munity. These problems are not confined to one country, and the Association of Scientific Workers welcomes the formation of a brother organization in America.

On behalf of the Association of Scientific Workers I would like to express the hope that you will receive great support from all scientific workers in America, and to wish you success in carrying out your policy.

At present the headquarters of the association is in Philadelphia, and we would be glad to receive inquiries from scientists in centers where there is not yet a local branch.

DONALD HORTON,
Corresponding Secretary

PHILADELPHIA, PA.

SCIENTIFIC BOOKS

CHARLES DARWIN

Charles Darwin. A Portrait. By GEOFFREY WEST. New Haven; Yale University Press. 1938. Pp. 359.

I TOOK up this volume with a feeling of prejudice; how could such an author, even after some years of diligent compilation, be in a position to appreciate Darwin's scientific work? Turning over some of the pages I found passages which confirmed my fears, and debated with myself whether to return the book to the editor unreviewed. Nevertheless, when I settled down to read the book page by page I had to admit that the recorded facts concerning Darwin had been collected with the utmost diligence, arranged with great care and set forth in a manner which made the book easy and profitable to read. With a reasonable amount of revision or expurgation, which I presume the author would not permit, the book might be described as a very satisfactory and illuminating biography. One can easily imagine the other side of the argument. It might well appear that after all a scientific worker who has grown up and lived in the Darwinian tradition was himself incapacitated for forming an impartial judgment. Morley, in writing the life of Gladstone, said that people would probably accuse him of partiality. He said that he would be sorry to be thought lacking in this quality; and one who is indebted to Darwin's influence in so many ways that it has formed a kind of atmosphere in which he has lived, cannot regard the matter with cold objectivity, or even wish to do so. It must be said of Mr. West, that throughout he regards his hero with respect and even affection, and shows little of the cheap cynicism with afflicts many biographers. He discusses the various personal and scientific matters, as they come up, with a lucidity which I fear few professional scientific workers could attain, and no one can read all this without profit. The available record as it stands probably does not do justice to the maturity of Darwin's mind when he sailed on the "Beagle." Having visited regions in South America which he described, I have been amazed at the accuracy and sagacity of his observations. I do not know who, to-day, could take such a comprehensive and understanding view of nature in a remote country visited for the first time. So again, his one important contribution to taxonomy, his monograph of the living and fossil barnacles, has stood the test of time as few such works have. This is the testimony of Pilsbry, the principal living authority on these animals. West's final chapter is headed "The Fragmentary Man," and he reaches the conclusion that "Darwin was incomplete and Darwinism accordingly inadequate as a philosophy by which men may live." I should put it differently. Darwinism is dynamic, and is not to be thought of as the basis of a static philosophy, nor does it pretend to deal with all aspects of reality. Since Darwin's time many important discoveries have been made, and were he living to-day, he would be the first to take account of them. The artist completes a work, and no one dares tamper with it; the scientific man, in contrast, is always on the road, never at the journey's end. In that sense all scientific work is fragmentary and incomplete, but this should not imply reproach. Considering his physical disabilities, and the limits of even the greatest human mind, Darwin was marvelous in his power of comprehending the larger aspects of nature, and the details of many matters. If he neglected subjects which we deem important we have no more right to complain than we should in the case of a noted pianist who did not play the flute.

The cry "back to Darwin" may have vitality to-day, as an encouragement to broader training and wider views, rather than the narrow specialization which is fostered by our educational methods. In this case, in spite of Mr. West's conception of Darwin as a "fragmentary man," I believe that his book will teach a different lesson, and may be read with profit as a stimulus to constructive thought and work.

T. D. A. COCKERELL

CONVERGENCE

A Text-book of Convergence. By W. L. FERRAR. Oxford University Press, 1938. viii + 192 pp. Price, $3.50.

As the title indicates, this book is a *text* on the theory of series. In the opinion of the reviewer it is clearly and carefully written, in a pleasant style, with good (albeit conventional) choice of material.

The subject-matter includes preliminary definitions

of limit (especially well done), study of monotonic sequences, series of positive terms, comparison and ratio tests, alternating series, the Cauchy condition, uniform convergence, binomial and logarithmic expansions, integral tests, double series, Cesàro sums, Fourier series.

There are several unusual features of the book. (i) The now standard shorthand, such as:

$$\alpha_n \to 0 \text{ } if \text{ } .$$
$$\varepsilon > 0;\ \text{EN} \cdot |\alpha_n| < \varepsilon \text{ } when \text{ } n \geqq N,$$

is introduced early, explained thoroughly and used consistently throughout the work. This is a great advantage in conciseness and clarity. (ii) The author divides all (real) series into three classes: convergent (when the sum S_n of the first n terms approaches a finite limit), divergent (when S_n becomes positively or negatively infinite), non-convergent (when S_n approaches no finite or definitely infinite limit). This classification is not commonly used, but is entirely appropriate. It is more discriminating than the usual classification, and notably more precise in such topics as power series and Abel's theorem. (iii) The book contains numerous well-graded and illuminating exercises. These are in part applications of the theory developed, in part elaborations of it; they alone are sufficient to justify the publication.

There are a few matters in which the reviewer fails to see eye to eye with the author. (i) The latter is not entirely consistent in his use of divergence, for he admits (p. 17) the notation $\alpha_n \to +\infty$, he asserts (p. 22) that if $S_n \to S$ then S is called the sum of the series, he later (p. 23, § 2.1) considers that a series has a sum if and only if S_n tends to a *finite* limit. (ii) More figures and better ones would be an aid to the beginner. For instance, the figures (pp. 84, 85) illustrating uniform convergence are not as closely related to the details of the definition as one might expect.[1] (iii) In proving (p. 84) the theorem on term-by-term integration in a finite interval of a uniformly convergent series, the author does not require continuity of the terms of the series, hence needs to *assume* the integrability of the sum of the series; he omits the remark that this condition is automatically fulfilled if the terms of the series are continuous. (iv) In the chapter on Fourier series, the author does not mention the least-square property of the partial sums; this omission is probably due to a desire to save space, but the property is an important one and can be established in a few lines. (v) The only general convergence theorem proved on Fourier series is that (granted integrability of the given function) of the series where convergent represents the average of the limits (assumed to exist) of the function approached from the right and left. This theorem is no shorter to prove and in the judgment of the reviewer much less interesting to the student (and to the physicist!) than the proof of convergence for functions say satisfying Dirichlet's condition, or even for functions that are piecewise smooth.

Despite these and other criticisms, the reviewer considers the book highly useful for undergraduates, especially when it is supplemented by lectures or tutorial instruction, and wishes it a wide-spread use in this country.

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SPECIAL ARTICLES

A METHOD OF EXTINGUISHING THE REFLECTION OF LIGHT FROM GLASS

H. D. TAYLOR discovered in 1892 that a tarnished photographic lens transmitted more light than a new lens. Since his discovery, several workers[1, 2, 3] have investigated means of treating glass surfaces so as to diminish the reflection and consequently increase the transmission of light by the glass.

Recent experiments have led to a method of coating glass with a film which extinguishes reflected monochromatic light. The film is made in such a way that the light reflected from the outer surface is equal in intensity and opposite in phase to the ray reflected from the glass-film surface. Under these conditions no light is reflected.

In order that a film shall have the property of extinguishing perpendicular light the film must fulfil the following two conditions:

(a) The substance of which the film is made must have a refractive index n_1, which has a value given by the equation

$$n_1 = n_0 n_g \qquad (1)$$

where n_g is the refractive index of the glass, and n_0 of the medium in which the glass is viewed which is commonly air.

(b) The film must have an optical thickness $n_1 t$, which is given by the equation

$$n_1 t = 0.25\ \lambda\ (2a + 1) \qquad (2)$$

where t is the thickness of the film and a is zero or an integer. A film having a thickness corresponding to the first order of interference, *i.e.*, a film for which $n_1 t = 0.25\ \lambda$, is far more effective in diminishing reflec-

1 F. Kollmorgen, *Trans. Soc. Illuminating Engineers*, 11: 220, 1916.

2 Ordnance Department Document, No. 2037, p. 76.

3 J. Strong, *Jour. Optical Soc. America*, 26: 73, 1936.

1 Contrast, for instance, Osgood, Funktionentheorie I (Leipzig, 1928), pp. 97, 98.