other third associated various names including Huxley, Einstein, and even Aristotle, and only the remaining third mentioned Darwin. (ii) One answer on an examination for the General Certificate of Education at Advanced Level was: "Darwin's theory was based on three solid pints [sic]: 1. The struggle for the exits. 2. The survival of the fattest. 3. Maternal selection." Sir Gavin could not decide whether the candidate for the Certificate was an innocent or a humorist.

Actually, Sir Gavin needs no excuse for his small book. It is accurate, clearly written in nontechnical language, and covers the chief events in Darwin's life. It covers both the personal and the scientific events. Sir Gavin describes briefly the pre-Darwinian concept of species—the concept of their assumed stability or instability—and, as part of the background from which evolution emerged, he gives a short account of Darwin's own concept of biology previous to his voyage on the *Beagle*. He thus places Darwin in his proper milieu. He then recounts in sufficient and, at times, amusing detail the events that preceded and those that followed the publication of the *Origin of Species*.

Darwin's proof that organic evolution had occurred was so overwhelmingly important that it diverted attention from his other scientific achievements, including his distinguished contributions to both botany and zoology. He published on variations in plants, animals, and man, on the expression of the emotions in man and animals, on the insect pollination of orchids, and on the effects of self and cross pollination in the flowering plants. He described the insectivorous and climbing plants, and he investigated the movement of plants in detail. He studied the different forms of flowers on plants of the same species. He described the formation of vegetable mould and the building of coral reefs and volcanic islands. Sir Gavin records all of Darwin's contributions but, necessarily, very briefly.

Although Sir Gavin has added little new to our knowledge of Darwin, his book has a value of its own. It would be an ideal gift to any high school student or college undergraduate, who is interested in evolution. It could also be read with profit by any historian of science who is not a professional biologist.

Asa Gray's *Darwiniana* is a collection of essays that was published in 1876, although the essays themselves had appeared earlier. Since its first publication, it has been evaluated many times. This new edition is a John Harvard Library Book, one of a series supported by the Belknap Fund, established to publish "rare, inaccessible or hitherto unpublished source material." The editor, A. Hunter Dupree, is the author of *Asa Gray: 1810–1888* (1959). He is, of course, the one person for the task, and his introduction and footnotes makes this edition by far the most useful. Gray was a correspondent and personal friend of Darwin's, whose preliminary announcement of natural selection in 1858 included a copy of a letter he had written to Gray.

Asa Gray was the first real champion of evolution in America, and, if we care to designate Darwin as Charles the Great, Asa Gray, T. H. Huxley, G. Henslow, J. D. Hooker, and Sir Charles Lyell can rank as the paladins. Gray fought for evolution. He crossed pens with Louis Agassiz, his colleague at Harvard. He debated Charles Hodge of Princeton, and he answered numerous other biologists who found evolution perturbing. His reviews of Darwin's works assured that they would have a fair hearing in America, and he very effectively used his own work on plant geography to overcome the opposition to evolution which many of the older botanists had grown up with.

Some of the leading evolutionists were nonreligious, but Gray himself was religious—in fact, he was a conservative Presbyterian. This was a source of strength for his defense of evolution, since it tended to keep the *odium theologicum* at a minimum. Gray, however, could reach only the literate fraction of his fellow countrymen. The *pagani* remained in opposition to evolution for almost another century, and the Fundamentalists among them have not yet been reached by any intellectual contact.

Gray was a doughty champion, although he did not always agree completely with Darwin and the English evolutionists. He accepted, for example, both teleology and natural selection and, in this, he differed with Darwin and Huxley. Logically, of course, natural selection, as a means, is not incompatible with some teleological end, but the leading evolutionists rejected this view. They recognized clearly that teleology and natural selection are rival hypotheses and that both are not needed to explain how evolution came about, or even to account for the fact that man himself had evolved. With the coming of evolution and the recognition of the role of natural selection, teleology found itself on the way out—at least within the biological fraternity.

Rereading *Darwiniana* does bring back the atmosphere of the early days of evolution. In this well-printed and reasonably priced edition this atmosphere is brought within the breathing range of any who wish to sample it.

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Pictorial Medical History

The World of Asclepios: A History of Medicine in Objects. Erwin H. Ackerknecht. Huber, Bern, Switzerland, 1963. 92 pp. Illus. $12.

A History of Medicine. Jean Starobinski. Hawthorn, New York, 1964. 111 pp. Illus. $5.95.

Both of these books offer new versions of the history of medicine in, or rather with, pictures. Both authors, curiously, teach medical history in Swiss universities. Both works are short on text, the first much more so than the second, and both are multilingual publications: Ackerknecht's is published with parallel German and English texts; Starobinski's, which was written in French, has been translated and published in a German edition as well as in this English edition. This is perhaps due to the high proportion of printing costs that go into the pictures, which are the same for any language.

Both works were printed in Switzerland. The quality of the reproductions is excellent, and some of the colored ones, especially the photographs of objects, are really quite striking. Both authors have used genuine sources rather than the reconstructions of an artist's imagination, a measure of the essential integrity of their purpose. Unfortunately both volumes demonstrate the difficulty of attempting to explain medical history in pictures. Illustrations can be extremely useful as supplements to text in certain cases—for example, to explain the mechanism of objects or as an aid in developing anatomical knowledge—where they elucidate struc-

tures that are difficult to describe in words. Although Ackerknecht, whose pictures are mostly of objects in a museum, comes much closer (and shows more originality in his approach), neither author is wholly successful in relating his text to the pictures. In Starobinski's book, this may be related to the fact that the "picture research" is credited to another person.

The serious student will find both works of some value as additional sources of some excellent pictures, the photographs of early instruments being particularly valuable for comparison with the illustrations and descriptions given in the contemporary texts. But both volumes are guilty of a fault that is all too common in picture books—inadequate documentation of sources. Those who wish a comprehensive view of the history of medicine will continue to use books in which the text is what counts.

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New Mathematical Library

Episodes from the Early History of Mathematics. Asger Aaboe. Random House, New York, 1964. x + 133 pp. Illus. Paper, $1.95; cloth, $2.95.

The number 13 is very appropriate for this volume in the New Mathematical Library series. The excellent collection of which it is the most recent (and possibly the best) number is intended for extracurricular use by superior high school students, but it is also highly appropriate reading for laymen. The material in number 13 is pitched nicely at the level intended, with clarity of exposition equal to that of its predecessors in the series; and the volume is especially welcome, for its history is as accurate as its mathematics is understandable. All too often the little mathematical history that does make its way into works on the secondary school level is tarnished by half-truths—or worse; but such is not the case here. Aaboe took his doctorate under Neugebauer, and he has read widely and deeply, with the result that in this book he has combined mathematics and history of comparable soundness, without a show of profundity. Elementary geometry and trigonometry suffice for comprehension of the themes undertaken, but the material is considerably removed from the routine topics characteristic of textbooks at this level.

The reader is properly warned in the title not to anticipate a systematic history, for the author has adopted a "block-and-gap" approach in which a limited number of "episodes" are explored in some depth. In the first episode, Aaboe describes Babylonian mathematics, with particular reference to place-value notation and its use in algebraic and geometrical problems, including the solution of quadratic equations and the use of the Pythagorean theorem. The episode closes with a brief account of the Mesopotamian table of Pythagorean triads (Plimpton 322) and with a reminder that, apart from some geometry, the Egyptians "did not get past elementary arithmetic."

The author's second episode is "Early Greek mathematics and Euclid's construction of the regular pentagon." Aaboe is appropriately cautious about contributions traditionally ascribed to Thales and Pythagoras, and he emphasizes the "critical reaction" that set in after Zeno had propounded his paradoxes and the existence of incommensurable line segments had been disclosed. The algebra that Greece had adopted from the Babylonians was reformulated in the geometric garb later definitively presented in Euclid's *Elements*. The solution of quadratic equations, for example, was now a problem in the "application of areas," rather than one of "finding a number."

The third and least unified of the four episodes (and in some ways also the least successful) is entitled "Three samples of Archimedean mathematics." Here for the first time Aaboe allows biography and legend to obtrude into an otherwise mathematically oriented account. Following his brief summary of the life and principal works of Archimedes, the author focuses attention on the Syracusan's trisection of an angle, his construction of the regular heptagon, and the application of his "mechanical method" in the discovery of the volume and surface area of a sphere. These aspects are well presented, but two questions come to mind in this connection: (i) Are the trisection and the heptagon (minor works which have come down through the Arabic) well adapted to the purposes of the series? (ii) Is not the section **3.3**, on modern criteria of constructibility, something of an anachronism as far as this volume is concerned?

The last of the four episodes is a tightly woven summary of Greek trigonometry, as found especially in Ptolemy's *Almagest*. Methods used in the construction of tables and in applications to the solution of triangles are described in admirably clear detail. In laudably relating the material to earlier contributions, it is pointed out that Ptolemy's value for $\sqrt{2}$ is the very same sexagesimal—1; 24,51,10—that is found in an old Babylonian tablet. Although there is no reference to the fact that the law of cosines appears in Euclid or that certain trigonometric inequalities were known to Aristarchus and others, the reader is reminded that trigonometry did not originate with Ptolemy (about A.D. 150). Such methods go back at least to the time of Hipparchus (about 150 B.C.), and it is quite possible that they were known to Apollonius. Aaboe also closes with a caveat that deserves close attention:

> It should be clear to anyone who has read this chapter that the commonly held notion that Greek mathematics is entirely geometrical is not quite correct. Greek mathematicians were perfectly capable of doing numerical work when they had to; indeed, one has to look far and wide to find Ptolemy's equal as a computer.

Intended as it is for student use (copies are available to elementary and secondary schools in the SMSG paperback series through the L. W. Singer Co., Syracuse, N.Y., at 90¢, to the teacher or the school), the book includes a small number of well-graded problems and a short list of admirably selected and critically evaluated "Suggestions for further reading." However, a book as well written as this one will inevitably find its way into hands far more numerous than those of schoolboys. It is recommended reading for all who delight in a thoroughly authoritative account of just how certain aspects of mathematics came about. Modern notations and language are used, but explanations are kept as close to the thoughts of the original creators as is consistent with ready comprehension by a reader today. We are far removed in space and time from the ancient cities of Babylon, Alexandria, and Syracuse, but that the gap can be bridged through superb exposition is effectively demonstrated in this book. The little volume is as high in value as it is low in price.

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