science through search for truth in an atmosphere of freedom. The gnawing of the elements in this climate will eventually wear away this structure of brick and concrete. But if the climate of liberty is preserved, truths will here be revealed which will live on and on. I trust they will serve not only to gratify intellectual pride, but may, through beneficent and wise application, work for the betterment of man.

SCIENTIFIC BOOKS

THE LIFE AND LETTERS OF LORD RUTHERFORD

Rutherford: Being the Life and Letters of the Rt. Hon. Lord Rutherford, O.M. By A. S. EVE, C.B.E., D.Sc., LL.D., F.R.S. Pp. xvi + 451. New York: The Macmillan Company; Cambridge, England: The University Press. 1939. $5.00.

THIS important book, written by so close an associate of Rutherford as was the author, will be read with the greatest of interest by physicists. Rutherford's influence extended beyond the domain of his science, so that his life is one of moment to the layman as well as to the specialist. However, while there are many sections of the book which will appeal to those who fall in the former category, the greater part of the contents is such as will be comprehended only by the professional man of science. It is not implied that the work contains profound or abstract material. It is composed very largely of letters and accounts of scientific achievements which, while simple in form of presentation and of outstanding interest for the physicist who knows what they are about, are apt to form rather dull reading for the ordinary layman.

Some of the most interesting and informative letters are those written in Rutherford's student days to the lady who was afterwards to become his wife. They are surprisingly detailed. They cover descriptions of everything and everybody, and in them one sees the young Rutherford working out the details of his finances, his hopes for their improvement and his general plans and ambitions for the future. In some cases he becomes quite technical, describing his apparatus and experiments in some detail, so that one almost gets the suspicion that he is conserving time and effort in combining into what should have been a love letter the opportunity of writing up his notes. The letters portray, as might be expected, a prodigious energy and an unfailing confidence in ultimate success, together with a continual aliveness to the essentials necessary to secure it, not only in the scientific, but also in the diplomatic and economic domains.

Rutherford's early life in New Zealand is interesting as foreshadowing the career that was to come, and perhaps we see in embryo an element of that resourcefulness of later years embodied in one of his own stories of this period:

> My mother sent me out to bring the cow home to the paddock and to collect some fire wood as well. So I drove the cow and pulled a big branch of a tree behind me. Then I thought, why shouldn't the cow help me? So I tied the branch with a rope to the end of her tail and she went quietly home till she came to a narrow gate. Here the branch jammed and the last bit of her tail broke off!

We find him as a boy making cameras, taking clocks to pieces and making water-wheels, as did Newton. Later, as a student at Canterbury College, we find him already engaged upon his work on the magnetization of iron by high-frequency discharges, which was later to provide his first claims to recognition when, as an 1851 Exhibition scholar, he continued his work at Cambridge, England.

Rutherford came to Cambridge at a transitional period, at a period when the scholar of the old school was dominant in the halls of learning and when scientific research was only beginning to come into its own for recognition. A degree for research had just been established, and Rutherford was the first research student to arrive in this category. We learn how one or two demonstrators with ancient prejudices that no good things came from the Colonies were wont to pass the door of his laboratory with a sneer, until he politely asked them in, told them he was in some difficulties with his experiments, and sought their advice, with the resulting complete collapse of their dignity and profundity; for they quickly realized that they had not the faintest shadow of a notion of what he was doing. That Rutherford was not long in establishing himself in the esteem of his surroundings is borne out by a remark of Dr. Andrew Balfour to the effect that "We've got a rabbit here from the Antipodes and he's burrowing mighty deep."

At Cambridge we have a picture of the development of his young student life, of his rapid incorporation in the community of the active investigators who resided in or visited Cambridge, of the growth of those elements which cemented his plans for the future, and withal, of the beneficent and almost fatherly interest in him shown by his great master, J. J. Thomson. Last but not least, we see a story so typical of one destined to blaze new trails in science. We see young Rutherford continuing, carrying to success, and even to the point of the attainment of considerable reputation, a field of activity—his work upon magnetic detectors, and the like—which, while worthy in itself,

was obviously bounded in its limitations. We sense the gradual recognition of this boundary and the diversion of interest to other fields, in particular, to those having to do with the conduction of electricity through gases, and finally we see the crystalization of interest upon the embryo of that special field—radioactivity—which was to form the main part of Rutherford's life work.

Following Cambridge, the picture turns to McGill, where Rutherford was called to succeed H. L. Callendar. Hardly could one find two men so different in their lines of work and even in their personalities. Callendar was a distinguished representative of the age of highly accurate thermal measurements. He was one of those who kept physics alive in this field at a time when there rang continually in the ears of the investigator the lament of that distinguished German scholar who had so recently maintained that all the important things in physics had been done and that little remained but to improve upon former work and add an extra decimal here and there. The work of Callendar concerned the one or two parts in ten thousand type of investigation, and in it he had justly attained a preeminence which established for his work the highest respect everywhere and in McGill in particular. Moreover, he was a man of quiet personality and apt to mingle but little with those around him. Then came Rutherford, with an entirely new type of apparatus, a type so characteristic of the newly born school of atomic physics. The high precision potentiometers were replaced by crude electroscopes made out of mustard cans. Pumps and sealing wax appeared everywhere, and one per cent. was a good limit of accuracy. Many of the methods used in the new field were representative, as viewed through the spectacles of the old realm of accurate measurement, of all that they should not be. It is natural that there should have been a period during which the new professor, so confident in his course, so energetic in his attack and so unconventional in his methods, should be regarded with uncertain appreciation and with some doubts as to the soundness of his reasoning. His rapid elucidation of the facts of radioactivity, and the thoughts revolutionary to the ideas of the day thereby established, raised conditions in which colleagues in other departments of the university gravely expressed the fear that the radical ideas about the spontaneous transmutation of matter might bring discredit on McGill University. At one open meeting of the McGill Physical Society, Rutherford was indeed criticized in this way and advised to delay publication and proceed more cautiously. That his McGill critics were not alone, however, is borne out by the remarks of other pillars of science of this period. We see the great Lord Kelvin suggesting that radium receives its energy "by absorption of ethereal waves" and that gamma rays are simply vapors of radium, while alpha rays are atoms of radium bromide. Professor H. E. Armstrong expresses himself "astonished at the feats of imagination to which he had listened" and leans towards Lord Kelvin's view of an "external source of energy." Rutherford's attitude towards some of these views is indicated rather clearly by a letter to his wife written in 1904, in which he writes: "Lord Kelvin has talked radium most of the day, and I admire his confidence in talking about a subject in which he has taken the trouble to learn so little."

It was, of course, at McGill that Rutherford's most pioneering work in radioactivity was done. It was while here that he built up his great friendships with Boltwood and Bumstead. It was at McGill that he collaborated with Soddy, and it was soon after the assumption of his professorship here that he married.

On the retirement of Professor Schuster from Manchester, Rutherford accepted a call to the chair and returned to England, where the rest of his life was spent. We read of his adjustment to the new conditions, a characteristic clash with the professor of chemistry who, before his arrival, had annexed certain of the rooms which previously belonged to physics, a clash which ended in his pursuit of the said professor to his study protesting that he was a nightmare—"like the fag-end of a bad dream."

Rutherford was always particularly outspoken, and perhaps one might say that diplomatic tact was not a distinguishing characteristic. It is, therefore, inevitable that two such forceful presonalities as Rutherford and Ramsay, each with his own particular branch of science claiming ownership of the new field of radioactivity, should come frequently into controversy, almost to the point of acrimony. Perhaps the general attitude may be summed up in a single paragraph of one of Boltwood's letters to Rutherford written from Yale. He writes:

> I write with some feeling on this matter because I had a devil of a time trying to persuade some of my chemical friends last summer that Ramsay was not the whole show in radioactivity. We had a general meeting of the American Chemical Society here in New Haven at the end of June and practically every mother's son that I met was firmly convinced that Ramsay was the biggest thing that could be seen on the horizon. Practically not a single one was willing to concede that he even "might be wrong." I did not attempt to persuade them that he *was* wrong, but only attempted to prepare their minds for the denials of his conclusions which I felt sure would be forthcoming. I think that most of them felt the same sort of pity for me that a good catholic feels for one who is not a true believer. For the Pope can do no wrong.

In view of the foregoing situation, it is natural

that we should find considerable trouble with Sir William Ramsay over the relative apportionment between the two investigators of the radium which was allotted for their use by the Kaiserliche Akademie der Wissenschaften of Vienna. However, the work proceeds with ever-increasing acceleration, the further unravelling of the details of radioactive phenomena and the determination of radioactive constants adding prestige to Rutherford's name, until he was rewarded in 1908 by the receipt of the Nobel Prize.

It was while at Manchester that Rutherford developed his ideas concerning the existence of a central atomic nucleus of small size. We read of his various contacts with colleagues the world over, of his interest in public affairs, and then of that period during the great World War in which, of course, much of his attention was devoted to war work. It is interesting to note that even during this period of stress, we find communications going on in friendly spirit between Rutherford and some of his former collaborators who were then in the ranks of the enemy. It would indeed be difficult to make a war out of such men, if they alone peopled the lands of the earth.

When Sir J. J. Thomson retired from the Cavendish professorship at Cambridge, England, Rutherford was the natural successor, and he accepted the appointment in 1919. Sir J. J. Thomson became Master of Trinity, but still retained some activities as professor of physics without stipend "with rooms and mechanics essential to the continuance of his research work." It is not unnatural to find Rutherford's dominant personality, coupled with J. J. Thomson's long control of affairs, the cause of some little necessity of adjustment. But all was soon amicably settled, and Rutherford drafted a statement by way of agreement. It is quoted as one "full of alterations, erasures, additions, all uninitialled; it was a document which would make a lawyer weep, but there are the initials at the bottom, J.J.T., E.R. It was sufficient; it worked."

We may sense Rutherford's impulsive yet humorous attitude from the following quotation concerning a conversation with his well-known assistant, Crowe: "Now, Crowe, have some mica absorbers ready tomorrow with stopping power equivalent to 50 cm of air." "Yes, sir." On the next day: "Now, Crowe, put in a 50 cm screen." "Yes, sir." "Why don't you do what I tell you—put in a 50 cm screen." "I have, sir." "Put in 20 more." "Yes, sir." "Why the devil don't you put in what I tell you—I said 20 more." "I did, sir." "There's some damned contamination." "Put in *two* 50's." "Yes, sir." "Ah, it's all right; that's stopped 'em! Crowe, my boy, you're always wrong until I've proved you right! Now we'll find their exact range!"

In treating of the period at Cambridge, the author naturally covers at the same time the history of the main developments which the Cavendish Laboratory brought forth during what is approximately the last twenty years of Rutherford's life. There are accounts of the famous experiments on nuclear disintegration by alpha particles, of the disintegration of matter by artificial means, of the discovery of the neutron, of the work of Kapitza and of Aston. We read of his increasing responsibilities and distinctions, and the book, after reviewing the circumstances attending his last illness, concludes with a brief summary of his achievements and a list of his honors.

We can, perhaps, conclude this review no better than by citing the following characterization of Rutherford quoted by the author from *Nature* (19 July, 1906):

> His own successes as an investigator may be traced to a few well-marked characteristics. The first is his pertinacious and reiterated assault at the particular point which he wishes to attack. He has also an instinctive insight which often makes his initial point of view more trustworthy than the deliberate conclusion of some befogged experimenter. Most noteworthy of all is the extreme simplicity and directness of his experimental methods. Some observers seem to grow happier as their apparatus becomes more complex.

Professor Eve has produced a work dealing with the life of one of the most distinguished men in all the history of science, a work which teems with interest for the physicist, both as a chronicle of achievement and as a picture of the personality of the central figure.

W. F. G. SWANN

BARTOL RESEARCH FOUNDATION OF
THE FRANKLIN INSTITUTE,
SWARTHMORE, PA.

SPECIAL ARTICLES

STUDIES ON THE FATE OF PLASMA PROTHROMBIN[1]

THE published studies on the metabolism of plasma prothrombin have been directed only at its site of formation; no report has described its site of destruction. That plasma prothrombin is being continuously destroyed in, or lost from, the circulating blood is indicated[2] by following the level in the blood after

[1] This study was carried out under a grant from the John and Mary R. Markle Foundation. From the Department of Surgery of the New York Hospital and Cornell University Medical College, New York.

[2] W. DeW. Andrus, J. W. Lord, Jr., and R. A. Moore, "The Effect of Hepatectomy on the Plasma Prothrombin and the Utilization of Vitamin K." *Surgery,* Vol. 6: 899–900, Dec., 1939.