting, and tolerably full.

54 (12 May 1892) 366

Mathematical Recreations, and Problems of Past and Present Times.

By W. W. Rouse Ball. Macmillan. 1892.

CSP. identification: MS 1365; Haskell. *Index to The Nation*. See also: Burks, *Bibliography*; Fisch and Haskell. *Additions to Cohen's Bibliography*.

Mr. Ball, whose sketch of the history of mathematics has been noticed in these columns, now selects a subject in which a flimsy treatment is excusable and almost expected; and as his book is decidedly entertaining, perhaps no fault ought to be found with it. On page 33 he gives an amusing example of a fallacy in geometry. The reasoning is of precisely the same nature as that of Euclid i. 16, and of several other theorems which are found in most of the elementary treatises. The only difference is that those propositions are true, or very nearly so, while this amounts to saying that any one line has the same length as any other. If the reasoning were thrown into the form of a *reductio ad absurdum*, it would appear somewhat more deceptive.

The expression "mathematical recreation" has acquired a pretty definite meaning. It signifies a puzzle amusing to any person of average capacity, and involving a mathematical question that does not readily yield to well-known methods. Such, for example, are Solitaire, the Knight's Tour, the arrangement of dominoes so that each number occurs in squares of four. A tolerably complete and accurate account of all such problems hitherto proposed is a desideratum; but the want is hardly filled by a work in which the author ingenuously says of one of his chief topics, "I know nothing of recent Continental works on the subject." This remark, extended to other subjects and other works, would very well describe the method of Mr. Ball's exposition.

Having disposed of mathematical recreations, in 149 pages, Mr. Ball ekes out his volume with five chapters upon miscellaneous subjects, treated in the same scrappy manner, to which copious and obvious references in footnotes impart an air of erudition. There is a chapter upon astrology in which the 'Tetrabiblon' is said to be "ascribed" to Ptolemy. This is not accurate, since the 'Tetrabiblon' purports to be by Ptolemy, and is addressed to his brother Syrus, like genuine

productions of his pen. There is a chapter upon hyper-space, in which perhaps as good a notion of a fourth dimension is given as could be acquired without serious study; but the sketch of the non-Euclidian geometry is not good, and the results of the "Continental" Klein and Riemann are misstated. There is a chapter upon time and its measurement in which we are informed that the earliest pendulum clock was made by Harris of Covent Garden, some "Continental work" being overlooked. The book concludes with a brief account of some theories, mostly British, of the constitution of matter.

54 (2 June 1892) 417

Moral Teachings of Science.

By Arabella B. Buckley. D, Appleton & Co. 1892.

CSP. identification: MS 1365; Haskell. *Index to The Nation*. See also: Burks, *Bibliography: List of Articles*.

Another subject so important, vast, and difficult it would be hard to name—a subject which not every philosopher of the first rank would be competent adequately to treat. Not mere clear insight into one aspect of philosophy is sufficient; a full appreciation of what belongs to the spirit of all the different leading schools of thought is required. To say that the subject is far beyond the powers of the authoress is no disparagement. Nor has she attempted any thorough or philosophical discussion. It is not science which has dictated her teachings, but traditional ideas, for which she ingeniously finds considerable countenance in facts of natural history. But these facts are somewhat isolated and sporadic; they are not the leading facts of any current scientific theory. That they play so little part in science perhaps indicates a defect in scientific theories.

Two widely different things might be understood by the "moral teachings of science." In the first place, the prosecution of scientific research necessarily requires and strengthens certain moral qualities, quite independently of what the results of that research may be, and the moral teachings involved must undeniably be good so far as they go, although they may be one-sided, fortifying only a part of the moral nature, and leaving another part neglected. The first of these teachings is perfect fairness and moral indifference as to the outcome of any inquiry. Suppose, for instance, the inquiry be as to the correct reading of a text of Scripture, "Thou shalt not steal," or "Thou shalt steal." (We purposely select an impossible case, in order to free the example from perplexities.) There is a conclusive argument to be drawn from the moral nature of man that the former and not the latter must be the correct reading. Nevertheless, in estimating the force of the purely historical evidence—in order to be scientific, in order to be logical—we must for the time being remove, if we can, all such prepossessions from our mind, and look upon the two commandments with an indifferent eye; not rejecting any considerations, but putting them aside for the time being. Many great scientists go to church, and are there very unlike what they are in their laboratories. At one time they are studying one aspect of truth, at another time another. To regard either aspect fairly and honestly, the other must for the time