

My Dear Eve ...

The Letters of Ernest Rutherford to Arthur Stewart Eve

Part IV: 1915-1919

Montague Cohen

Parts I-III of this article, annotated transcripts were presented of 28 letters, plus two postcards, by Ernest Rutherford in Manchester to Arthur Stewart Eve in Montreal. These letters and cards, written in the period 1907-14, are part of a hitherto unknown collection found during the reconstruction of the old Macdonald Physics Building of McGill University. This article is the last in the series and comprises six letters written in 1915, plus one dated April 1919. As in the previous articles, Rutherford's letters are interleaved with annotated extracts and summaries of nine letters from Eve to Rutherford written in the same period; these are part of the Cambridge University collection. Since this correspondence was exchanged wholly during World War I, many events related to the War are mentioned or discussed, ranging from raids on English and German cities, the use of asphyxiating gases on the battlefield, the sinking of the liner Lusitania and the call in the London Times for the replacement of Lord Kitchener as Secretary for War. The role of science and scientists in the war is a recurrent theme, but the attitude of the two men is quite different: Rutherford is fully occupied with the detection and location of submarines on behalf of the Admiralty Board of Invention and Research, but manages to find time for a small amount of radiation research, particularly on the properties of the new Coolidge X-ray tube, a comparison of the penetrating powers and frequencies of X- and γ -rays, and the interaction of high-speed α -particles with light atoms. Eve at first combines academic duties with the military training of McGill students but in July 1915 becomes a full-time army officer and by October 1916 is sent to England as Second in Command of the 148th Regiment. However, his wish to go to the front is denied and in September 1917 he is appointed (somewhat reluctantly) Director of the Admiralty Experimental Station at Harwich in succession to W.H. Bragg. The correspondence closes in April 1919 with a pair of letters relating to Rutherford's appointment to the Cavendish Chair of Physics at Cambridge and Eve's plans to return to academic life in Montreal.

Dans les parties I à III de cet article, sont présentées les transcriptions annotées de 28 lettres et deux cartes postales envoyées par Ernest Rutherford alors à Manchester à Arthur Stewart Eve à Montréal. Ces lettres et cartes écrites entre 1907 et 1914 font parties d'une collection jusqu'ici inconnue que l'on a découvertes durant la reconstruction de l'ancien pavillon Macdonald de physique à l'Université McGill. Cet article est le dernier de la série et il comporte six lettres écrites en 1915 et une autre datée d'avril 1919. À l'instar des articles précédents, les lettres de Rutherford sont interfoliées avec des extraits et des résumés annotés de neuf lettres d'Eve à Rutherford écrites durant la même période; celles-ci font partie de la collection de l'Université de Cambridge. Étant donné que cette correspondance a été échangée entièrement durant la Première Guerre mondiale, beaucoup d'événements y ayant trait y sont mentionnés ou analysés, comme les raids lancés sur des villes anglaises et allemandes, l'utilisation des gaz asphyxiants au champ de bataille, le naufrage du paquebot Lusitania et l'appel lancé par le Times de Londres pour le remplacement de Lord Kitchener comme ministre de la Guerre. Le rôle de la science et des scientifiques dans la guerre est un thème qui revient souvent, même si l'attitude des deux hommes est très différente à cet égard: Rutherford est entièrement occupé par la détection et la localisation des sous-marins au nom du Board of Invention and Research de l'Amirauté, mais il réussit à trouver le temps de faire quelques recherches sur les radiations, notamment sur les propriétés du nouveau tube de Coolidge, sur les pouvoirs

pénétrants et les fréquences des rayons X et γ et l'interaction des particules α de grande vitesse et des atomes légers. Eve parvient tout d'abord à mener de front ses fonctions d'universitaire et l'entraînement militaire d'étudiants de McGill mais, en juillet 1915, il devient officier de l'armée à plein temps et en octobre 1916, il est envoyé en Angleterre comme commandant adjoint du 148^e Régiment. On refuse toutefois d'accéder à sa demande d'aller au front et en septembre 1917, il est nommé (à contrecœur) directeur de la station expérimentale de l'Amirauté à Harwich en remplacement de W. H. Bragg. L'échange de correspondance se termine en avril 1919 par deux lettres relatant la nomination de Rutherford à la chaire Cavendish de physique à l'Université de Cambridge et les plans d'Eve de reprendre sa vie d'universitaire à Montréal.

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This article is the fourth, and final, part of a series devoted to the correspondence of Ernest Rutherford and Arthur Stewart Eve in the period 1907-19. The four articles were made possible by the discovery, during the reconstruction of the old Macdonald Physics Building of McGill University, of a hitherto unknown set of 35 letters, plus two postcards, sent by Rutherford in Manchester to his friend and colleague Eve in Montreal. (The collection includes two further letters written in Rutherford's Cambridge period, but these are omitted for reasons stated in the Postscript at the end of this article.) The three previous articles were devoted to the periods 1907-8 (Part I), 1909-11 (Part II) and 1912-14 (Part III).¹

As in Parts I-III, the letters *from* Rutherford are interleaved with summaries of Eve's letters *to* Rutherford in the same period. Unlike the Rutherford letters, those of Eve are part of the Cambridge University Collection, have long been in the public domain, and are listed in the *Rutherford Correspondence Catalog*.² The summaries of Eve's letters in this and the previous articles are published by permission of the Syndics of Cambridge University Library.

The present article includes six letters from Rutherford to Eve, and five from Eve to Rutherford, written between January and December 1915. There follow summaries of three letters from Eve written between May 1916 and September 1917, but no letters in the other direction have survived. Strictly speak-

ing, these three letters are not part of a coherent correspondence but are included because they throw interesting light on Eve's military career; furthermore, they act as a bridge between the 1915 correspondence and the final pair of letters in this series, written in April 1919: Eve's letter congratulating Rutherford on the latter's appointment to the Cavendish Chair of Physics at Cambridge and, at the same time, expressing both hope and apprehension for his own return to academic life at McGill. Rutherford's reply, written nine days later, expresses his own hopes for the new, and final, phase of his career in which "... our work is ... to see the younger ones are given a free hand to develop. I quite agree that sterility of ideas is in general an aftermath of war conditions but it will probably soon pass." This modest statement was written just weeks before Rutherford published a series of articles announcing (*inter alia*) the achievement of artificial disintegration of the atom, an event of incalculable importance for the future of science and of the world.³

Examples of the correspondence in this article are given in Figure 2 (part of letter E-34, 4 July 1915) and Figure 4 (letter R-37, 13 April 1919). The latter is published by permission of Cambridge University Library.

Ernest Rutherford, 1915-19

When World War I broke out in August 1914, Rutherford and his wife and daughter were in Australia, where he gave several public lectures and attended the meeting of the

British Association in September. At the end of the B.A. meeting Rutherford did not return immediately to Britain but went on to visit his home country, New Zealand, for several weeks and thence to Vancouver, Montreal and New York. He arrived back in Manchester only in January 1915, a few days before writing the first letter in the present article on January 12.

Rutherford's attitude towards the War was ambivalent. He was certainly not neutral: the comments in practically every letter in this article are alone sufficient proof of his support of the Allied cause. If further proof were needed, his disapproval of Bertram Boltwood's mild pro-German stance may be cited.⁴ Most of all, Rutherford threw his time and scientific talents wholeheartedly behind the British war effort, especially in the Board of Invention and Research where his main task was to devise a method of detecting and locating submarines (see under *Science and the War*, 1914-19 in this Introduction). At the same time, Rutherford could not be described as a militarist. His leisurely return from Australia on the outbreak of hostilities, while many of the participants in the British Association meeting hurried back immediately, may be regarded as an indication of his attitude. Rutherford's obituary of Moseley (see *Science and the War*, 1914-19) as well as the letters in this article clearly show that he did not approve of scientific talent being wasted in the trenches. For example, in letter R-36 (11 Dec. 1915) he wrote to Eve, with reference to the latter's decision to go in for active military service: "I appreciate your patriotism, but I think you have now reached that position of seniority where you could probably do better work training men than leading them in active service. If I recall rightly, I am relatively an infant compared with you."

Perhaps the best illustration of Rutherford's attitude to the War is the oft-told, but unverified, story that he apologized for his late arrival (or absence: the story varies) at a meeting of an Allied anti-submarine panel in London, because he wished to complete some experiments in Manchester in which he believed he had demonstrated, for the first time, artificial splitting of the atomic nucleus:

"If this were true, its ultimate importance is far greater than that of the war." Rutherford was quite right!

The story above illustrates the fact that Rutherford continued to undertake research on radioactivity and related phenomena whenever he could spare the time from his "official" war research. Rutherford produced seven publications in 1915, although four of them were reports or summaries of public review lectures given in London and Washington (see Note 3 of letter R-34). In the three years 1916-18 he published only 4 papers, although (as indicated) he continued to do 'basic' research whenever possible, but publication of the results was deferred until 1919. The topics of Rutherford's non-military research were: the β and γ -ray spectra of the radioactive elements; the relationship between betas and gammas (e.g., the production of secondary betas by the absorption of γ -rays); the properties of the new Coolidge X-ray tube and the comparison of X-ray and γ -ray spectra; and the interaction of fast-moving α -particles with atoms of light elements.³ The latter topic was not begun until July 1917 (by which time Rutherford's involvement in anti-submarine work was at an end) and was actually a continuation of the 1914 investigation of Marsden in which he observed long-range hydrogen nuclei projected by α -particles passing through hydrogen gas.⁵

Of the above subjects of investigation only the properties of the Coolidge X-ray tube and a comparison of X and γ -rays are discussed in the correspondence in this article. Critical summaries of Rutherford's non-military scientific work during the period covered by this article are given in a series of short articles in Volume II of the *Collected Papers of Lord Rutherford*.⁶ Particularly relevant are the articles by Wood⁷ and Feather.⁸

No photograph of Rutherford taken in the period 1915-19 is available, but Figure 5 shows Rutherford and Eve at a somewhat later date, believed to be about 1927. The identity of the lady in the photograph is unknown.

My Dear Eve... The Letters of Ernest Rutherford to Arthur Stewart Eve



Figure 1. Stewart Eve, his wife Elizabeth, daughters Joan and Cicely and son Richard, at Glenmere, 1924.
(Courtesy of Mrs C. Grinling.)

Arthur Stewart Eve, 1915-19

The Eve of this article is a military officer rather than a university professor, although in the early letters he makes a valiant attempt to combine the two careers, as Commander of the McGill Company of the Canadian Officers' Training Corps. By July 1915 (letter E-34) Eve writes that he has to wear uniform all the time, "and 'amen' to Physics for the present." At this stage Eve predicts that (contrary to his personal wishes) he will not be sent overseas but will remain in Montreal to train companies in succession as long as the war lasts. In fact, by the end of 1915 he is promoted to the rank of Major, Second in Command of the 148th Regiment and "I may be in England about April [1916] & in France or the Balkans in the summer. It is a great wrench to leave my family, but needs must when the Kaiser drives." The next-but-one letter (E-37, October 1916) is, in fact, written in England where "we start seriously at our English training and we are of course absolutely in the dark as to where we move and when we go ... we hope to go to France as a unit, & not broken up for reinforcements" (Figure 3). For Eve personally, however, this is not to be. In September 1917 (letter E-38) he writes as Director of the Admiralty Experimental Station at Parkeston Quay (Harwich) in succession to Sir William Henry Bragg (Bragg *Senior*) who has been appointed Scientific Advisor to the Admiralty. Eve has accepted the switch from active military service (albeit not at the front line) to scientific work with some reluctance but he is forced to accept the fact that, at 55 years of age, he is considered too old for service in France. Finally, in April 1919 (letter E-39) he is ready to return to academic life in Canada although "it is very puzzling to know whether Canada or England is the better for us as a whole."

Objective accounts of Eve's life in this period are virtually non-existent. In his biography of Rutherford, Eve scarcely mentions his own wartime activities. At best, we may turn to the obituaries of Eve written in 1948-49, those of Norman Shaw⁹ and J.S. Foster.¹⁰ Both agree that "... as in all his dealings with men, Eve was firm, fair, and always had very much at heart the best interests of

those under his command."¹¹ Figure 1 shows Eve and his family at a somewhat late date (1924) than the period of this article.

Science and the War, 1914-19

The letters in this article were all written during the First World War, the majority in 1915. It is not surprising, therefore, that some aspect of the War features in practically every letter. Rutherford, especially, comments on the military situation, the bombardment of towns on Britain's east coast by German warships and airships, the sinking of the passenger liner *Lusitania*, German military losses, conditions on the front in France and Flanders, newspaper criticism of the British Secretary for War (Lord Kitchener) and so on. Eve, on the other hand, does not comment on specific events (except for the use of asphyxiating gas on the battlefield) but writes of his personal military career and of the recruitment and training of volunteer soldiers in Montreal.

Since this correspondence is between two scientists, the role of science is a recurrent theme. Thus, on June 10, 1915 (letter E-33), Eve wrote, with respect to the Canadian Government's attitude towards inventions, "... at present they pigeon-hole the lot at Ottawa." Furthermore, it is clear that—at least in the early months of the conflict—neither the British nor the Canadian governments and military authorities envisaged any special role for scientists. A scientist of military age, no matter what his qualifications, was expected to serve in the armed forces on the same basis as anyone else. Both Rutherford and Eve recorded that their respective departments of physics were severely depleted and, furthermore, outstanding young men were permanently lost to science. The best known of these was Henry Moseley, without doubt a potential Nobel Laureate, killed in Gallipoli on August 10, 1915. Another such casualty, also in Gallipoli, was Robert Bragg, son of William Henry Bragg and younger brother of William Lawrence Bragg.

In his biography of Rutherford, Eve records that, in July 1915, "a friend wrote to Rutherford suggesting that Moseley would be

much better employed [rather than as a Brigade Signalling Officer] if he were set to solve some scientific problem presented by the war." Eve states that Rutherford wrote at once to Sir Richard Glazebrook (Director of the National Physical Laboratory) asking whether suitable scientific work could be found which would justify Moseley's recall from the war front, but it was too late: Moseley was killed soon after Rutherford took this initiative.¹² It is interesting to note that, in re-telling this episode, Wilson identifies the "friend" who wrote to Rutherford, suggesting Moseley's release from active military duty, as Eve himself.¹³ If so, Eve's letter has been lost, since it is not part of the Cambridge collection, nor is there any reference to the suggestion in a letter written by Rutherford to Bertram Boltwood on 14 September 1915, in which he announces the deaths of both Moseley and Robert Bragg.¹⁴ Rutherford's obituary of Moseley in *Nature*¹⁵ is an admirable example of level-headed thinking at a time of unbridled jingoism or, as Wilson comments: "This was brave stuff in a society where young women could give white feathers to non-uniformed men in the streets and where there could be a public outcry against men such as Schuster because of their Germanic names."¹⁶

It is not entirely true, however, that no attempt was made to harness science to the war effort. Rutherford noted on June 15, 1915 (letter R-35) that his colleague Chaim Weizmann had been asked to develop the manufacture of explosive materials by a fermentation process. Indeed, Weizmann's contribution to the war—and to the subsequent history of the Middle East through the 1917 Balfour Declaration—are well-documented. Weizmann himself attributed his involvement to a circular from the British War Office, at the onset of the War, inviting scientists to report discoveries of potential military value (see Note 7 of letter R-35).

On the British side, the most important agent for the utilization of science was the Admiralty Board of Invention and Research (BIR). The Board was created in July 1915 by A.J. Balfour, who succeeded Winston Churchill as First Lord of the Admiralty in May 1915. The President of the Board was

Lord Fisher, a highly controversial naval officer, and the central committee included J.J. Thomson, whose influence as President of the Royal Society was largely responsible for the creation of the BIR. The panel of scientific experts recruited to assist the Board included Rutherford, Bragg Senior and other leading scientists such as Sir William Crookes and Sir Oliver Lodge. Rutherford's main work related to the detection and location of submarines. In due course (1917) Eve was transferred from military duties to the BIR, as Director of the Admiralty Experimental Station at Parkeston Quay (Harwich), a move which he accepted with some trepidation: see letter E-38 (9 September 1917).

While the BIR is certainly referred to in the correspondence in this article, it cannot be said that it plays a major role. This is because of the absence of letters—at least, of surviving letters—from Rutherford to Eve in the period between December 1915 and April 1919. The single letter from Eve to Rutherford written in May 1916 (E-36) and Eve's letter to Lady Rutherford in October 1916 (E-37) were both concerned with the writer's military, rather than scientific, duties.

Eve's biography of Rutherford reveals very little of Rutherford's scientific activities during the War, or indeed of wartime science in general. The whole period 1914-19 is covered in a few pages.¹⁷

On the other hand, Wilson devotes a whole chapter to "Rutherford at War" in which the work, and the difficulties, of the Board of Invention and Research are described in detail.¹⁸ Wilson sums up the BIR as follows:

The ... BIR was an ill-fated, short-lived body, brought into existence by mixed and irreconcilable objectives. Yet it was an important initiative, the first conscious attempt to harness the power of scientific investigation to the needs of a nation at war, it planted the seed from which many more important organizations sprang. It must be said, however, that the short history of the BIR is one of the most disgraceful episodes in the history of

the Royal Navy, and fully justified the charges made by modern American naval historians of the technological backwardness of the navy, caused largely by the social snobbery which so seriously afflicted the senior service in the years leading up to, and including, the First World War.”¹⁹

The failure of the BIR to achieve its principal objective—the elimination of the German submarine menace—cannot be blamed on Rutherford and the other scientists involved. They worked hard and intelligently in spite of incessant bureaucratic meddling and political intrigue. Perhaps, however, it would be kindest to conclude that the failure of World War I scientists to solve the problem of detecting and locating submarines was basically a failure of early 20th century technology to achieve the sophistication of the computer age.

Highlights of the Correspondence

Among the topics discussed in this article, the following are of particular interest:

- Nomination of Eve for the Fellowship of the Royal Society of London (letter E-31).
- Seemann’s measurements of X-ray spectra (letter R-32).
- Properties of the Coolidge X-ray tube (letters R-32, E-33, R-35).
- Loss of the German cruiser *Blücher* (letter R-32).
- German shelling and air-raids on towns on the east coast of England (letter R-32).
- Bragg *Senior*’s move from Leeds to University College, London and the resulting vacancy in Leeds (letters R-33, R-34).
- Stephen Leacock’s fictional interview with General Friedrich von Bernhardt, author of *Germany and the Next War* (letter R-33).
- Comparison of the penetrating powers and frequencies of γ -rays from radium C and X-rays (letters R-33, R-34).
- Setting up of facilities for radium treatment at the Manchester Royal Infirmary (letter R-33).
- Sinking of the ocean liner *Lusitania* with the loss of over 1100 lives, mostly U.S. citizens (letter R-33).
- Meeting of the Royal Society of Canada in Ottawa, May 1915 (letter E-32).
- Use of poison gases on the battlefield (letters E-32, R-35).
- Military training at McGill University (letter E-33).
- Rutherford’s Friday evening discourse at the Royal Institution, London, June 1915 (letter R-34).
- Andrade’s estimate of the viscosity of mud on the battlefield in France and Belgium (letter R-34).
- Air-raids on Southend-on-Sea (England) and Karlsruhe (Germany) (letter R-34).
- Estimates of German military losses (letter R-34).
- The deaths in Gallipoli of Robert Bragg and Henry Moseley (letter R-34 and Introduction).
- Birth of the Eves’ third child (letters E-33, R-35).
- Suggestion by the London *Times* that Lord Kitchener (Secretary for War) be replaced (letter R-35).
- Chaim Weizmann’s role in the mass production of acetone, an essential solvent in the manufacture of cordite (letter R-35).
- Eve’s role in the training of the McGill military contingent (letter E-34).
- Louis King’s work on the absorption of light from stars in interstellar space (letter E-34).
- The Board of Invention and Research (letters R-36, E-38).
- *Sound ranging* on the battlefield (letter E-37).
- Rutherford’s appointment to the Cavendish Chair of Physics at Cambridge University (letters E-39, R-37).
- A McGill dinner in London (England) in honour of Sir Auckland Geddes, the newly appointed Principal (letters E-39, R-37).
- The interaction of fast-moving α -particles with the nuclei of light atoms (letter R-37).

Introduction Notes

1. Montague Cohen, "My Dear Eve ... The Letters of Ernest Rutherford to Arthur Eve, 1907-1908," *Fontanus* 1 (1988), 3-37; "My Dear Eve ... The Letters of Ernest Rutherford to Arthur Eve, Part II, 1909-1911" and "Part III, 1912-1914", *Fontanus*, 2 (1989) 111-138 and 4 (1991), 69-108.
2. Lawrence Badash, *Rutherford Correspondence Catalog* (New York; American Institute of Physics, 1974).
3. Ernest Rutherford, "Collision of alpha particles with light atoms," Parts I-IV, *Phil. Mag.* Ser. 6, 37 (1919), 537-61, 562-71, 571-80 and 581-87. (The report of artificial disintegration is in Part IV, "An anomalous effect in nitrogen.")
4. David Wilson, *Rutherford. Simple Genius* (Cambridge, Mass., MIT Press, 1983.) Wilson notes (pp. 344-5) that "Rutherford's relationship with Boltwood cooled considerably during the war, as Boltwood continued to argue the German point of view." In a letter to Rutherford dated 8 December 1914, Boltwood wrote: "You may feel grieved, but I don't think you can be justly disappointed to learn that I am considered here to be PRO-GERMAN. No, I haven't grown any horns or hoofs or changed in any particular ... I don't think any less of the Germans or the English than I did before, my attitude on their relative merits ... has not altered, and I cannot be persuaded that everything the Germans have done is all wrong and everything the English have done is all right, or the contrary." (Lawrence Badash, *Rutherford and Boltwood. Letters on Radioactivity* [New Haven: Yale Univ. Press, 1969], 299.)
5. E. Marsden, "The passage of alpha particles through hydrogen." *Phil. Mag.*, Ser. 6, 27 (1914), 824-30. E. Marsden and W.C. Lantsberry, "The passage of alpha particles through hydrogen. II." *Phil. Mag.* Ser. 6, 30 (1915), 240-43.
6. James Chadwick (Ed.), *The Collected Papers of Lord Rutherford, Vol. II: Manchester* (London, George Allen and Unwin, 1963).
7. Norman Feather, "Rutherford at Manchester: an epoc in Physics," in Chadwick (ref. 6 above), 15-33.
8. A.B. Wood, "Some Reminiscences of Rutherford during his time in Manchester," in Chadwick (ref. 6 above), 307-11.
9. A. Norman Shaw, "Arthur Stewart Eve (1862-1948)," *Proc. Roy. Soc. Canada*, Ser. 3, 42 (1948), 87-93.
10. J.S. Foster, "Arthur Stewart Eve (1862-1948)," *Obituary Notices of Fellows of the Royal Society*, 6 (Nov. 1949), 397-407.
11. J.S. Foster, *ibid.*, 402.
12. Arthur S. Eve, *Rutherford. Being the Life and Letters of the Rt. Hon. Lord Rutherford, O.M.* (Cambridge, Cambridge University Press, 1939), 247.
13. D. Wilson, *Rutherford. Simple Genius*, 343-44.
14. L. Badash, *Rutherford and Boltwood*, 311-12.
15. Ernest Rutherford, "Henry Gwyn Jeffreys Moseley," *Nature*, 96 (9 Sept. 1915), 33-34.
16. D. Wilson, *Rutherford. Simple Genius*, 344.
17. A.S. Eve, *Rutherford*, 247-56.
18. There is some confusion as to the correct name of the Board. Both Eve and Wilson, in their biographies, refer to the "Board of Inventions [plural] and Research" but other publications give "Invention" in the singular. The official report in the *London Times* of 11 November 1915 uses the singular and this form is adopted in the present article.
19. D. Wilson, *Rutherford. Simple Genius*, 345.

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TABLE I
The Rutherford-Eve Correspondence
Part IV: 1915-1919

Rutherford to Eve		Eve to Rutherford	
R-31	12 January 1915	E-31	12 January 1915
R-32	25 January 1915		
R-33	8 May 1915	E-32	30 May 1915
		E-33	10 June 1915
R-34	19 June 1915		
R-35	22 June 1915	E-34	4 July 1915
		E-35	29 November 1915
R-36	11 December 1915		
		E-36	24 May 1916
		E-37	25 October 1916*
		E-38	9 September 1917
		E-39	4 April 1919
R-37	13 April 1919		
Postscript			
(R-38)	29 December 1920. Not included)		
(R-39)	4 May 1926. Not included)		
R-40	6 May 1933		

* This letter was addressed to Lady Rutherford

R-31 Rutherford to Eve

The Physical Laboratories
The University
Manchester
Jan. 12th., 1915

My dear Eve,

I received your letter and draft this morning and enclose herewith formal receipt.¹

We spent a day in New York where the weather was rather bad. Boltwood² came down and spent a great part of the day with us, and we got away from New York in fine

weather; we had four calm but cold days, then two days' gale, and arrived in Liverpool after eight days' journey. We got home safely and found everything in good order.

We saw a couple of cruisers off Sandyhook and another off Cape Clear; but otherwise no signs of war.³ As far as I can see, Manchester is much as usual, recruiting is going strong. They have raised 63000 men in the city.

I find everything going very quietly in the University. Our students are about three to four hundred down, due to enlistment, and this will no doubt increase; but the first year

entries are about the same as usual. Our classes in Physics are rather down, but not very seriously. We shall get along all right with the remaining staff.

We have all pretty well got rid of our colds, and Eileen is leaving this week for boarding school. We had a very pleasant time in Montreal, and are much indebted to you for looking after us so well.

Give my love to Joan and Dick and tell them I hope they will make good use of their presents.

I will answer your letter later re a possible man.⁴ I am pretty busy just now starting up.

Yours very sincerely,
E. Rutherford

R-31 Notes

1. The letter from Eve is no longer extant. Except, perhaps, for the question of "a possible man" (see note 4 below), it was probably only a brief note enclosing the \$62.50 half-yearly interest (due January 1st) on the mortgage granted by Rutherford to Eve in 1911 for the purchase of a plot of land near Montreal (see, for example, note 4 of letter E-16). Since his last letter to Eve, dated June 15, 1914 (letter R-30), Rutherford and his wife and daughter Eileen had made a leisurely round-the-world journey, encompassing the meeting of the British Association in Australia in September, a prolonged visit to New Zealand which included a civic reception and a public lecture as well as time with relations and friends, and a transit of North America, including Montreal where he apparently stayed with the Eves and gave a lecture at McGill. (See note 1 of letter E-31 below; also Wilson, *Rutherford. Simple Genius*, 341-43.)

2. Bertram Boltwood was Professor of Radiochemistry at Yale University and an important collaborator and correspondent of Rutherford. (See Badash, *Rutherford and Boltwood*, also note 6 of letter R-9 and note 2 of letter R-10).

3. Sandy Hook is a small peninsula on the coast of New Jersey, immediately south of New York City. Cape Clear is on Clear Island, off the south coast of Ireland.

4. The reference to Eve's enquiry "re a possible man" is obscure, especially since Rutherford did *not* return to the subject in a later letter, at least those in the present series. We may assume that the staff of the Macdonald Physics Building at McGill had been depleted because of the war (there was no conscription in Canada at this time but many young men volunteered for the armed forces; see also Note 4 of letter E-31 below) and Eve was seeking a replacement from England. However, as Rutherford clearly implies in this letter, the Manchester department was itself depleted.

E-31 Eve to Rutherford

McGill University
Montreal
The Macdonald Physics Building
12 Jan. 1915

This letter crossed in the mail with Rutherford's letter (R-31) of the same date. It begins by wishing the Rutherfords a safe homecoming since "war has certainly increased to some extent the risks of travel." Eve also notes that he has heard "great appreciation from many quarters of that excellent lecture you gave us."¹

Eve states that he is forwarding a duplicate list of his papers and "I shall greatly appreciate the double honour of being proposed by the Royal Society [of London], and of being proposed by you."²

The letter notes that Barnes and McIntosh have returned from B.C. and "found the contract for the new University buildings there all held up, so that it is extremely doubtful what will happen."³ Meanwhile at McGill "we are full steam ahead with war, and with all sorts of drills, musketry, bayonet fighting. Also there is to be trench making and drills on snowshoes."⁴

The letter concludes by reporting that "Margaret, wife of Willie Gordon (C.B.'s brother) died suddenly on New Year's Eve, leaving 4 children, the youngest girl only 2½, a sad thing."⁵

E-31 Notes

1. A joint meeting of the McGill Physical and

My Dear Eve... The Letters of Ernest Rutherford to Arthur Stewart Eve

Chemical Societies was convened at short notice on December 23, 1914. Rutherford lectured on "The Spectra of X rays and Gamma Rays." The Chairman was Howard T. Barnes. The minutes of the Physical Society indicate that the lecture took the form of a review of the mechanisms of radiation emission by the atom.

2. Since the question of Eve's election to a Fellowship of the Royal Society of London was not mentioned previously in this correspondence, we must assume that the matter was discussed during Rutherford's recent stay in Montreal. The proposal was successful but the formal election of Eve to the rank of FRS was delayed until 1917. He had earlier (1910) been elected a Fellow of the Royal Society of Canada.

3. Howard Barnes, the Director of the Macdonald Physics Building at McGill, had formally resigned in order to take up (on September 1, 1915) the post of Professor of Physics at the new University of British Columbia in Vancouver. However, as Eve's letter indicates, Barnes found that the promised facilities at B.C. were far behind schedule. He therefore withdrew his resignation and remained at McGill until 1918, when a serious breakdown obliged him to resign (see also Note 5 of letter E-29 and Note 1 of letter R-30). A. Douglas McIntosh was Professor of Physical Chemistry at McGill. He had also resigned from McGill in order to move to B.C. as Professor of Chemistry; in his case the resignation stood in spite of the delay in providing facilities and he duly moved in May (?) 1915.

4. This is the first reference in this correspondence to the military activities of the students and staff at McGill University, although it may be assumed that Eve had informed Rutherford of these activities, and in particular of his own role in the McGill Contingent of the Canadian Officers' Training Corps, during the latter's recent stay in Montreal. For further details see the Introduction to this article, under "Arthur Stewart Eve, 1915-19."

5. Charles Blair Gordon (1867-1937), referred to by Eve as 'C.B.', was Eve's brother-in-law. Gordon's wife was Edith Annie Brooks, elder

sister of Eve's wife, Elizabeth, and of Harriet Pitcher, Rutherford's research student at McGill in 1900-1902. At the time Gordon was President of the Dominion Textile Company and a Director of several other companies including the Bank of Montreal. Later in 1915 he was appointed Vice-Chairman of the Imperial Munitions Board in Canada. In 1917-18 he was Director-General of war supplies for Great Britain (headquartered in Washington, D.C.). Gordon was knighted in 1917.

R-32 Rutherford to Eve

17 Wilmslow Road
Withington, Manchester
Jan. 25th, 1915

My dear Eve,

I have received your last letter and thank you for the list of papers enclosed.

There is nothing much to report here since my last letter. Eileen has gone to boarding school and the house is at present in the hands of decorators and carpenters for substantial changes.

You will be interested to hear that I have seen the recent numbers of the *Phys. Zeit.* and *Annalen*, owing to the kindness of Bohr, who gets them forwarded to him from Copenhagen.¹ Several obituary notices have appeared of scientific men, and a number are to follow, but there are none that I know well. One of the most interesting papers to me was a note by Seeman of Wurtzburg, showing a beautiful photograph of the X-ray spectrum of platinum. It is absolutely filled with fine lines from 2° to 12° including the strong lines found by Bragg and Moseley. He has used a remarkably perfect crystal of rock salt and a very penetrating X ray bulb.²

I am ordering to-day a Coolidge tube from Garry Cox in London, and am interested to see what can be done with it.³

Marsden leaves for New Zealand this week.⁴

We have just heard this morning of the defeat of the German raiding squadron, and the loss of the *Blucher*.⁵ I think everybody in

this country will feel that they have got a little back for the Scarborough and Zeppelin raids.⁶

Give my love to the youngsters and kind regards to your wife and sisters-in-law. Tell Mr. Gordon⁷ that I have much appreciated the cigars he presented to me on Christmas Eve. I was sorry to hear of the untimely death of his sister-in-law.

Yours sincerely,
E. Rutherford

P.S. I have heard from J.J.T. [Professor J.J. Thomson] that his boy has been at the front since November and had just had his first experiences of three days in the trenches. J.J. informs me that the big elementary laboratory for Medical students is used as a camping place for troops, and that there are in all 26,000 men at Cambridge.

R-32 Notes

1. Direct correspondence between Britain and Germany was impossible in wartime, but indirect communication via a neutral country was still practical if a suitable intermediary was available. At the time Niels Bohr was a lecturer in Rutherford's department in Manchester, having been granted two years' leave (1914-16) by the University of Copenhagen. (See Poul Dam, *Niels Bohr. Atomic Theorist, Inspirator, Rallying Point* [Royal Danish Ministry of Foreign Affairs, Copenhagen, 1985]; also the Introduction to Part III of this article, under *The Nuclear Atom*, 1904-14). It was presumably not difficult for Bohr to communicate with his colleagues in Denmark, who in turn received journals from Germany.

2. H. Seemann, *Das Röntgenspektrum des Platins. Physikalische Zeitschrift*, 15 (1914), 794-97. (Rutherford's spelling of both the name Seemann and the city, Würzburg, were in error.) The X-ray spectrum, i.e. the range of frequencies emitted by an X-ray tube, comprises two components: a *continuous* (or white) spectrum containing every frequency up to a maximum proportional to the peak kilovoltage applied between the anode and cathode of the tube; and a characteristic spectrum comprising a number of discrete fre-

quencies *characteristic* of the element in the target (anode) in which the rays are generated. The measurement of the latter spectrum had recently become possible with the demonstration of X-ray diffraction by von Laue in 1912 and the development of the theoretical basis of the phenomenon by W.L. and W. H. Bragg in 1912-13 (see Note 3 of letter R-20). The angles mentioned by Rutherford are those by which a narrow beam of X-rays are deviated (diffracted) by a crystal (in this case rock salt, i.e. sodium chloride) placed in the path of the beam; these angles can be translated into X-ray wavelengths by means of Bragg's Law ($2d \sin \theta = n\lambda$). Rutherford speaks of a "very penetrating X ray bulb" but it is interesting to note that Seemann does not quote the voltage applied across the X ray tube, because it was not measured. This voltage had to be at least 78 kV to produce all the so-called K-lines of the characteristic spectrum of platinum, although the longer wavelength (lower frequency) L-series of lines of platinum are produced at a relatively low kilovoltage, in the range 7-14 kV. It is the L-series that gives rise to the reflections at larger angles, according to Bragg's Law, and Moseley's Law, in turn, relates the X-ray frequencies to the atomic number of the target element. The papers by Bragg and Moseley referred to by Rutherford are as follows: W.H. Bragg, "The reflection of X-rays by crystals," Part II, *Proc. Roy. Soc. A*, 89 (March 1914), 246-48. (Part I of this paper, with W.L. Bragg, was published in July 1913 but did not include data relating to platinum); H.G.J. Moseley, "The high-frequency spectra of the elements," Part II, *Phil. Mag. Ser. 6*, 27 (April 1914), 703-13. (Again, Part I of the paper, published in Dec. 1913, included data only for relatively light elements. It may be added that, while Moseley carried out the Part I investigation in Manchester, for Part II he worked in the Electrical Laboratory at Oxford under Professor T.S. Townsend.)

3. In the first 18 years after their discovery by Röntgen in 1895, X-rays were produced exclusively in a gas discharge (Crooke's) tube. This comprised a glass bulb into which two metal electrodes were sealed. The gas in the tube was evacuated to a low pressure but sufficient residual gas remained to allow an elec-

trical discharge to occur when a high voltage (thousands of volts) was applied between the two electrodes. As a result the positive electrode (anode) was bombarded by negatively charged particles (electrons) moving at high speed; the rapid deceleration of these electrons in the metal anode resulted in the production of X-rays. Unfortunately the gas X-ray tube had several disadvantages: its behaviour was erratic and changed with time as the gas pressure in the tube altered with use; it was impossible to control the quantity (intensity) of the X-rays produced independently of their quality (penetrating power); and the output of X-rays was low, necessitating rather long exposures.

William Coolidge (1873-1976) was a physicist at the Research Laboratories of the General Electric Company in Schenectady, New York. In December 1913 Coolidge described a new type of X-ray tube based on a totally different principle. (W.D. Coolidge, "A powerful Röntgen ray tube with a pure electron discharge," *Physical Review*, 2nd ser., 2 [Dec. 1913], 409-30; a condensed version of this paper was published by Coolidge, under the same title, in the January 1914 issue of the *American Journal of Roentgenology*, 1 [1914], 115-24.) The gas pressure in a Coolidge tube is reduced to the lowest value achievable by vacuum technology and the negative electrode (cathode) is replaced by a tungsten filament which is heated by an electric current derived from a low voltage supply independent of the high voltage applied between the cathode (filament) and the anode. When the filament temperature is high enough – several thousand degrees Celsius – electrons are given off from the filament by the process of *thermionic emission*. These electrons move through the vacuum in the tube under the attraction of the positive high voltage and produce X-rays in the tungsten anode ("target"). A metal ring surrounding the filament serves to focus the electron stream on a very small area of the target.

The Coolidge tube is far superior to the gas tube in terms of constancy, reliability, controllability and output of X-rays. Following its invention, the Coolidge tube gradually replaced the gas X-ray tube but it was many

years before this process was complete and before the mechanism of X-ray production was fully understood. Rutherford, for example, cautiously waited a year before ordering one of the new tubes.

4. Ernest Marsden was Lecturer in Physics and John Harling Fellow at Manchester University. In 1914 he was appointed Professor of Physics at Victoria University College in Wellington, New Zealand, and was now leaving England to take up the new post. (See also Note 2 of letter R-25.)

5. On January 24, 1915 four German battle-cruisers, several light cruisers and a number of destroyers were sighted in the North Sea, apparently making for the east coast of Britain. The German ships were attacked by a British flotilla; the cruiser *Blücher* was sunk (with the loss of over 700 lives) and two other battle-cruisers severely damaged. The British denied a German claim that a British battle-cruiser was also sunk during the fight (see also Note 6 below).

6. On December 16, 1914 a number of German cruisers shelled three towns, Hartlepool, Whitby and Scarborough, on the north-east (Yorkshire) coast of England. The raid caused over 100 deaths and several hundred non-fatal casualties, all civilians. In addition there was extensive damage in the three towns. The British press and public condemned the raid as an "outrage." Shortly afterwards there were several reports of raids by Zeppelin airships. For example, on January 19, 1915 a raid on Yarmouth, on the east coast of England, killed two persons. On January 21 an editorial in *The Times* questioned the objective of these raids since they caused comparatively little material damage. The writer concluded that the purpose of the raids was to restore the tarnished prestige of Zeppelin in Germany and, at the same time, to instill a feeling of apprehension in Britain.

7. Mr. Gordon: see Note 5 of letter E-31.

R-33 Rutherford to Eve

17 Wilmslow Road
Withington, Manchester
May 8th., 1915

My Dear Eve... The Letters of Ernest Rutherford to Arthur Stewart Eve

Dear Eve,

I got your note this morning and am sorry to hear of the death of your mother. This was my first intimation. I can quite appreciate that it will make a big difference to your home visits.¹

I have no objection to your use of my name as a reference for the London Chair. As a matter of fact, I am an Advising Member of the London University Committee, and have received all the letters of application. I may tell you privately that the post was initially offered to Bragg, and he declined the proposal mainly on account of laboratory deficiencies. Later, he was approached again by the University College people, and they promised conditions so satisfactory that I think he will accept it. After his refusal, the post was advertised, and I suppose Bragg will not come in with the others. The meeting to settle the matter is on May 25th., and I think it probable that Bragg will be appointed.² In that case, Leeds will be vacant, and I have already mentioned privately to Bragg your claims for consideration. I presume you would be very glad to get a good position of that kind in England.³

I was interested to hear of your change of residence, and hope the property at Côte des Neiges is not too much of a drain on your funds in the meantime.⁴

As Barnes is staying another year I presume nothing will be done for some time to fill his post.

I received the other day an illustrated War number of the McGill paper. It was well got up, and I was much amused in reading Leacock's interview with Bernhardt—a very typical production.⁵

I am hard at work here analyzing the radiation from a Coolidge tube with steady potentials, and have got some interesting results. As far as I can see, it will be impossible for us to obtain X rays as penetrating as the γ -rays from radium C from an X ray tube, unless we could use uranium as an anti-cathode and potentials as high as a million or two volts. I am not quite clear of the reason of this, but I think it is in some way due to the increase of mass of the electron with speed.⁶

Things are very flourishing in the Radium Department of the Infirmary here where they are using nearly a gram of radium for medical purposes. One of my men is in charge as physicist.⁷

We have heard that the heavy Canadian losses have resulted in increasing volunteering in Canada. They seem to behave exceedingly well, and have stood very heavy losses. We have just heard this morning of the torpedoing of the Lusitania.⁸ It will be interesting to see what America has to say, for no doubt there will be a number of American losses. In view of their previous announcements, I do not see how America can avoid doing something drastic unless they are going to allow themselves to be terrorised by the Germans. It looks to me as if the neutral world will have to combine to stop her outrages on their ships, for apparently they would just as soon sink a Danish, Swedish, or American ship as an English one. There is much talk of Italy joining in, but I will only believe it after she has crossed the frontier. I believe that Italy is known in diplomatic quarters as the "hyena," because she wants her meat killed first.

Give my kind regards to the Pitchers and the Gordons, and to Barnes, Gray and King. Has King heard anything about the Adams Prize? I have made some enquiries but have heard nothing here.⁹

Give my love to Dick and Joan, who, I hope, have not completely forgotten me. Eileen is back again at school, where she is counting the days till her next holidays. The school suits her health very well, for she gained twelve pounds last term, and lost three on her holidays. Apart from a relaxed throat, which I have now got rid of, I am feeling fairly fit, and have been hard at work.

With remembrances to Mrs. Eve,

Yours very sincerely,
E. Rutherford

R-33 Notes

1. Eve's letter announcing the death of his mother has not survived. In a letter dated January 15, 1914 (see Note 8 of letter E-27), Eve's mother expressed the desire to move

from Southport to Hull in order to be near her other son Frank, but it is not known whether she actually made the transfer. It seems that Eve visited England regularly (once a year?) primarily in order to see his mother.

2. The post referred to is that of Quain Professor of Physics at University College, London. Rutherford clearly implies that Eve has applied for the post, or at least is considering an application, although there is no confirmation of this in Eve's letters in the present series. In the event (as Rutherford predicts), W.H. Bragg was appointed and took up the post in the autumn of 1915. His main reason for accepting the post was "to be nearer the centre of things where he hoped he could be of use in getting science and scientists employed to help the war effort." (G.M. Caroe (née Bragg), *William Henry Bragg, 1862-1942. Man and Scientist* [Cambridge Univ. Press, 1978], 80). In a letter dated March 26, 1915 to Professor Arthur Smithells, an influential member of the Leeds University Council, Bragg explained his motives for the move, including the need to use science for the economic well-being of the country after the war, an objective which he felt he could promote better in London than in Leeds. (Caroe, *ibid.*, pp. 138-40.)

3. Bragg's probable departure would leave a vacancy in Leeds University and Rutherford's reference to "your claims" implies that Eve has already expressed an interest in that post as well as the University College post. In the event, the Leeds chair was not filled at all until 1919, when Eve apparently applied for the post but withdrew when he found the pension provisions unsatisfactory: see letter E-39 below. The decision to postpone the appointment to the Cavendish Chair—as the Senior Chair in Physics at Leeds is known—until after the war was made in June 1915 by the Cavendish Chair Committee. Meanwhile, an Assistant Lecturer and Demonstrator in Physics, A. O. Allen, was appointed Acting Head of the department. In August 1919, out of a field of 13 candidates, R. Whiddington, a Lecturer in Physics at Cambridge and Fellow of St. John's College was appointed to the Cavendish Chair. Whiddington's candidature was supported by J. J. Thomson. His subse-

quent research interests at Leeds included X-ray spectra, applications of thermionic valves and the interaction of electron beams with hydrogen, helium and other gases. As for Allen, in 1916 he was promoted to Lecturer in Optics, a position he held until his retirement in 1930. (I am grateful to Professor A. A. Watson, Chairman of the Department of Physics at the University of Leeds, his colleague Dr. P. Rhodes and Mrs. Mary D. Forster, of the Leeds University Archives, for help in providing this information.)

4. The "property at Côte des Neiges" was the land originally purchased by Rutherford in 1906 or 1907 and later (1911) sold to Eve (see Note 5 of letter R-10). Rutherford had granted Eve a mortgage of \$2500 at 5%, hence the half-yearly payments of \$62.50 featured regularly in this correspondence, but Eve apparently made no attempt to build on the land and eventually (1925?) sold it to his brother-in-law G. Blair Gordon (see Note 4 of letter E-11). Eve's latest move was to Westmount, an affluent and, at the time, almost exclusively anglophone community close to downtown Montreal and McGill University. According to an advertisement inserted in the *Montreal Gazette* on February 4, 1915 by Fitz-James E. Browne, a Real Estate Auctioneer, the house was sold to Eve by auction the previous day, the price being \$10,100.

5. In 1912 a Cavalry Officer in the German army, General Friedrich von Bernhardi, published a book titled *Deutschland und der nächste Krieg* (Germany and the Next War.) The purpose of the book, as frankly stated in the preface and chapter headings, was to alert the German people to the dangers of settling major disputes by negotiation. "Public opinion ... did not understand the dangers of our political situation, and the sacrifices which a boldly-outlined policy would have demanded." War was a "biological necessity" and a "moral obligation"; Germany had "the duty of self-assertion" and "the right of conquest." The book was an immediate success and was reprinted many times. An English translation was published (London: Edward Arnold) and became an instant "best-seller." The "popular edition" (1914) was reprinted at least 18 times, reviewed in the *London Times Literary*

Supplement (27 Aug. 1914) and was even the basis of a long letter in the *Times* (25 Sept. 1914) warning the United States of the folly of remaining neutral in the war.

The McGill Daily was founded in 1911 and was one of the first daily newspapers produced by and for university students. In March 1915 the *Daily* issued a 58-page "Special War Contingent Supplement" which included a humorous article by Stephen Leacock titled "Side Lights on the Supermen. An Interview with General Bernhardt." At the time Leacock (1869-1944) was Professor of Political Economy at McGill and was well-known both for his scholarly works and his humorous books, the best of which were published in the period 1910-14.

In the *Daily* article, Leacock describes how, late one night, he is visited in his room at College by General von Bernhardt. The Prussian General wants to discuss "Germany and the Next War," a copy of which is lying on Leacock's table. Bernhardt complains that "My book is misunderstood. You English readers have failed to grasp its intentions. It is not meant as a book of strategy. It is what you call a work of humour. The book is to laugh. It is one big joke." The General quotes, as examples of humour, passages dealing with Germany's historical mission, a nation's moral obligations and the rules of war. However, the book is not *all* humour—there are also facts, such as the inevitable breakup of the British Empire in the event of war. The visitor is exasperated by Leacock's inability—or unwillingness—to distinguish the humorous from the factual passages and, in a fit of rage, collapses onto the spike of his helmet lying on the sofa. The General deflates like a punctured balloon, and vanishes. Then Leacock wakes up.

6. Rutherford was right in equating the γ -rays from radium C with X-rays generated at "a million or two" volts, but it is unnecessary to use uranium as the "anti-cathode" (anode). Any heavy metal will serve, provided that the voltage across the X-ray tube is high enough. (In practice tungsten is used as the target in most X-ray tubes, but this is because tungsten has several important physical properties such as hardness and a very high melting

point.) The penetrating power of both X- and γ -rays depends on the energy of their constituent photons (which behave like particles of zero mass) and this, in turn, depends on the energy balance in the process giving rise to the radiation: rapid deceleration of moving electrons (\rightarrow X-rays) or changes in energy states (including the conversion of mass into energy) within the atomic nucleus (\rightarrow γ -rays and other kinds of emission). Evidently Rutherford underestimated the energy involved in a nuclear transformation giving rise to a photon of γ -radiation. The basic problem was that the mechanisms of X-ray production in the electron orbits of the atom, and of γ -ray production in the nucleus, were not properly understood at this stage. Indeed, in his lecture at the Royal Institution in June 1915, subsequently published in July 1915 (see Note 3 of letter R-34 below for details), Rutherford stated: "There appears to be no doubt that the penetrating γ -rays have their origin in some sort of disturbance in the rings of electrons nearest to the nucleus, but do not represent, as some have supposed, the vibrations of the nucleus itself." (See also Note 3 of letter R-33 below.)

7. The following information has been kindly supplied by Dr. W.J. Meredith, Chief Physicist at the Christie Hospital and Holt Radium Institute, Manchester (1936-72) and by the present Chief Physicist, Ms. Pamela M. Nuttall:

"The Infirmary" was, and is, the Manchester Royal Infirmary. The radium was bought mainly as a result of the initiative of Alderman Edward Holt (later Sir Edward Holt) who, in February 1914 initiated a fund for the purchase of radium for the treatment of cancer in Manchester hospitals. He himself offered £2000 and this sum was doubled by other donations within a week. In all over £30,000 was collected. At first accommodation for the treatment was provided in a basement of the Infirmary, and the Radium Laboratories were formally opened at the end of 1914. The task of organizing the laboratories fell to Ernest Marsden, until he left for New Zealand in January 1915. Better premises were provided later when the name *Holt Radium Institute* was coined. At the same time the Manchester Home for Incurables, later renamed the

Christie Cancer Pavilion and, later still, the Christie Hospital, was accommodated in a large house in the Infirmary grounds. It was only in 1931 that the *Christie Hospital and Holt Radium Institute* came together in a newly-built hospital in Withington, the suburb of Manchester in which the Rutherfords lived.

The “physicist in charge” referred to by Rutherford was Henry Lupton, B.Sc., who had previously been employed in the Physical Laboratories of Manchester University. It seems that Lupton acted as Advisory Custodian of the radium, but he could not be described as an early “Medical Physicist” since he had no role in planning the treatments. The latter were carried out by surgeons entirely on an *ad hoc* basis since the principles of radium dosimetry were as yet unknown. Much of the radium stock was in solution, from which ‘emanation,’ i.e. radon gas, could be extracted and compressed into hollow metal ‘needles’ for ‘interstitial’ application in which the radioactive sources were implanted directly into tissue. (The advantage of radon for this type of treatment is that it has a short half-life, 3.8 days, so that the sources become inactive and can be left in the tissue permanently—unlike radium—thereby avoiding the need for a second surgical procedure to remove the needles.) Alternatively, radium was loaded into tubes for ‘intracavitary’ treatments (for example, tubes inserted into the uterus) or for the construction of surface ‘moulds’ for the treatment of skin or superficial cancer.

8. The British ocean liner *Lusitania* (Cunard line), on a voyage from New York to Liverpool, was torpedoed off the Irish coast on May 7, 1915. The ship sank within 40 minutes, with the loss of 1134 lives, while 772 passengers and crew survived. (At first 1502 fatalities and 658 survivors were reported, but these numbers were subsequently corrected.) About four-fifths of the passengers were U.S. citizens. A few days before the event, several American newspapers carried advertisements, issued by the Imperial German Embassy in Washington, that vessels flying the flag of Great Britain or its allies were liable to destruction in the waters adjacent to the British Isles. At the same time many intended passengers of the *Lusitania* received telegrams

signed by “John Smith” or “George Jones.” The one sent to a prominent American passenger, A.G. Vanderbilt, read “Have it on definite authority *Lusitania* is to be torpedoed. You had better cancel passage immediately.” It seems, however, that very few of the intended passengers heeded the warning and cancelled their passages. (Mr. Vanderbilt was one of the casualties.) *The Lusitania* incident had a profound effect on American public opinion, although two more years would pass before the U.S. abandoned its neutrality and declared war on Germany.

9. Pitcher: see Note 11, letter R-1; Gordon: see Note 5, letter E-31; Barnes: see Note 3, letter E-31 and Note 1, letter E-21; Gray: see Note 7, letter R-20; King: see Note 7, letter R-29; Adams Prize: see Note 7, letter R-24, also letter E-32 below.

E-32 Eve to Rutherford

490 Mountain Avenue
Westmount,
Montreal
30 May 1915

Eve begins by thanking Rutherford for his letter (R-33) and for the message of sympathy with respect to the death of Eve’s mother. Eve also encloses the semi-annual mortgage interest due on June 1st.

The letter goes on to mention the “excellent meeting of the Royal Society of Canada in Ottawa” in which there were 40 papers “of a high order” in the Physics section. Eve mentions specifically a paper by McLennan concerning “a new lamp with which he stimulates zinc or cadmium vapour & then with a low potential he gets the single line spectrum or fundamental “note” of the vapour.”¹

Next, some news about colleagues at McGill: “King did not get the Adams Prize, it was not quite close enough to the subject prescribed ... However he is walking away gaily and is not discouraged. He has been made Associate Prof and given a small rise—about the only one.² McIntosh has gone to Vancouver. Barnes holds off for a year, with nothing decided as to what he will do a year

hence. I think that Leeds would suit him nicely, also Bragg's house!"³

In reply to Rutherford's expression of concern with regard to the financial implications of his new residence, Eve replies that he can manage both the new house and the interest payments due to Rutherford because "I came into a bit extra since my mother died." He adds the surprising news that "We are expecting a new arrival about 3-10 June" –only a week ahead.

The remainder of the letter is concerned with the War: "Boyle was at Ottawa. He had heard from Kovarik that Geiger was sent home from the trenches with rheumatism, and that he (Geiger) took a rosy view of the Germans' chances.⁴ I am glad to see that England is realizing the magnitude of the task." Eve states that "Our McGill Company sailed last week, and another one is forming. A large number have gone with other regiments." Eve's personal role involves "... a good fortnight's camp at Niagara-on-the-Lake & I hope to go soon to qualify as a Major, although they will only make me a Captain for it! ... Since the "Lusitania" and poison gases I have been wanting to go for the Germans personally."⁵

E-32 Notes

1. J.C. McLennan, Professor of Physics at the University of Toronto, and his colleagues presented 8 of the 40 papers in Section III of the May 1915 meeting of the Royal Society of Canada. The work quoted by Eve was: J.C. McLennan and E. Edwards, "On the absorption spectra of mercury, cadmium, zinc and other metallic vapors," *Proc. Roy. Soc. Canada*, Ser. 3, 9, Section III (1915), 167-77.

2. See Note 9 of letter R-33.

3. See Note 3 of letter E-31, also Note 3 of letter R-33.

4. R.W. Boyle was a staff member of the McGill Physics Laboratory during Rutherford's final year (see Figure 1 in Part II of this article.) He remained at McGill after Rutherford's departure but moved to the University of Alberta in 1912. In a letter to Rutherford dated 12 September, 1912

(Cambridge Univ. Collection), Boyle wrote: "The equipment of apparatus for physics gave me quite a surprise. I did not expect to find it so good for such a young institution." Alois F. Kovarik was an American physicist who had worked with Rutherford in Manchester in 1910-11 and was now a professor in the University of Minneapolis. The meeting of the two men at Ottawa refers to the Royal Society of Canada conference (see Note 1 above). During Kovarik's period in Manchester he had collaborated with Hans Geiger (see Note 5 of letter R-9) and they had published a joint paper on the ionization produced by beta particles. It is not surprising, therefore, that Geiger wrote to Kovarik and this was still possible because the United States was neutral in the war at the time. However, it is possible that Rutherford knew about Geiger before Eve's letter arrived, since Kovarik wrote to Rutherford as follows (the letter is undated but appears to have been written early in 1915): "It may interest you to learn something about Geiger as I believe you have not heard from or about him since the war started. He has written me ... from Erlangen where he was then in a hospital with rheumatism. He fought at Nancy and Verdun having been called out the second day of mobilization." (Cambridge Univ. Collection.)

5. *Eve's personal role*: see Note 4 of letter E-31. *Lusitania*: see Note 8 of letter R-33. *Poison gases*: on April 17, 1915, the German Army issued an official telegram stating that, east of Ypres (Flanders) the British used shells and bombs emitting asphyxiating gases. This was denied by the British. The official British communiqué of April 23 admitted that a German attack had forced a French retreat near Ypres. The statement continued: "The attack was preceded by heavy bombardment, the enemy making use of a large number of appliances for the production of asphyxiating gases. The quantity produced indicates long and deliberate preparations for the employment of devices contrary to the terms of the Hague Convention to which the enemy subscribed. The false statements made by the Germans a week ago to the effect that we were using such gases is now explained. It was obviously an effort to diminish neutral criticism in advance."

E-33 Eve to Rutherford

McGill University
Montreal
The MacDonald Physics Building
10 June 1915

This letter begins with important news: "On Sunday, 6th, my wife presented us with a fine little girl baby, 10 lb & more, and I am thankful to say that so far both are doing very well."¹

Next, news about military training at McGill: "We are starting an auxiliary battalion at McGill and training men who want to be ready for later call, & we had 300 on Tuesday & there are to be 600 tonight ... We hope to find it a valuable recruiting ground for city & overseas regiments as they are called upon."²

Eve announces that we (presumably a McGill group) are starting a scientific committee to advise the government on inventions. He complains that "at present they pigeon-hole the lot at Ottawa."³ He notes that "people here are becoming unreasonably pessimistic, as they were optimistic some time ago."

Next, news about two colleagues at McGill: "Gray has just had 6 weeks training as an Artillery N.C.O. at Kingston & he is probably going overseas as range and direction finder ... McGill keeps his place open & pays him the difference between his full salary & his military pay."⁴ Eve reports also that "the other Gray" will probably accept a Professorship of Electrical Engineering at Cornell at a salary of \$3500. "Quite a loss to us."⁵

Except for a reference to Peterson's K.C.M.G.,⁶ the rest of the letter is concerned with the problem of the relationship between the current and the applied voltage in a Coolidge X-ray tube. Eve writes: "We have a Coolidge now and I am hoping to experiment with it soon. I wonder if there is a "space charge" which cuts down the effective voltage." He quotes (with rough sketches) his own experiments, reported in a letter to *Nature*, with an internally silvered carbon lamp. "Instead of Richardson's curve [sketch] going to infinity, I got Langmuir's, thus [sketch] with a rather abrupt transition ... Is it possible that even in the high vacuum of the

Coolidge there is a volume charge which back up against the applied potential?"

E-33 Notes

1. The new arrival, Cicely (foretold in letter E-32), was the Eves' third and last child.
2. On 16 June, 1915 the *Montreal Star* reported that over a thousand men had joined the McGill C.O.T.C. (Canadian Officers' Training Corp.) At a meeting of officers, including Captain Eve, it was decided that only 50 more recruits would be taken in. See also the Introduction to this article, under "Arthur Stewart Eve, 1915-19."
3. The lack of appreciation by Government and Military of the potential contribution of Science to the war effort was a constant complaint of scientists at this stage of the war, both in Britain and in Canada. This problem is discussed in the Introduction to this article, under "Science and the War, 1914-19."
4. J.A. Gray was a Lecturer in Physics at McGill.
5. Alexander M. Gray was an Assistant Professor of Electrical Engineering at McGill.
6. William Peterson was the Principal of McGill University: see Note 7 of letter R-9. On June 4, 1915 the *Montreal Gazette* reported that 11 Canadians were included in the British Birthday Honours List. Peterson was made a Knight Commander of the Order of St. Michael and St. George (K.C.M.G.).
7. See Note 3 of letter R-32 above for a discussion of the Coolidge X-ray tube. Eve was concerned with the effect of varying the voltage between the anode and the filament (cathode) of the tube, in particular the effect on the thermionic current, i.e. the stream of negative electrons emitted by the hot filament and attracted to the positively-charged anode. It seems that he would not risk experimenting with his newly-acquired Coolidge tube and instead used a modified carbon filament lamp with the inside of the glass bulb silvered (and connected to the outside by a wire) so as to form an anode. Unfortunately it is impossible to assess Eve's experiment properly, since his short letter in *Nature* is lacking in essential

detail; A.S. Eve, "The Thermionic Current," *Nature*, (April 15, 1915), 174.

Eve's letter speaks of a voltage which was varied from 100 to 165 volts, but it is unclear whether this was applied across the filament (in order to vary its temperature) or between the filament and the anode. The anode was connected to earth via a telephone receiver, which transformed fluctuations in the thermionic current into a noise of variable loudness. The most plausible interpretation is that the voltage was across the filament in which case there would be an effective anode-to-filament voltage of about half the filament voltage. Eve reports that the noise in the telephone receiver increased significantly as the voltage was raised from 100 to 140 volts, but suddenly ceased at 142 volts and remained silent up to 165 volts. He interprets this result as indicating that the thermionic current obeys Richardson's law (i.e. an exponential increase with filament temperature) only up to a certain value. Thereafter the curve of thermionic current vs filament temperature flattens out, i.e. the current becomes saturated. Eve was right in his tentative conclusion: there is a space charge in the high vacuum of a Coolidge tube and this limits the current between the filament and the anode unless the anode voltage is high enough to dissipate the space charge. Unfortunately Eve's experiment was faulty in that, unlike Langmuir, he used only one variable (the filament temperature) instead of two independent variables (filament temperature and anode voltage).

Owen W. Richardson was a graduate student at Cambridge when he read his landmark paper on thermionic emission to the Cambridge Philosophical Society on 25 Nov. 1901: O.W. Richardson, "On the negative radiation from hot platinum," *Proc. Camb. Phil. Soc.*, 12 (1902): 286-95. (See also Note 6 of letter E-26.) Irving Langmuir was a scientist at the G.E.C. Research Laboratories in Schenectady, New York—the laboratory where Coolidge developed the modern X-ray tube. I. Langmuir, "The effect of space charge and residual gases on thermionic currents in high vacuum," *Physical Review*, Ser. 2, 2 (1913): 450-86.

R-34 Rutherford to Eve

17 Wilmslow Road
Withington, Manchester
June 19th., 1915

Dear Eve,

I have received your letter and enclose herewith a formal receipt for the Bank draft.

I was interested to hear your news about the Royal Society and McLennan's paper,¹ but was sorry to hear that King had not got the Adams Prize.² I had an idea that they would be rather frightened at the volume of experimental work on points so unsettling to the normal mathematical physicist.

I gave my lecture at the R.I. a fortnight ago, and had a good audience, including J.J.T. in the gallery. I did not show many experiments, but had plenty of diagrams. I think an account of the lecture will soon appear in "Nature", but I forward you herewith an abstract which has appeared in "Engineering".³

I have little to report except that we have been very busy with the Examinations, which are now over. I am expecting Zeleny to come up and stay with me for a few days next week.⁴ My wife has been very busy visiting the Canadian and New Zealand wounded in Manchester, of which she is in general charge. She discovered five Canadians in a hospital who were put down in the Times as "died of wounds". There are a good number of Canadians here at present, and I have seen several of them. One of them from B.C. named Flewin, was a graduate of McGill, I think in Civil Engineering, and was there in my last year.⁵ He was a very pleasant fellow, but I think he has now sufficiently recovered to go to a convalescent home.

Most of my Second Year Honours students have gone to work in putting up chemical plant for War contracts. They receive, I think, 25/- a week.⁶ J. Barnes, who is with me, is thinking of doing some X ray work for the Canadian hospitals before he has to return to his work in Bryn Mawr.⁷ I got a letter from Andrade recently; his business is to supply ammunition to one of the heavy gun batteries in France.⁸ He says he received great kudos

from his Mess for discovering a supply of strawberries in a village destroyed by the Germans. Things in England go on much as usual, and we have had a most extraordinary spell of sunny weather—about a month on end. It is interesting to see how the Germans have been disturbed by the raid on Karlsruhe. I expect part of their annoyance is quite genuine, for the Germans have always reported their raids on Southend and English villages as on fortified places.⁹

I am trying to get some research done during the next month, and if I am wanted, will help the Engineering Department in testing aeroplane apparatus. The process of knocking out Germans at the rate of 300,000 a month goes on merrily, and we may be able to do something worth while in two months' time.¹⁰ It looks as if the Germans had very strongly fortified their positions opposite to us in France, and are concentrating their artillery against us. I got a note from Geiger's father the other day, saying that he was at the front again but was all right when he wrote.¹¹

I have not heard anything definite for some time about Leeds, and do not know what they are likely to do. It is possible that they may think of appointing young Bragg to succeed his father, but, of course, he is not available just now.¹²

With kind regards to your wife and Joan and Dick,

Yours very sincerely,
E. Rutherford

R-34 Notes

1. See letter E-32, especially Note 1.
2. Adams Prize: see letter E-32, also Note 7, letter R-24.
3. Rutherford gave the traditional Friday evening discourse at the Royal Institution of Great Britain (R.I.) in London on June 4, 1915. The audience included Rutherford's mentor, Sir Joseph J. Thomson, (J.J.T.), Cavendish Professor of Physics at Cambridge. The lecture was published in full in *Nature*, 95 (July 1, 1915), 494-98, under the title "Radiation from Exploding Atoms." This lecture, together with Rutherford's two lectures

in April 1914 to the U.S. National Academy of Sciences (see Note 3 of letter R-26), provides an excellent summary of what was known in 1914-15, and equally what was not known, about α , β , γ and X radiations and their relationships. For example, Rutherford stated that "...the highest frequency of the radiation emitted by radium C is only about twice that obtainable by a hard X-ray tube excited by 100,000 volts. It thus appears that there is a definite limit to the frequency of the radiation obtainable from a given atom, however high the speed of the disturbing electron." In fact, the most energetic γ -rays emitted by radium have a photon energy (2.198 MeV) almost 22 times that of the most energetic X-rays generated at 100,000 volts (0.1 MeV) and hence (since frequency is proportional to photon energy) a frequency 22 times higher. The discrepancy arises from the fact that X-rays are generated in the electron orbits of the atom, external to the nucleus, whereas γ -rays arise within the nucleus itself.

4. John Zeleny was Professor of Physics at the University of Minnesota at Minneapolis. He had known Rutherford since the 1890s when they were both research students in the Cavendish Laboratory. Zeleny's field of interest was ionization in gases rather than radioactivity (the two fields overlap to some extent) but nevertheless the two men had maintained a regular correspondence on scientific and other matters (see Badash: *Rutherford Correspondence Catalog*).

5. I am unable to trace any student named Flewin in the McGill records for Rutherford's last year, 1906-07, or earlier. However, Walter R. Flewin was listed as a first-year student in Applied Science in 1908-9 and as a second-year student in this field in 1910-11. He does not appear in the 'lists' for 1909-10, 1911-12 and thereafter, and there is no record of his graduation. If, therefore, this is the Flewin who talked with Rutherford, it seems that he exaggerated his academic achievements for the latter's benefit.

6. 25/- means 25 shillings or £1.25, about \$6.25 at the time.

7. J. Barnes is not to be confused with Howard Barnes, the Director of the

Macdonald Physics Laboratory at McGill. James Barnes was a visiting (American?) research student at Manchester and, in 1915, published four papers (two as co-author with Rutherford) on X-ray spectra and the efficiency of X-ray production (see the Bibliography in Birks, *Rutherford at Manchester*.) Bryn Mawr College, in Pennsylvania, was founded in 1885 for the education of young Quaker women, although it soon became non-denominational. It was the first women's college in the U.S. to develop graduate instruction leading to the doctorate for women, and remains today the only predominantly women's college (male students are now admitted) with extensive graduate programs. Barnes was presumably an instructor at Bryn Mawr—the Faculty included both sexes.

8. Edward Neville da Costa Andrade (1889-1971) was an English physicist who, after obtaining a Ph.D. in Heidelberg, spent a year as a graduate student at Manchester under Rutherford (1913-14). On the outbreak of war in 1914 he became an officer (eventually a captain) in the Royal Garrison Artillery. The *Rutherford Correspondence Catalog* lists seven letters from Andrade to Rutherford in 1915 (in the Cambridge collection), all highly readable accounts of life with the British Expeditionary Force in France and Belgium. The “strawberry” incident mentioned by Rutherford was related by Andrade in a letter dated June 15, 1915. An earlier letter, dated February 21, 1915, contains the following interesting description of the conditions under which he was serving: “The mud is beyond words and covered with a layer of water in most places: its viscosity is about 10^8 c.g.s. [centimetre-gram-second] units.” *Viscosity* is the property of a substance—a kind of internal friction—that determines how easily it flows under pressure. Andrade's statement should not be interpreted in strictly numerical terms—he was in no position to measure the viscosity of mud—but rather as a physicist's way of telling another physicist that the conditions were horrendous. (On the same cgs scale, the viscosity of water is about 0.01, of motor oil about 2 and glycerine about 10.)

9. On May 10, 1915, there was an airship

(Zeppelin) raid on Southend-on-Sea, a town on the east coast of England. According to the *London Times*, nearly 100 bombs were dropped indiscriminately over an area of five square miles, killing a woman and causing damage to the extent of about £20,000. However, the official communiqué from German Army Headquarters in Berlin referred to the raid “on the fortified place of Southend, at the estuary of the Thames.” A second raid on Southend took place on May 27. The French air raids on Karlsruhe, a town in the Rhine valley near the French border, took place on June 15 and 18, 1915, causing 17 and 84 casualties respectively. The official German communiqué described Karlsruhe as “an open town ... far from the theatre of operations ... not in any way fortified.” On June 18 the newspaper *Deutsche Tageszeitung*, commenting on the first raid, said that “Germany's answer to this foul attack must be ruthless reprisals not only on military cities and fortresses as the Germans have done so far, but on civilians.” The writer suggested that the ideal target for this purpose was the West End of London. Up to this stage of the combat neither side had been willing to admit that its strategy included, or should include, the killing of civilians.

10. I cannot give a precise reference for Rutherford's statement that German losses were 300,000 a month. However, unofficial estimates put the figure, if anything, even higher. For example, on March 8, 1915 the *London Times* carried an estimate of German casualties based on the official casualty lists published daily by the German general staff. The *Times* article concluded that in the first seven months of the war the German infantry losses alone amounted to over 3 million men. If the cavalry and artillery regiments were taken into account it was “impossible to estimate less than 3 million.” A 1912 estimate of the total strength of the German army, including untrained personnel, was nearly 10 m. It is difficult to reconcile the figure of 3 m. German losses in the first 7 months of World War I with more recent estimates of about 5.4 m. German casualties, including 1.8 m. dead, for all 51 months of the war: see, for example, the *Cambridge Encyclopedia* (Cambridge Univ. Press, 1990). It is impossible to guess what

My Dear Eve... The Letters of Ernest Rutherford to Arthur Stewart Eve

Rutherford had in mind with his suggestion of doing "something worth while in two months' time."

11. Since direct correspondence between Germany and England was not permitted, the note from Geiger's father presumably came through a neutral go-between, such as Bohr in Denmark. The previous news of Hans Geiger (see letter E-32, including Note 4) was that he was in hospital but evidently that episode was now over.

12. In his letter of 30 May, 1915 (letter E-32), Eve had stated that the Leeds position "would suit him [Barnes] nicely" but there is no indication that either Barnes or Eve himself was an active candidate (see, however, Note 3 of letter R-33). Meanwhile the younger Bragg (William Lawrence) had become a Fellow of Trinity College, Cambridge and, after a period in a military troop (the 'King Edward's Horse') attached to the University, had received a commission in the Army and was posted to the Leicestershire Royal Horse Artillery. Hence Rutherford's statement that "he [Bragg Junior] is not available just now." In the autumn of 1915 Bragg was sent to France by the War Office "to take over the French method of locating enemy guns by sound, and to start sound-ranging for the British Forces." (Caroe, *William Henry Bragg*, 79; see Note 12 of letter R-33.)

It may be added that Robert C. Bragg, the younger brother of William Lawrence, was an undergraduate at Cambridge at the outbreak of war in August 1914. He, too, joined the 'King Edward's Horse' and, in the summer of 1915, was sent to Gallipoli with the Expeditionary Force. Like Rutherford's brilliant research student, Henry Moseley (see Note 5 of letter R-20), Robert Bragg was killed on active duty in Gallipoli at the age of 24. (Caroe, *ibid.*, 80-81.)

R-35 Rutherford to Eve

17 Wilmslow Road
Withington, Manchester
June 22nd., 1915

My dear Eve,

Congratulations to you and Mrs. Eve on the

latest heavy weight addition to your family.¹ My wife and I are delighted to hear that all is going well. I judge that your state was not quite normal when you wrote to me, for you addressed me as Sir Edward Rutherford for the first time!²

I think I told you in my last letter that I was glad to see that Peterson has got his K.C.M.G.³ As you know, I tried to stir some of the people up about the matter when I was there at Christmas, and I hope that it helped.

Re the Coolidge tube, I have no doubt that for very heavy discharges there will be the regular volume distribution of electrons, and that the current will reach a maximum independently of the temperature of the wire.⁴ I have not tried to examine this question, as I do not want to smash my bulb.

I was interested to hear about Gray and the military movements in McGill.⁵ I think the outbreak of pessimism you refer to was largely the result of the Times and Daily Mail's attempt to throw out Kitchener and force conscription.⁶ I think it was a great pity that both of the papers were not stopped for a week or two, for they did a great deal of harm not only in this country but amongst the Allies.

One of our chemists, Weizmann, is likely to leave us during the war to help in starting factories for the manufacture of explosive materials by a method which he has worked out.⁷ I should not be surprised if one of the factories were started in Canada, for they will want them all over the world.

We are thinking of going for our holidays in August to Llanfairfechan in North Wales, and will join my colleague, the Hicksons, for a change.⁸ I have only spent one summer at the seaside since my arrival in England. Of course if there were any special work for me to do I shall stay in Manchester; but there seems to be very little chance that they are going to make any definite use of scientific people as a whole.⁹

With kind regards,
Yours very sincerely,
E. Rutherford

R-35 Notes

1. The Eves' third child, Cicely, born on June 6, 1915, weighed "10 lb & more": see letter E-33.

2. The mistake was evidently on the envelope, which has not survived. The letter itself (E-33) began, as usual, "My dear Rutherford."

3. See Note 6 of letter E-33.

4. The Coolidge X-ray tube, and its advantages over the gas discharge X-ray tube, were discussed in Note 3 of letter R-32 above, while the specific problem of the dependence of the current flowing across the tube on the temperature of the filament was discussed in Note 7 of letter E-33 (Eve's experiment with a carbon filament lamp.) Rutherford's conclusion that "the current will reach a maximum independently of the temperature of the wire" was mistaken. In fact, the tube current (and hence, the intensity of the X-radiation emitted, which is proportional to the tube current) depends on both the temperature of "the wire," i.e. the filament, and the voltage applied between the filament and the anode (target). For a given filament temperature (which, in a Coolidge tube, depends on the independent current flowing through the filament) the tube current (the flow of electrons from the filament to the anode) increases at first as the anode voltage increases but eventually reaches a maximum value (the *saturation* value) which does not change (or changes only slightly) as the anode voltage is further increased. In other words, the number of electrons reaching the anode cannot be greater than the number leaving the filament by the process of thermionic emission. However, an increase in the filament temperature results in higher thermionic emission and therefore a higher saturation current. A modern Coolidge tube is always operated with an anode voltage sufficient to attain saturation.

5. Gray: see Note 4 of letter E-33. Military movements in McGill: see Note 2 of letter E-33.

6. The *Times*' and *Daily Mail*'s "attempt to throw out Kitchener" must be viewed in the light of the worsening military situation. In World War I the small town of Ypres in

Flanders was the scene of three major battles. The first, in Oct.-Nov. 1914, resulted in the halting of a German offensive and the Germans were prevented from reaching the Channel ports. However, Ypres itself remained dominated on three sides by German-occupied heights. The second Battle of Ypres, in April-May 1915, forced the Allies to retreat. This was the battle in which the German forces used poison gases for the first time, as mentioned in letter E-32 above (see Note 5 of that letter.) The third battle, in 1917, resulted in minimal gains and appalling casualties.

On May 19, 1915, Lord Kitchener (the Secretary for War) made a statement in the House of Lords in which he deprecated the German gas attacks at Ypres and called for 300,000 recruits to form new armies. Two days later the London *Times* carried an Editorial which stated: "Our armies in the field have notoriously been deficient in the men and high explosive shells which they need to beat the Germans ... They need reinforcements; they need shells—and shells of the right kind. Neither have been provided in adequate quantities, for the simple reason that LORD KITCHENER'S orders were given too late, plain warnings were disregarded, the nation was lulled into an utterly false security by misleading official reports; and the consequence is that hundreds and thousands of British lives have been sacrificed in an unequal contest ... We are strongly of the opinion that ... LORD KITCHENER must be relieved of the business of supplying our troops at the front and at home with munitions and other necessities of war."

On the same day as the *Times* Editorial, May 21, the *Daily Mail* carried a leading article entitled "Lord Kitchener's tragic blunder." The next day there were unusual scenes on the floor of the London Stock Exchange, in which copies of the *Daily Mail* were burnt and other newspapers, including the *Times*, were denounced. The attacks on Lord Kitchener and his policies were described as "unpatriotic" and "ill-timed." Telegrams of support were sent to Kitchener and the Prime Minister, Mr. Asquith. A letter in *The Spectator* called for support for Asquith and

Kitchener but admitted that they did not anticipate the demand for high explosive shells. In the light of subsequent developments in the War, Rutherford's comments were unjustified. In fact, in 1916 both Kitchener and Asquith were replaced by David Lloyd George.

7. Chaim Weizmann (1874-1952) was a Russian chemist who emigrated to Britain (via Berlin and Geneva) in 1904. In 1915 he was a Reader [Associate Professor] in Biochemistry at the University of Manchester. In 1910-11 he became interested in the chemistry of fermentation, since he wanted to produce isoamyl alcohol, which is a by-product of alcoholic fermentation, in large quantities as a step towards the production of synthetic rubber. In his autobiography, *Trial and Error*, (New York: Harper & Brothers, 1949), 171-75, Weizmann relates how, in August 1914, he responded to a circular from the War Office, inviting scientists to report discoveries of potential military value. Weizmann promptly offered his fermentation process and, as a result, the process was taken up by Nobel, a major manufacturer of explosives in Ayrshire, Scotland. Furthermore, Weizmann was summoned to the British Admiralty, where the head of the powder department explained that there was a serious shortage of acetone, which was an essential solvent in the manufacture of cordite; without this solvent it would be necessary to make far-reaching changes in the naval guns. For a few months Weizmann continued teaching in Manchester whilst simultaneously constructing a pilot plant in London. (In the autobiography, Weizmann dates this part of his career as the spring of 1916, but Rutherford's letter, whose date of June 1915 is beyond dispute, indicates that Weizmann's memory may have been at fault and the actual period was the spring of 1915. This would also fit the date, August 1914, stated above as Weizmann's initial response to the War Office circular.)

Weizmann goes on to relate how, after a few months, he left Manchester and began working full-time for the Admiralty, under Mr. Winston Churchill. Churchill's first words, on meeting Weizmann, were: "Well, Dr. Weizmann, we need thirty thousand tons of

acetone. Can you make it?" Weizmann replied: "So far I have succeeded in making a few hundred cubic centimeters of acetone at a time by the fermentation process. I do my work in a laboratory. I am not a technician, I am only a research chemist. But, if I were somehow able to produce a ton of acetone, I would be able to multiply that by any factor you chose. Once the bacteriology of the process is established, it is only a question of brewing...." Weizmann comments: "Thus began a task which was to tax all my energies for the next two years, and which was to have consequences which I did not then foresee." (*Trial and Error*, 173). Eventually distilleries throughout the British Isles were converted to the production of acetone, but the supply of the raw material, maize [corn], was insufficient and production was shifted to Canada and America. In Canada the process was particularly successful under the direction of Weizmann's former pupil, Herbert Speakman, who later became Professor of Biochemistry at the University of Toronto (*ibid.*, 174).

In 1917 Churchill was replaced at the Admiralty by Arthur James (later Lord) Balfour, whom Weizmann had met earlier (1906) in Manchester. Weizmann had been a life-long Zionist and his relationship with Balfour, and with Lloyd George (who became Prime Minister in 1917), paved the way to the Balfour Declaration of 1917, which in turn led to the establishment of the State of Israel in 1948, although Weizmann vigorously denied that the Declaration "was a reward given me by the Government ... for my services to England." (*ibid.*, 150.). Weizmann subsequently became the first President of Israel. It may be added that, according to his autobiography, Weizmann's relationship with Rutherford was that of colleagues who were on close, amiable terms. They clearly enjoyed friendly banter and "leg pulling" (*ibid.*, 119.)

8. I am unable to identify "the Hicksons." There was presumably a Hickson in another department of Manchester University but no one of that name is listed in the Physics Department.

9. See "Science and the War, 1914-19" in the Introduction to this article.

distribution. But limitations of
space are wholly unthinkable.

I wish the war was going better
it looks like a long hard slog.

I am not to go overseas
but remain at the Depot here in
Imperial & train a 4th, 5th & 6th
company in succession as long
as the war lasts. I shall try &
lecture, too if they will let me.

I get about £1 a day
& save it.

The children are very well.
We all send good wishes to
you & Lady Rutherford & to Sir F.F.S.
Yours ever loving
Abba

490 Mountain Avenue
Westmount
Montreal.

4.7.15.

My dear Rutherford,

Forgive me for calling
you Sir Edward, & mentioning
"The Importance of being Ernest"

I'm better in 4 weeks & 1/2 & scales
10 3/4 lb., my wife is doing well
but is very tired, & the nurse left
yesterday. We have a cool
summer, quite pleasant.

I am a Captain in Genl.
pay just now & command
until I know or not when

Figure 2. First and last pages of a letter from Eve to Rutherford (E 34).

E-34 Eve to Rutherford (Figure 2)

490 Mountain Avenue
Westmount
Montreal
4.7.15

Eve opens this letter with an apology for addressing Rutherford in the previous letter (E-33) as Sir Edward, and "overlooking 'The Importance of being Ernest.'"¹ He notes that the baby is 4 weeks old and scales 10 3/4 lb.

The main subject of this short letter is Eve's role in training the McGill military contingent. He is "a Captain in Govt. pay just now & onward until I know not when." McGill has already sent two companies overseas and now Eve must "raise, equip & train the Third Universities Company for overseas." He adds that he now has to wear uniform all the time, "and 'amen' to Physics for the present." However, "what will happen on 1st October I don't know, as both the Govt. and the University may claim all my time, but for the present the extra work is congenial & the pay *very acceptable* ... I get about £1 a day and earn it." Eve predicts that he will not be sent overseas but will remain in Montreal to train companies in succession as long as the war lasts. But "I wish the war was going better, it looks like a long hard plug."

A subsidiary subject of this letter is the "interesting and important letter" that Eve's colleague Louis King is just sending off to *Nature*:² "From astronomers' data on the absorption of light from stars in interstellar space & from Rayleigh's scattering law he finds 4000 molecules of say Hydrogen(?) in interstellar space per cm³. That makes the invisible matter 100,000 times as much as the visible matter of the stars, which is certainly a curious thing. If the number of stars is limited as some astronomers hold, then space must be limited, if there is random distribution. But limitations of space are wholly unthinkable."³

E-34 Notes

1. The mistake was presumably on the envelope, which has not survived. *The Importance of Being Ernest* is an allusion to the popular

comedy by Oscar Wilde, first produced in 1899.

2. L.V. King, "The density of molecules in interstellar space," *Nature*, 95 (Aug. 26, 1915), 701-03.

3. The "limitation of space" is no longer as "unthinkable" as Eve supposes, if the "curvature" of space postulated in modern cosmology is taken into account. Modern theory also agrees with the notion that 'invisible' matter is the larger component of the universe.

E-35 Eve to Rutherford

490 Mountain Avenue
Westmount P.Q.
29.11.15

The main purpose of this short letter is to enclose the "usual draft," i.e. the half-yearly mortgage interest owed by Eve to Rutherford.

However, there is some important personal news: Eve announces that he has passed his medical and, on December 6th, "as a Major, Second in Command, [will] help Major Alan Magee raise the 148th Regt. So I may be in England about April & in France or the Balkans in the summer. It is a great wrench to leave my family, but needs must when the Kaiser drives." Eve adds that his 4th Universities company has just sailed, "a very good one."

E-36 Rutherford to Eve

17 Wilmslow Road
Withington, Manchester
December 11th., 1915

My dear Eve,

I have received your note this morning, and also the draft, the formal receipt of which I enclose.

I was very interested to hear of your decision to go in for active service. I appreciate your patriotism, but I think you have now reached that position of seniority when you could probably do better work training men than leading them in active service. If I recall rightly, I am relatively an infant compared with you. However, you are in the best posi-

tion to judge; but I would not be in a hurry to make a final decision.¹

Our term's lectures have just come to an end, and I have been exceedingly busy with my work for the B.I.R., and have had very little time to think of anything else. I have made several trips to Scotland for experimental work, and we have made some progress.²

We are expecting Eileen back from school next week. She has not yet got rid of homesickness, and is very keen to be back for her holidays.

Most of the people in my laboratory have been attested, but some of them I want to keep for my own work, including Kay, my faithful steward, who is helping me in all my experiments.³

Give my love to Joan and Dick, and please expend for me a dollar apiece in buying them a Christmas present from me. I enclose herewith a postal order for that amount. I presume the infant has not yet reached the stage of appreciating Christmas!

With kind regards to Mrs. Eve and yourself, and wishing you all a happy Christmas and a prosperous New Year.

Yours very sincerely,
E. Rutherford

R-36 Notes

1. Eve's "decision to go in for active service" refers to his letter of November 29, 1915 (letter E-35) in which he predicts that he may be in England in April [1916] and in France or the Balkans in the summer. Rutherford was right about their relative ages: Eve was born in 1862, Rutherford in 1871. Eve was therefore 52 years of age at this time.

2. The Board of Invention and Research was created in the spring of 1915 for the purpose of mobilizing and utilizing Britain's scientific and inventive talent in the war effort. Rutherford was a member of the anti-submarine committee of the Board. For further details, see the Introduction to this article, under "Science and the War, 1914-19."

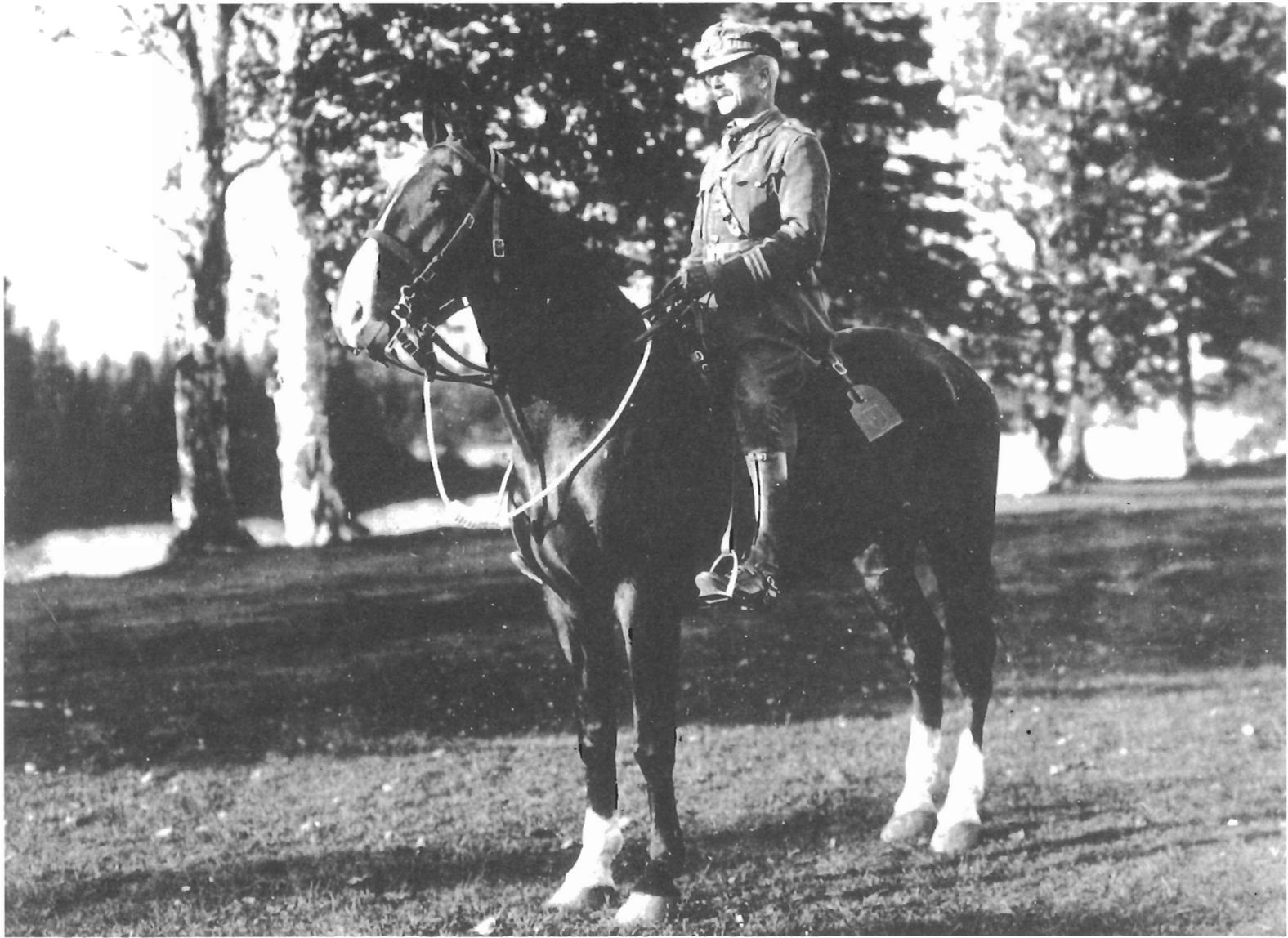
3. Rutherford appears to be using the verb *attest* in the sense of *testify* or *certify*. He is say-

ing that most of the (greatly reduced) number of scientists remaining in the Manchester Department of Physics are fully qualified and no longer in the status of graduate students. As such they are entitled to work on problems of their own choosing, not necessarily related to Rutherford's special interests. However, Rutherford wants some of them, at least, to remain in the broad field of radiation physics. Of the 19 papers published in the 3 years 1916-19 by members of the Manchester Physics Department (excluding the 11 papers published by Rutherford, either alone or with a co-author), 7 can be considered as falling within Rutherford's special area of interest while 12 are outside that area, although not necessarily totally removed from it: for example, optical spectroscopy is related to the structure of atoms and molecules. (See the Bibliography in J.B. Birks [ed.], *Rutherford in Manchester* (1962); also Table II in the Introduction to Part III of this article.)

E-36 Eve to Rutherford

148th Overseas Battalion
24 May 1916

Eve opens this short letter by thanking Rutherford for his "kind & thoughtful letter" which presumably (since the letter has not survived) questioned whether Eve can still afford the half-yearly mortgage interest payments now that he is a full-time army officer. Eve, however, assures Rutherford that "at present our financial position is sound & we can pay the interest all right." However, there follows a list of other problems: "We have been trying to sell our house or our lot, but there are no bidders, and I do not suppose that there will be for 2 or 3 years. Also we could not let our house furnished or unfurnished." In addition, the Eves cannot get a cook or a general [servant] and the governess has sprained her ankle. In the circumstances the Eves have decided to shut up their house: his wife and children will go (for a month at least) to Mempremagog, to a "charming farmhouse 6 miles from Magog, at Mrs. Shuttlemouth's," while the 148th Battalion will go to Valcartier Camp for a few weeks before going to England.¹ "I expect to be in England in August, but that is guessing."



My Dear Eve... The Letters of Ernest Rutherford to Arthur Stewart Eve

Figure 3. Eve at Whitley Camp for Canadian soldiers, 1917. (Courtesy of Mrs C. Grinling.)

E-36 Notes

1. *Magog* is a small town in the Eastern Townships region of Quebec, about 120 km east of Montreal. It is located on the northern tip of Lake Memphremagog. *Valcartier* was, and is, a Canadian Armed Forces base about 30 km west of Quebec City.

E-37 Eve to Lady Rutherford

180 Woodstock Road
Oxford
25.10.16

This letter, addressed to Lady Rutherford, was written five months after E-36. As Eve had predicted in that letter, the 148th Battalion was sent to England during the summer or early autumn of 1916. Mrs. Elizabeth [Betty] Eve joined her husband in England, presumably after his arrival [this is unclear], but it seems that Lady Rutherford had invited Mrs. Eve and her children to become house-guests in Manchester even before Eve himself received his overseas posting. In this letter Eve thanks Lady Rutherford for "your kind invitation for Betty to stay with you to meet me. But neither port, boat or date were known to us, and on landing we were rapidly moved to Witley and thence to Bramshall Camp.¹ Then the whole battalion was ordered six days leave in which I now revel. On return to camp we start seriously at our English training and we are of course absolutely in the dark as to where we move and when we go we hope to go to France as a unit, & not broken up for reinforcements."

The letter then states that his wife has taken a furnished house in Oxford and that both children are at school in that city,² "so that they are all comfortably settled for the winter, & probably for the spring."

Eve states that H.L. Cooke is coming over at Bragg's suggestion for scientific work of a military type.³

Apart from the usual salutations, the letter ends as follows: "The life suits me well & is full of interest, but I am ready to turn into a professor again when the Kaiser gets tired, a lengthy process."

E-37 Notes

1. *Witley* is a small town in Surrey, in the south of England. However, it is probable that Eve's spelling was in error and he meant *Whitley*. There are actually three Whitley's in England but the most likely candidate is the one near Liverpool, assuming this was the port of arrival. This would make sense as a staging point for Bramshall, about 50 km north of Birmingham.

2. The Eves had *three* children, but the youngest, Cicely, was only 16 months old at this time.

3. Hereward Lester Cooke was a graduate in physics at McGill and subsequently a demonstrator in Physics. In 1903 he was awarded an 1851 Exhibition Scholarship which enabled him to spend three years as a graduate student at Cambridge. The "scientific work of a military type" was sound ranging in France, i.e. the location of enemy heavy guns by means of a number of microphones distributed in a fan-shaped area. The responses of the microphones to the sound of the gun were recorded on a moving film and time differences in the arrival of the sound enabled the gun position to be fixed within a few feet. The technical head of the sound ranging team was Major W.L. Bragg, i.e. Bragg Junior, and the team included several scientists from Manchester such as Darwin and Andrade, as well as Cooke from Canada. (See Eve, *Rutherford*, 250-1.) Cooke later became a Professor of Physics at Princeton.

E-38 Eve to Rutherford

B.I.R. [Board of Invention and Research]
Parkeston Quay
9.9.17

This letter was written almost 11 months after Eve's previous letter (E-37). The absence of any explanation for the gap indicates that there were probably intervening letters, since lost.

Eve states that he has been at Parkeston for about two weeks, but "You & Bragg have covered so much of the available ground, that I am coming in rather late with my little spade,

and the next steps are not easy to find. I am reading and picking up all I can ... In addition to making various experiments I am going to put together the B.I.R. reports so that anyone wanting to know previous work, successes & failures, may be able to get it quickly with references. This should save a good lot of trouble, and will also make me acquainted with the present state of affairs. The main problem seems to be to hear the faint hum of distant engines above all the strong racket of your own ship in motion."¹

Eve follows with a statement of his own predicament: "I am not yet quite clear if I was right to give up military work for the B.I.R. work. There seemed no prospect of my going to France, as they only want subalterns, and I am over age for that, and there would not have been enough income for my family. Officers who have not been to France are not thought much of for training or teaching so I was not keen on continuing at that work indefinitely. After all the S.M. [submarine] problem is the key to the whole position."²

The letter also contains some personal business: "My wife is now family paymaster and was under the impression that interest to you 62⁵⁰ was paid yearly and not half yearly. We know that you were paid June 1916 and June 1917 but I cannot find that you were paid in December 1917 Please look this up, and I will send you a cheque without delay & with my apologies." Eve adds that his family is settling down in Oxford, "where schools are good and air raids come not."

E-38 Notes

1. Shortly before this letter was written Major Eve had been appointed Director of the Admiralty Experimental Station at Harwich (on the east coast of England), in succession to Sir W.H. Bragg (*Bragg Senior*) who was now Scientific Advisor to the Admiralty. (See also "Science and the War, 1914-19" in the Introduction to this article.)

2. A *subaltern* is an army officer of junior rank, i.e. below the rank of captain. At the time of this letter Eve was almost 55 years of age and had reached the rank of colonel. There is certainly a note of frustration in Eve's

complaint that he is considered too old for active service, but he must have known this to be the case from the beginning of the war. It seems that, on the outbreak of war or soon afterwards, Eve wrote to the Marlborough College Battalion of the Officers' Training Corps in England, enclosing a letter for the War Office. Eve had taught at Marlborough College before coming to McGill in 1903, and had commanded the Marlborough Cadets Corps. The O.T.C. Commanding Officer, A.H. Wall, replied on September 10, 1914: "There is not the slightest chance of your being called upon except perhaps to assist to train recruits. The old members of the O.T.C. have come forward in their hundreds and thousands and there are not enough places for them to fill. No master officers [i.e. teachers who were officers in the O.T.C.] have been called out though all have volunteered ... Personally I think that the Germans will get all they want in a few days—our strategy has been hard to follow but it is going to succeed." (Eve Correspondence Collection in McGill University Archives.)

E-39 Eve to Rutherford

G.W. [Great Western] Hotel
Paddington
4.4.19.

This letter, the last in the present series, was written almost 19 months after the previous letter (E-38) and 5 months after the Armistice in November 1918. There were probably intervening letters that have not survived.

The letter opens with felicitations to Rutherford on his appointment to the Cavendish Chair of Physics at Cambridge University: "Accept my ardent congratulations on your appointment to so illustrious a Chair! In this case both Man and Chair can be congratulated without stint, and each brings fame and a fair future to the other."¹

Eve relates that, the previous night, he attended "a great McGill dinner in honour of Sir A. Geddes as Principal."² The chief speakers were Borden,³ Milner,⁴ Bonar Law⁵ and Geddes and "the room was full of generals

(e.g. Turner, Burkett) & colonels (e.g. Adams,⁶ Tory,⁷ Adami,⁸ etc.)”

Eve states that he has seen Smithells but “found pension fund lacking at Leeds, so I said that they had better look elsewhere, as far as I was concerned, but it is very hard to know whom to recommend.”⁹

Eve indicates that “we shall get away at the end of this month”—presumably back to Canada—but “it is very puzzling to know whether Canada or England is the better for us as a whole.” He adds that he expects to see McGill “go ahead with rather a swoop.” He adds that he himself feels good for hard work and teaching and organisation, but “I fear for originality in research work as I get nearer to GO. Even young men seem rather sterile for ideas, just at present.”¹⁰

The letter ends on a peaceful note.: “I am a man of leisure for the first time since the war began, and I am browsing a book, & getting up to date as far as possible.”

E-39 Notes

1. The Cavendish Chair of Physics at Cambridge University was (and is) one of the most prestigious appointments in the world of science. The Chair was founded in 1871, when the Cavendish family endowed the Cavendish Laboratory as a memorial to Henry Cavendish (1731-1810), the physicist/ chemist who ascertained that water is a compound of two gases. The Cavendish Professor is also the Director of the Laboratory. The vacancy occurred through the retirement of Sir Joseph J. Thomson, Rutherford’s mentor who had held the post since 1884. Previous occupants were James Clerk-Maxwell (1871-79), who supervised the building of the laboratories, and Lord Rayleigh (John William Strutt, 1879-84). Rutherford remained at the Cavendish Laboratory until his death in 1937.

2. Sir Auckland Geddes was a Professor of Anatomy at McGill when the war began in 1914. He immediately resigned, joined the Army and served in France. In 1916 he was recalled to the War Office, appointed Director of Recruiting and subsequently Minister of National Service. In April 1919 he was appointed Principal of McGill in succession to

Sir William Peterson, who had held the post since 1895. However, Geddes never actually carried out his duties as Principal. In May 1919 the President of the Board of Trade in Britain, Sir Albert Stanley, resigned for reasons of ill-health and Geddes was asked to take charge of the department on a temporary basis. McGill agreed to postpone Geddes’ appointment for 12 months, until the autumn of 1920, and meanwhile Frank Dawson Adams, Dean of the Faculty of Applied Science, served as Acting Principal (see Note 8 below.) However, in 1920 Geddes was appointed British Ambassador to the United States and resigned the Principalship.

3. Sir Robert Laird Borden was Prime Minister of Canada from 1911 to 1920. He represented Canada in the Imperial War Cabinet (1917) and in the Imperial War Conference (1918). Borden received an Honorary LL.D. from McGill in 1913.

4. The *Milner* mentioned by Eve was probably Sir Alfred Milner, the Secretary of State for War since 1918 and a Member of the War Cabinet, 1916-18. He had no direct link with McGill University.

5. Andrew Bonar Law was Leader of the House of Commons (1916-21) and a member of the War Cabinet (1916-19) at the time of the dinner. He had previously held the post of Chancellor of the Exchequer, 1916-18 and would later (1922-23) serve as British Prime Minister. Bonar Law had no direct link with McGill University.

6. Lieut.-Colonel Frank Dawson Adams was Deputy Director of Educational Services of the Canadian Forces Overseas (the Khaki University of Canada), 1918-19. He was Dean of Applied Science and Vice-Principal of McGill, 1920-24, and (as stated in Note 3 above) served as Acting Principal in 1919-20. He was also Professor of Geology at McGill and had collaborated with Eve in early investigations on radioactivity (see Note 3 of letter R-3, also letter E-2.)

7. Colonel Henry Marshall Tory was Director of Educational Services of the Canadian Forces Overseas (the Khaki University of Canada), 1917-19. He was Professor of Mathematics at McGill, 1897-1908 and then became Principal

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of the new University of Alberta at Edmonton, a position he maintained throughout the war (see letter E-3).

8. John George Adami was a Colonel in the Canadian Army Medical Corps. He was Professor of Pathology and Bacteriology at McGill, 1892-1919. In 1919 he published *The Story of the Canadian Army Medical Corps*. (See also Note 4 of letter R-19.)

9. Professor Arthur Smithells was an influential member of the Leeds University Council (see Note 2 of letter R-33 above). An appointment to the Leeds Chair of Physics was, in fact, made soon after this letter: see Note 3 of letter R-33.

10. Eve was right in stating that scientists who had been away from science (by which he meant "pure" science as distinct from science applied to the solution of military problems) were devoid of new ideas. That was only natural. However, this did not apply to Rutherford, who had continued his work on radioactivity, albeit at a much reduced pace, throughout the war years and was ready to make a giant leap forward with artificial radioactivity, prediction of the neutron and other advances: see Note 4 of letter R-37 below.

R-37 Rutherford to Eve (Figure 4)*

17 Wilmslow Road
Withington, Manchester
April 13/19 [1919]

My dear Eve,

I appreciate your very kind letter of congratulations and good wishes over the Cavendish Post & it will hearten me up to tackle the job with vigour.¹ I found it rather difficult to make a decision but hope I have done the right thing in the interests of Physics & secondarily of myself. I shall remain here till the end of the session but hope to take up residence in the [...]** to survey the land before the beginning of term. We have or rather my wife and Eileen have already been house hunting but it is not an easy job to get anything suitable except at extravagant prices. We are considering at the moment Routh's [?] old house—Newnham Cottage but it will be rather expensive to get it into decent shape.²

I was interested to see you have got Auckland Geddes as Principal of McGill.³ His price is high but I suppose it is regarded as a dividend in the capital he is to take in. It certainly seems an appointment that will give McGill a jump in the public eye both here & in Canada.

I suppose we all tend to go slow in ideas as we yet older & our work is then to see the younger ones are given a free hand to develop. I quite agree that sterility of ideas is in general an aftermath of war conditions but it will probably soon pass.⁴

We go for a week in the country nearly this week for a little change which I need badly.

With kind regards to Mrs. Eve & Dick & Joan.

Yours sincerely,
E. Rutherford

* This letter is written by hand and is difficult to decipher.

** Illegible word

R-37 Notes

1. See Note 1 of letter E-39.

2. The Rutherfords did, in fact, purchase Newnham Cottage on Queen's Road and lived there until Rutherford's death in 1937. I am unable to identify Routh.

3. See Note 2 of letter E-39.

4. Rutherford was right in saying that the sterility of ideas "will soon pass." This was certainly true in the Cavendish Laboratory, which soon became a hive of activity under Rutherford's direction. Indeed, in his own case, there was no period in which he was devoid of ideas. On the contrary, throughout the war Rutherford devoted whatever time could be spared from his specifically military investigations to experiments on the interaction of fast-moving α -particles with the nuclei of light atoms such as hydrogen, oxygen and nitrogen. This work was carried out alone, with the help only the laboratory steward William Kay, and led to the first evidence of artificial disintegration of the atom. The results were not published until 1919, when

April 13/19

My dear Eve

I appreciate your very kind letter of congratulation & good wishes on the Cavendish Post. It will hearten me up to tackle the job with vigour. I found it rather difficult to make a decision but I hope I have done the right thing in the interests of Physics & secondary of myself. I shall remain here till the end of the session but hope to take up residence in the house to survey the land before the beginning of term. We have a rather nice wife & Eileen have already been house-hunting but it is not an easy job to get anything suitable

except at extravagant prices. We are considering at the moment Rutherford's old house - Newnham College - but it will be rather expensive to get it in into decent shape.

I was interested to see you have got Auckland felled as Principal of Welfill. His price is high but I suppose it is regarded as a dividend on the capital he is to make in.

It certainly seems an appointment that will give Welfill a good in the public eye better there & in Canada.

I suppose we all tend to go slow in ideas as we get older & our work is then to see the younger ones are given a free hand to do what I quite agree that Sturtevant's ideas is in general an aftermath of our conditions but it will probably soon pass.

We go for a week in the country nearly this week for a little change which I need badly.

I am
 Ernest Rutherford

Figure 4. Letter from Rutherford to Eve (R 37)

four consecutive papers appeared: E. Rutherford, "Collision of alpha particles with light atoms," *Phil. Mag.*, Ser. 6, 37 (1919), 537-61, 562-71, 571-80 and 581-87.

Postscript

The final letter in this article, and indeed the series of articles, was written by Rutherford in April 1919, just before he left Manchester to take up a new post in the Cavendish Laboratory. This is an appropriate endpoint for a correspondence that spans the whole of Rutherford's Manchester career, from 1907 to 1919. However, the collection which provides the theme of this series includes two further letters from Rutherford to Eve which have not been published. Letters R-38 and R-39 are dated 29 December 1920 and 4 May 1926 respectively, but unfortunately there are no linking letters from Eve, in spite of the fact that the Rutherford Correspondence Catalog lists nine letters from Eve after E-39, the last contribution from Eve included in this article. Letters R-38 and R-39 cannot therefore be considered as part of a coherent correspondence.

In letter R-38 Rutherford comments on a number of physicists who have presumably applied for a post in the McGill Physics Department, now directed by Eve since Barnes resigned in 1919. Rutherford adds: "I keep going pretty well and enjoy life. My experiments go slowly but I hope to straighten things out gradually."

In the second post-1919 letter, R-39, Rutherford acknowledges the receipt of a 'magnum opus' written by Louis King but "after a hasty glance through it, I handed it on to R.H. Fowler [Rutherford's son-in-law]."

There is, however, a third post-1919 letter which is not included in the 'recently discovered' group, since it has long been part of the McGill University Archives and, indeed, is listed in the Rutherford Correspondence Catalog. This letter was sent by Rutherford to Eve in May 1933 after she had informed him of the untimely death of his sister-in-law Harriet Pitcher, née Brooks. (Eve's letter has not survived.) Since Harriet Brooks was an early collaborator of Rutherford and features

a number of times in the present series of articles, Rutherford's letter is reproduced in full below. As indicated in the letter, Rutherford contributed an obituary of Brooks in *Nature* shortly after writing the letter.¹ Very recently a full-length biography of Harriet Brooks has been published.²

R-40 Rutherford to Eve

Newham Cottage
Queen's Road
Cambridge
May 6, 1933

My Dear Eve

It was very good of you to write me news about Harriet Pitcher. I had not heard of her illness and a few days before your letter, Mary had spoken of writing to her. It is a very sad business. The last time she came to see us about two years ago, one could not but recognize the obvious loss of vitality but this was quite understandable after her family calamities.³ I have the happiest remembrances of our friendship in the old days at McGill and the renewal of these during our occasional visits to Montreal. She was a woman of great personal charm as well as of marked intellectual interests. I am afraid her domestic life was not without serious trials which she bore with astonishing fortitude. My wife and I held her in great affection and her premature death is a grievous blow to us. I shall see whether I can compose a short statement of her scientific contributions for 'Nature' in the next few weeks.⁴

I am enclosing a note for Pitcher of whose address I am uncertain. I hope we shall have an opportunity of seeing Pitcher again. Fowler has just returned from California and the children are all well and flourishing. I am sure you know of our deep sympathy with you and Elizabeth in this great breaking of family ties. With best wishes to you all.

Yours ever,
Rutherford

Postscript and R-40 Notes

1. Ernest Rutherford, "Harriet Brooks (Mrs.



Figure 5. Rutherford, and Eve, ca 1927. The identity of the lady is unknown. (Courtesy of Mrs C. Grinling and Peter Fowler.)

Frank Pitcher)," *Nature*, 131 (17 June 1933), 865.

2. Marelene F. Rayner-Canham and Geoffrey W. Rayner-Canham, *Harriet Brooks. Pioneer Nuclear Scientist* (McGill-Queen's University Press, 1992).

3. Two of Harriet Pitcher's three children died in their teens.

4. See note 1 above.

Acknowledgements

I am grateful to Prof. Ferdinand Terroux, the first Curator of the Rutherford Museum at McGill University, for drawing my attention to the existence of the letters discussed in this article; to Mr. A. E. B. Owen, Keeper of Manuscripts at Cambridge University Library, for supplying the photocopies of the letters from Eve to Rutherford; to the Syndics of Cambridge University Library for permission to quote from these letters; and to the staff of the McGill University Archives and Libraries, in particular Mrs. Phebe Chartrand, for assistance in searching for obscure facts and explanations. Finally I must thank Mrs Cicely Grinling (née Eve) and Professor Peter Fowler (grandson of Ernest Rutherford) for supplying photographs and useful information. However, they have not seen the text of this article: any mistakes and omissions are my responsibility alone.