in the profits and prosperity of the industries and firms responsible for these great technical advances. The first question any firm will ask is, What return can we expect from expenditure on research? The answer is partly given above, for there will always be brilliant prizes to be won. But the short answer is that no firm can afford to neglect research, as it is the only safeguard of the future."—*The Time,* London.

SCIENTIFIC BOOKS

SIR J. J. THOMSON

The Life of Sir J. J. Thomson. By LORD RAYLEIGH. x + 299 pp. Cambridge: At the University Press; New York: The Macmillan Company. 1943. $6.00.

IN this book Lord Rayleigh has not only given a dignified and colorful picture of one of the most outstanding pillars of science of the generation which has passed, but he has woven the picture into a most valuable historical development of those discoveries which have been the landmarks of the journey from the territory sown by Newton and Galileo to that in which we live to-day. Truly, in no epoch has the scenery changed as rapidly and with such enhancement in the richness of the foliage. There is absolutely no reason for the partial apology cited by the author in his preface and concerned with the book's being too scientific; for not only are scientific matters treated with a clarity which should leave no stumbling-blocks for the layman, but they are moulded with such skill with the personalities of their discoverers as to make them form a part of the story of the whole romance in which they figure as topics vying in interest, even to the layman, with those topics more particularly concerned with the personal life of J. J. Thomson himself.

Starting with Thomson's early youth, we find him obtaining a scholarship to Trinity College, Cambridge, when Clerk Maxwell was the director of the Cavendish Laboratory. It seems strange to realize that apparently he never met that great pioneer whose work formed so much of the basis of his later discoveries. It is also rather remarkable to learn that he had so little scientific contact with Sir Joseph Larmor, who was his life's contemporary, interested in the same fields of science, but to some extent in the more abstract domains thereof. Thomson himself was a mathematical physicist of no mean order of attainment, as his earlier writings very fully demonstrate. Indeed, later, when, on the retirement of the late Lord Rayleigh from the Cavendish professorship, he was appointed to that position at the early age of twenty-eight, not over-enthusiastic letters of congratulation from some of his rivals for the position expressed surprise at the appointment, founded upon the assumption that he was a mathematician rather than a physicist. It is true that none of his fellow workers, even then or since, have regarded him as much of a manipulator of apparatus. We read that "He had little knowledge of mechanical processes and technique and was at no time ready with his hands." His actual experimental work was always carried out by an assistant, and he was indeed fortunate in his choice of these men. One of them, H. F. Newell, however, writes: "J. J. was very awkward with his fingers, and I found it very necessary not to encourage him to handle the instruments! But he was very helpful in talking over the ways in which he thought things ought to go." We learn that he was an excellent elementary lecturer and insisted upon the importance of numerical examples.

In these days of elaborate equipment, it is interesting to read his account of the difficulties encountered in his very early days as a student of Balfour Stewart at Manchester, for he writes: "It may be worthy of remark that as many of the pieces of apparatus used were required for the ordinary work of the laboratory, the whole arrangement had to be taken down and put together again between each determination." An experienced experimntal physicist of to-day would rather demur against his additional remark on the supposed advantages of this procedure to the effect that "this must have had the effect of getting rid of a good many accidental errors." Even in 1914, after the major portion of his work as Cavendish professor had been completed, we read that about thirty research students were working in the laboratory and the cost of their researches was about £300 ($1,500) per annum.

It is generally recognized that J. J.'s influence in the Cavendish Laboratory was mainly one of general stimulation and encouragement, and that his advice frequently did not extend in useful form down to practical details. This phase is dealt with in entertaining vein with a full understanding that one who can be great in many things can afford his weaknesses in a few. We read of his advising the student to measure the diameter of a quartz fiber by wrapping a spiral thread around it and measuring the length. We read of his conversation with John Zeleny, who had just succeeded in the then by no means easy feat of getting results on ion mobilities for atmospheric ions, and we find him suggesting that results be secured for metallic vapors and coming round, moreover, a few hours later wanting to know if such results had

been obtained. We learn that he considered a slide rule a device for wasting time, and he apparently never used one. On the other hand, there are various citations of profound wisdom and understanding. To a student who complained how uphill research was, he replied: "Yes, that is why there is so much credit in doing anything." We find him deploring the fact that research students of to-day require so much. "They expect," he said, "to be given a properly designed piece of apparatus which will *work*. In the earlier days we had to make it work ourselves as best we could, whatever its natural deficiencies might be." We find him dilating upon the position of industrial research and upon the dangers of fundamental research being done under conditions in which the researcher is paid for his efforts. He ends by stating: "You want this kind of research, but if you pay a man to do it, it will drive him to research of a different kind. The only thing to do is to pay him for doing something else and give him enough leisure to do research for the love of it."

J. J., while a radical in the physics of mid-Victorian times, was very conservative in his own radicalness, and was never happy with even the older quantum theory, apart from the new. We find him quoted as saying in a letter: "Again, I differ from you about the value of the conception of an ether, the more I think of it the more I value it. I regard the ether as the working system of the universe. I think all mass, momentum and energy are seated there, . . ." It would have been perhaps interesting if the book had included some reference to Niels Bohr's association with the Cavendish Laboratory.

Like many of the famous physicists of the nineteenth and early twentieth centuries, J. J. was for a time interested in psychical investigations and is even sufficiently sympathetic towards the phenomenon of water divining to remark that there is no doubt of the reality of the process of "dowsing."

The period of transition between Thomson's resignation of the directorship of the Cavendish Laboratory and the appointment of Rutherford is one which must have been fraught with many delicate considerations. Thomson, having retired from the directorship of the Cavendish Laboratory, had assumed an independent professorship, and the ironing out of responsibilities between a new director as forceful in personality as Rutherford and a retired director as eminent as J. J., and who was still active in the laboratory, must evidently have necessitated rather difficult diplomatic adjustments. Thomson was very evidently anxious to have Rutherford accept the directorship, and his own characteristic modesty is well exemplified by his remarking, in connection with the potentialities which the post afforded, that: "There are very great opportunities for making a very great school of physics at Cambridge. . . ." As the author remarks, Thomson, in this phase, "does not give the slightest hint of what was obviously the fact, that he himself *had* made a very great school of physics at Cambridge, and that the problem for his successor was to maintain it."

It will come as a surprise to many that in spite of the relatively small emoluments pertaining to even such a distinguished man of science, emoluments which do not appear to have been supplemented from such extraneous sources as patents or independent professional activities, J. J. Thomson's will was ultimately proved for no less a sum than 82,000 pounds sterling, which Lord Rayleigh attributes to a skill in investments which would have caused him to have attained distinction in the business world of affairs if he had chosen that line instead of science.

The author stresses everywhere the fact of J. J.'s informality, simplicity and the lovableness of his disposition. We see a man whose great influence on science has come as much through the permeation of his great spirit into the souls of those who surrounded him as by his own researches and formal writings. In reading the book one is conscious, in the reverence and love which the writer shows for his great master, of the absorption within himself of something of that spirit.

W. F. G. SWANN

ORGANIC CHEMISTRY

Textbook of Organic Chemistry. By GEORGE HOLMES RICHTER. Second edition. 6¼ × 9¼ in. 759 pp. Artistically bound in gray and blue cloth. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1943. $4.00.

THE new edition of this excellent text, in its very attractive blue and gray binding, will be warmly welcomed by all who have used or are familiar with its predecessor, which appeared just five years ago.

The changes made in the older edition consist mainly in the rearrangement of old and the addition of new subject-matter. Thus, the discussion of natural products, previously scattered through various chapters, has been assembled in a single chapter and a new section on terpenes added. Many other similar illustrations might be cited. As to new matter, supplementary information has been provided concerning hormones, vitamins, drugs, plastics (including synthetic rubbers), hydrocarbons, gasoline, octane ratings of fuels and halogenation; as well as resonance, tautomerism, the reactions of Claisen, Elbs, Scholl and Stephen; and the rearrangements of Demjanow, Jacobsen and Wagner.

The book is warmly recommended as one of the best in its class.