A hard day's night

A Review[1] by Professor A. Pais, Professor Emeritus, Rockefeller University, New York

of

The Scientific Letters and Papers of James Clerk Maxwell, Volume 1, 1846-1862

edited by P.M. Harman.
Cambridge University Press: 1990.

JAMES CLERK MAXWELL'S first biography appeared in 1882, three years after his death at the age of 48. (In 1969 it was reissued by the Johnson Reprint Corporation). It was written by the Reverend Lewis Campbell, Maxwell's life-long friend ever since their school days (1841-1847) at the Edinburgh Academy, together with William Garnett, Maxwell's Demonstrator at the Cavendish Laboratory at Cambridge. This charming and instructive book is still the best source for Maxwell's personal life, but leaves much to be desired with regard to a sketch of his scientific contributions. The book also contains some, but not all, of Maxwell's correspondence.

In 1890 the Cambridge University Press published *The Scientific Papers of Maxwell* (reissued by Dover in 1952). It contains most but not all of his technical papers: shorter publications were omitted.

Now we have before us the first volume of Maxwell's scientific letters and papers, currently known to exist, edited by Peter Harman. Taken together with the two books mentioned before, this excellent, thoroughly documented and handsomely produced work, and its promised sequels, will fill the basic needs of present and future Maxwell students and will introduce him to a broad audience as "a man of wide reading and deep learning, a scholar as well as a scientist".

The regrettable repetition of the term 'scientific papers' in the title of Harman's book, also used in the 1890 book mentioned above, fails to emphasise an essential difference between these two works. In the earlier work the main published papers are reproduced, none of which reappears in the new volume. One novel feature of Harman's book is that there one finds unpublished drafts of many of these same papers, a great help in obtaining new insights into the evolution of Maxwell's thinking. Not all drafts led to corresponding publications, but where that is the case one always finds a helpful note referring back to the earlier book.

The present volume covers the years 1846-62, thus spanning Maxwell's last school year, his university studies in Edinburgh (1847-50) and Cambridge (1850-54), and his professorships at Marischal College, Aberdeen (1856-59) and, in part, King's College, London (1860-65). It opens with a draft of Maxwell's paper (1846) on oval curves, written while still at school. As it ends, in 1862, we are still two years away from the publication of his fundamental memoir on electromagnetic field theory. Yet we learn that he already had many of its main ideas clear in his mind. Thus Maxwell to Faraday, 19 October 1861: "We have now strong reason to believe, whether my theory is a fact or not, that the luminiferous and the electromagnetic medium are one . . . I avoided all the old traditions about forces acting at a distance" (pages 686-688). To William Thomson (Kelvin), 10 December 1861, he writes of the "nearness between the two values of the velocity of propagation of magnetic effects and that of light" (pages 695, 690). Maxwell discussed this last point quantitatively in part III of his article 'On physical lines of force' published in early 1862 (see *The Scientific Papers of Maxwell*, page 489). This major paper is not found in Harman's book, because apparently no drafts are extant. The moral of this is that Harman's book will be appreciated better with a copy of the earlier work at hand.

In the nine years following 1846, Maxwell published only four papers, including his first on physics (1849), on equilibrium of elastic solids (Harman, pages 120-185). He had, however, already written a manuscript on the effects produced by polarized light (Harman, pages 99,101), work that was influenced by his acquaintance with old William Nicol of Edinburgh (he of the prisms).

In 1855 another topic which had long interested him came to fruition when he founded the science of quantitative colorimetry. "My theory only professes to prove that there are three and only three [primary colours] and does not define them" (Harman, page 568). He pursued this subject for several years (Harman, pages 600-680), not only as theoretician but also as a consummate experimentalist (a combination not that uncommon in these days). His letters to colleagues show him having a great time with rotating disks and tops, and reporting important contributions to the origins of colour blindness, repeatedly requesting them to send him colour-blind students for testing.

Also beginning in 1855 Maxwell turned his attention to "The stability of the motion of Saturn's rings" (Harman, page 438), the subject for the Adam's Prize of 1856 awarded to him in 1857, and keeping him busy for several years thereafter. In this work we encounter Maxwell for the first time as the mature, powerful theoretician.

The main other drafts found in Harman's book deal with Faraday's lines of Force (pages 337-371). The book concludes (page 713) with a draft on motions and collisions of particles. The corresponding paper (see *The Scientific Papers of Maxwell* Volume 1, page 377) on the Maxwell distribution of velocities, ingenious in concept and results, flawed in execution, marks the beginnings of Maxwell's role in statistical physics, along with colour vision and optics, and with electromagnetism the third main theme in his *oeuvre.*

Of particular interest among hitherto unpublished material is Maxwell's inaugural lecture at Aberdeen (page 419) in which he urges study of the world so as "to subdue the earth and have dominion over the creatures". In another lecture (page 452) he tells students "to know, to submit to, and to fulfil the laws which the Author of the Universe has appointed". At Aberdeen he taught 15 hours a week (page 557). To Campbell: "The total oblivion [pupils] for definite intervals is a necessary condition for doing them justice at the proper time" (page 712). I may interject here a story about Maxwell's teaching told me by Kapitza, who had it from Horace Lamb, who had followed Maxwell's courses in Cambridge. According to Lamb Maxwell would often make mistakes in his lectures. Then he would calmly say: something is wrong, then search the blackboard, then calmly say: here is my mistake. That behaviour by a great man had been truly inspiring, Lamb said.

My greatest pleasure came in reading Maxwell's letters (those to him are merely listed in an appendix). Scientifically the most important are those to Stokes and Thomson. Letters to friends reveal more about Maxwell the man. Just a few samples: *"After breakfast is the best time for reading Greek and Latin, because if I read newspapers or any of these things then it is dissipation and ruin"* (page 193). On studying in Cambridge: *"He starves while being crammed. He wants man's meat not college pudding"* (page 208). On his impending marriage: *"Working together and thinking together we shall both be free"* (page 586). On Faraday: *"What a painful amount of modesty he has"* (page 556).

It is fitting to conclude this revue of a fine book with these words from a great man (page 583): *"Let us work while it is day, for the night is coming and work by day leads to rest by night".*