

My Dear Eve...

The Letters of Ernest Rutherford to Arthur Eve. Part II, 1909-1911

by Montague Cohen

In a previous article, annotated transcripts were presented of seven of a set of 37 hitherto unknown letters. These seven letters were written in 1907-08, from Ernest Rutherford in Manchester to Arthur Eve in Montreal. This article contains a further eight letters from Rutherford written in the years 1909-11. These letters are interleaved with annotated summaries of 13 letters from Eve to Rutherford written in the same period, which are owned by Cambridge University. The period covered in this article saw Rutherford's first publication of the nuclear model of the atom, the beginning of the quantum theory of radiation, and a greatly improved knowledge of the properties of radioactive elements and of the radiations emitted in the radioactive process. The correspondants participated in the First International Congress of Radiology in 1910, which resulted in the setting up of an International Radium Standards Committee. In addition, the correspondence deals with private matters such as Rutherford's efforts to sell land owned by him near Montreal and Eve's application for a vacant Chair of Physics at Bristol University.

Un article a déjà été consacré à la présentation annotée des sept premières lettres inédites d'une série de 37 qu'Ernest Rutherford a écrites de Manchester à Arthur Eve à Montréal. Les sept lettres on été écrites en 1907 et 1908. En deuxième partie de cet article, huit lettres que Rutherford a écrites entre 1909 et 1911 sont présentées. Celles-ci sont entrecoupées des résumés annotés des 13 lettres d'Eve à Rutherford, écrites pendant la même période, lesquelles font partie de la collection de l'université de Cambridge. La période retracée dans cet article est marquée par la première publication de Rutherford sur le modèle atomique, les prémisses de la théorie des quanta sur la radiation et l'élargissement des connaissances sur les propriétés des éléments radioactifs et des radiations émises dans le cadre du processus de radioactivité. Le premier congrès international de radiologie s'est également tenu en 1910 et a donné lieu à la création d'une commission internationale sur les normes du radium. Ces lettres portent également sur certains aspects de la vie privée des deux correspondants, notamment sur les efforts déployés par Rutherford pour vendre un terrain à proximité de Montréal et sur la candidature d'Eve à la chaire de physique de l'université de Bristol.

An earlier article (Part I)¹ presented the first seven of a series of 37 hitherto unknown letters written from Manchester, England, by Ernest Rutherford to his friend and former colleague, Arthur S. Eve at McGill University. These letters, which are not listed in the *Rutherford Correspondence Catalog*² were recently discovered among other documents and letters

at McGill. This article continues the story by presenting annotated transcripts of eight further letters from Rutherford to Eve, written in the years 1909-11.

As in the previous article, the letters written by Rutherford are interleaved with annotated extracts and summaries of 13 letters written by Eve to Rutherford in the same three-year period. Eve's letters have long been in the public

domain since they are part of the Rutherford Collection in the Library of Cambridge University. These letters are therefore not reproduced in full, but it is hoped that the extracts (published by permission of the Syndics of the Cambridge Library) will provide a measure of coherence to what was, after all, a two-way correspondence.

To my knowledge, no photograph exists showing Rutherford and Eve together in the period covered by this article. The nearest substitute (Figure 1) shows the staff of the McGill Physics Laboratory in 1907-08. Apart from Rutherford and Eve, the group includes several colleagues mentioned in the present correspondence.

Ernest Rutherford, 1909-11

At the onset of the period covered by this article, Rutherford had been Head of the Physical Laboratories at the Victoria University, Manchester (usually called simply Manchester University) for almost 18 months. The settling-in period was over, he was firmly in control and had put together a first-rate team of researchers, several of whom would subsequently become world famous. It was undoubtedly one of the most productive, as well as one of the happiest periods in Rutherford's life. Several excellent essays on this period are included in the book *Rutherford at Manchester*,³ which commemorates the 50th anniversary of Rutherford's 1911 nuclear model of the atom. The nuclear atom is, of course, mentioned in the correspondence presented in this article, but it would be untrue to say that it occupies a central place. On the contrary, both Rutherford's reference to his new atomic model and Eve's response are low key, almost casual. Indeed, it was not until 1913, when Neils Bohr gave Rutherford's atom a mathematical, quantum framework that the scientific world began to accept the theory.

Further background information on the period covered by this article is found in the biographies of Rutherford by Eve (1939)⁴ and Wilson (1983),⁵ in the series of short biographies of 'Radiological Physicists' published by del Regato (1985)⁶ and in a number of other publications listed in the Introduction Notes in Part I.

Arthur S. Eve, 1909-11

During the period under review, Eve rose from the rank of Assistant to Full Professor of Physics at McGill, although his rapid promotion is not mentioned in the correspondence presented in this article.⁷ Eve's research in radioactivity in 1909-11 continued along the lines of his earlier work, i.e. measurement of the radioactivity of air, water and rocks; investigation of the secondary radiations produced by β and γ rays; and determination of the properties of β rays, including the absorption of the rays in air and their rate of production of ions. None of these investigations was seminal in the sense of leading to a profound new insight into the nature of matter or of radioactivity, but Eve certainly made a significant, albeit unspectacular, contribution to the science of radioactivity. The growth of this science is illustrated by the fact that, fourteen years after Becquerel's discovery of radioactivity, Marie Curie required almost 1000 pages to cover the subject in the two volumes of her *Traité de radioactivité*.⁸

The correspondence, 1909-11

The arrangement of letters in this article is shown in Table I. The table indicates that the correspondence in this period was erratic; letters were not sent and received in an orderly sequence in either direction. There are several possible explanations for this. Firstly, we cannot rule out the possibility that some letters have been lost, particularly those written in 1909. Secondly, it must be borne in mind that Eve and his family travelled to England regularly – they seem to have spent most summers in England (1911 was an exception) and Eve probably saw Rutherford during these visits. Also, Rutherford visited Canada in August 1909 (for a meeting of the British Association for the Advancement of Science) and the two men met during that visit. Thirdly, in contrast to the correspondence between Rutherford and Bertram Boltwood,⁹ the Rutherford-Eve correspondence was mainly a *business* correspondence, in the sense that each wrote when he had something specific either to communicate or to request. Thus Eve requested Rutherford to act as god-parent to his son, to calibrate a radium source, to write a testimonial, to forward a paper for publication, to send reprints of papers. Rutherford, in his turn,



Figure 1. Ernest Rutherford, Arthur Eve and colleagues.

needed Eve's advice on the value, and possible sale, of a plot of land which he (Rutherford) owned near Montreal. It is true, of course, that most letters contain other news and comment, but the correspondence for this period nevertheless gives the impression that the prime purpose of writing was to make a specific request or to provide needed information.

The analysis just made should not be taken to imply that the relationship between the two men was purely formal. We know from earlier correspondence and other evidence (see, for example, Part I) that the two men were good friends and held each other in high regard, at both personal and scientific levels. It seems, however, that by 1909 this warm relationship did not *need* a regular flow of letters to sustain it. Correspondence could therefore be relegated to an intermittent exchange as and when needed.

The Rutherford-Boltwood correspondence was quite different. On average, Rutherford's letters to Boltwood were considerably longer than those to Eve, and the style was different, too. The explanation, I believe, is two-fold. Firstly, Boltwood was a *chemist* who could supply Rutherford with information and advice on chemical aspects of radioactivity and radioactive substances – information which Rutherford needed but which lay outside his own expertise. Just as Rutherford had earlier collaborated with the chemist Frederick Soddy, he now needed and valued the collaboration of Boltwood, either by correspondence or (in 1909-10) by Boltwood's presence in Manchester. Secondly, the Rutherford - Boltwood correspondence contains an element of *banter* which is absent in his exchanges with Eve. Rutherford had a puckish sense of humour which he obviously enjoyed exercising when writing to Boltwood. Thus, on 19 September 1911, Rutherford wrote to Boltwood: "I am surprised at a man of your reputed ability imagining that you can determine such a probability curve with a mere 200 observations without the use of the scientific imagination, which is so unusual in your chemical brethren..."¹⁰ Such a statement (and there are many other examples) is unimaginable in a letter to Eve. The reason, I believe, is that Rutherford was aware that Eve had little or no sense of humour.

The first and last pages of Rutherford's first letter in this sub-set (R-8) are reproduced in Figure 3.

Two problem letters

The dates of two letters in this set are doubtful. The first, E-9, is clearly dated 6 February 1910 but Note 1 of E-9 sets out four reasons for believing that Eve actually wrote the letter on 6 February 1911 and '1910' was a simple mistake. Nevertheless, this letter has been placed in its nominal (1910) position in relation to other letters.

The other doubtful letter, E-15, also from Eve, is undated. In the Cambridge Collection this letter is provisionally dated September 1911 but there are good reasons for believing (see Note 1 of E-15) that the letter was written several months earlier, in late April or early May. In this article the letter has been assigned a place corresponding to April 1911.

Scientific background to the Correspondence, 1909-11

The letters in this article were written during a period which was particularly productive in physical science: major advances were made in both experimental and theoretical physics and, in addition, three events took place which were important landmarks in the development of physics and radiology. Many of these themes, summarized below, are reflected, to a greater or lesser extent, in the Rutherford-Eve correspondence:

- The genesis of the nuclear model of the atom. Rutherford's first paper on the nuclear atom was published in 1911, although the underlying observations and measurements, on the diffusion (scattering) of α -particles by matter date back to 1906 and especially to 1909-10. However, the earlier work is not discussed in the present correspondence and (as already pointed out) even the 1911 nuclear atom receives little more than a passing mention.
- The emergence of the quantum theory of radiation. The idea that energy flows in discrete bursts or *quanta* was advanced by Planck as far back as 1900, but the hypothesis was not applied seriously to X and γ rays until 1909-11, when Stark and later W.H. Bragg put

THE INTERNATIONAL RADIUM STANDARDS COMMITTEE.

Members:
B. HOLLWOOD; M. CURIE; A. DEBIERNE;
A. S. EVE; H. GEITEL; O. HAHN; ST. MEYER;
E. RUTHERFORD; E. v. SCHWEIDLER; F. SODDY.

Secretary:
PROF. Dr. STEFAN MEYER
Institut für Radiumforschung, Wien,
IX., Waisenhausgasse 3 (Austria).

Bruxelles, 15. Sept. 1910.

Congres internat. De radiologie.

Statement of the Standards - Committee.

- 1). Mme Curie has kindly consented to prepare a radium standard containing about 20 milligrams of radium (element).
- 2). As soon as the Standards-Committee reimburse Mme Curie for the cost of the standard, the latter comes under the control of the Committee and is only to be used for purposes of comparison with the secondary standards. The standard is to be suitably preserved in Paris.
- 3). Through the Committee and at their discretion National Scientific Laboratories willing to pay the costs are to be provided with the international standard.
- 4). In due course, by such methods, as the Committee after due investigation approve, smaller standards are to be prepared.
- 5). Since the radium-emanation is now so much used in scientific investigations the Committee consider it desirable to adopt a unit for the quantity of emanation. Following the suggestion of the Conference, the Committee recommend that the name "Curie" be given to the quantity or mass of emanation in equilibrium with one gram of radium (element). For example the amount of emanation in equilibrium with 0.001 gr. radium would be called one "Milli-Curie".
- 6). The Committee have under consideration the question whether special names should be given to a small quantity of radium and for the emanation in equilibrium with it.
- 7). Since some members of the Standards - Committee are not present at the Congress (Bruxelles) the suggestions made above are necessary tentative. The Committee reserve full power to modify them on further consideration.

Figure 2. Preliminary statement of the International Radium Standards Committee drafted by the Secretary of the Committee, Professor Stefan Meyer, on 15 September 1910. (This document was found among Eve's papers at McGill University.)

forward a 'corpuscular' explanation of the properties of these rays and, in particular, their observed interaction with matter and the production of secondary radiations. These problems receive a fair amount of attention in the Rutherford-Eve correspondence.

- The nature and properties of radium emanation (radon) continue to feature prominently in Rutherford's work and in his letters, as do his complaints about Sir William Ramsay's work in this field.
- The first International Congress of Radiology and Electricity took place in Brussels in September 1910, and both Rutherford and Eve participated. An important decision of the Congress was the setting up of an International Radium Standards Committee charged with defining a unit of radioactivity and preparing an International Radium Standard. Rutherford was one of the two British representatives on the Commission (the other was Soddy) while Eve represented Canada. The preliminary statement of the Committee, drafted by its Secretary, Professor Stefan Meyer of Vienna, is shown in Figure 2.
- A further important event was the first Solvay Conference held in Brussels in October, 1911. The conference was organized and paid for by the Belgian industrialist Ernest Solvay and about 15 of the world's leading scientists, including Rutherford, Marie Curie, Einstein and Planck were invited. The subject discussed was the "Theory of Radiation." Unfortunately, Rutherford made no mention of this conference in his letters to Eve, although he published an account of the meeting in *Nature*.¹¹

Private background to the Correspondence, 1909-11

The background to the correspondence in this article includes private as well as scientific events. The most important private matters covered in the letters are as follows:

- Rutherford's desire to evaluate, and subsequently to sell, the plot of land near Montreal which he had purchased (in 1905?) for the purpose - never fulfilled - of building a house. This matter occupies a prominent place in the correspondence from October 1909 onwards, especially since Eve himself eventually purchased the land in June 1911.

Thereafter, for the next 20 years, Eve wrote to Rutherford at least twice a year, if only to enclose the half-yearly interest payment of \$62.50 on the \$2500 mortgage which Rutherford had provided.

- In 1910 Eve made an unsuccessful application for the vacant Chair of Physics at Bristol University in England. The matter unfortunately dragged on, since no appointment at all was made for several years, and this occasioned some caustic comment by Rutherford in his letters.
- At the beginning of the present set of letters there is an exchange relating to Eve's newly-born son Richard Stewart and Eve's request that Rutherford assume the role of god-parent. Rutherford accepted but did not attend the christening.

Introduction Notes

1. Montague Cohen. "My Dear Eve... The Letters of Ernest Rutherford to Arthur Eve, 1907-1908," *Fontanus*, 1 (1988): 3-37.
2. Lawrence Badash. *Rutherford Correspondence Catalog* (New York: American Institute of Physics, 1974).
3. J. B. Birks, ed. *Rutherford at Manchester* (London: Heywood and Co., 1962).
4. Arthur S. Eve. *Rutherford. Being the Life and Letters of the Rt. Hon. Lord Rutherford, O.M.* (Cambridge: Cambridge University Press, 1939).
5. David Wilson. *Rutherford, Simple Genius* (Cambridge, Mass.: MIT Press, 1983).
6. J. A. del Regato. *Radiological Physicists* (New York: American Institute of Physics, 1985).
7. The promotion to Associate Professor, in 1909, had been delayed a year by budgetary constraints, while the further promotion, in 1910, was perhaps spurred by the fact that Eve was known to be applying for professorial posts elsewhere.
8. Marie Curie. *Traité de radioactivité* (Paris, Gauthier-Villars, 1910).
9. Lawrence Badash, ed. *Rutherford and Boltwood: Letters on Radioactivity* (New Haven: Yale University Press, 1969).
10. Badash. *Rutherford and Boltwood*: 253-54.
11. E. Rutherford. *Report on Conference on the Theory of Radiation* (Brussels, 29 Oct.-4 Nov. 1911.) *Nature*, 88 (16 Nov. 1911): 82-83.

TABLE 1

**The McGill Collection of Rutherford-Eve Correspondence
Section II: 17 January 1909 – 1 November 1911**

Rutherford to Eve		Eve to Rutherford	
R-8	30 January 1909	E-8	17 January 1909
R-9	6 May 1909		
R-10	28 October 1909		
R-11	30 September 1909	E-9	6 February 1910 ¹
		E-10	8 October 1910
		E-11	11 October 1910
		E-12	16 October 1910
R-12	16 October 1910		
		E-13	4 November 1910
R-13	21 January 1911	E-14	5 January 1911
R-14	15 February 1911		
		E-15	? April 1911 ²
R-15	14 June 1911	E-16	8 May 1911
		E-17	19 June 1911
		E-18	28 August 1911
		E-19	17 October 1911
		E-20	1 November 1911

¹ This letter is clearly dated February 1910 and is therefore placed in this position in the collection. However, there is strong evidence that the actual date of writing was February 1911: see Note 1 of letter E-9.

² This letter is undated but is ascribed to September, 1911 in the Cambridge University Collection. However, the context of the letter points to an earlier date, April (or possibly early May) 1911: see Note 1 of letter E-15.

E-8 Eve to Rutherford

167 Hutchison Street, Montreal
17 January, 1909

Eve begins by thanking Rutherford for his letter of congratulation¹ on the birth of a son, the second child of Dr. and Mrs. Eve. He then requests Rutherford to "confer the great favour of becoming godfather to our young man.... If you are too burdened with work and other calls, please do not hesitate to refuse if you think fit. We should be disappointed but not hurt." The letter mentions that Harriet Pitcher² had consented to be godmother and that Eve's nephew Jack Eagles, a scholar at Oxford, would be asked to be the other godparent: "With a Nobel man and an Eagle, the unnamed one ought to soar."

Eve next states that he has been reading Curie's collected works. This is a reference to Pierre Curie, husband and collaborator of Marie Sklodowska-Curie. Eve comments: "It is astonishing how slow he was to accept your conclusions,³ when the facts and evidence were before him. I believe if it had not been for you the whole subject would have been a grotesque muddle to this day, and goodness knows where Ramsay⁴ would have led us. Yet Curie seems to have been quite a sound man."

The letter concludes with a short scientific note accompanied by a freehand sketch: "I have put a paper cone on the top of Eberts machine⁵ and fired γ rays only through the top. + ions greatly exceed - ions. Ratio 1.8 or 1.4 to 1. There is no free emanation here.... I am going to get to the bottom of this."

E-8 Notes

1. See letter R-7.
2. Harriet Pitcher, *née* Brooks, was Eve's sister-in-law and a former research student of Rutherford. See Note 11 of letter R-1.
3. The "conclusions" related to the nature of radioactivity and the transmutation of elements resulting from radioactive disintegration.
4. Ramsay: see Note 4 of letter R-3 and Note 3 of letter R-9.
5. "Eberts machine" refers to the apparatus designed by H. Ebert of the Physics Institute of the Technical High School in Munich and published in the Proceedings of the German Physical Society in 1905. (H. Ebert, "Eine neue Form des Ionen-Aspirations-Apparates." *Berichte der Deutschen Physikalischen Gesellschaft*, 7, 1/2 (1905): 34-37. An earlier version of the apparatus was described by Ebert in *Phys. Zeit.*, 2 (1901): 662.) The instrument was used to measure ionic charges in the atmosphere, and was often referred to as an "ion counter." It comprised a gold leaf electroscope surmounted by a cylindrical metal condenser through which air was drawn by means of an aspiration wheel driven by clockwork. Knowing the rate of inflow of air, the rate of change of voltage on the electroscope and the electrical capacity of the condenser and electroscope, the charge of either sign in one cubic cm of incoming air could be calculated. The apparatus was available commercially from a German manufacturer and was widely used by researchers.

Eve's experiment, as briefly described in this letter and, shortly afterwards, in a letter to *Nature* [A. S. Eve "Ionisation in the Atmosphere." *Nature*, 80 (March 11, 1909): 36-37. A French translation of this letter was printed in *Le Radium*, 6 (March 1909): 88-89.], involved channelling the air drawn into the ion counter through a paper funnel, the top part of which was irradiated by means of an external radium source. As a result, the number of ions of each sign per cm³ of air increased from about 1000 (in the absence of radiation) to nearly 40,000 (depending on the intensity of the external radiation). Nevertheless, the ratio of positive to negative charges measured by the ion counter remained about the same - even somewhat higher - than was the case without an external source of radiation. Eve argued that, since the radium source produced positive and negative ions in equal numbers, the discrepancy in the numbers must be due to some other cause, such as the production of doubly-charged positive ions or a difference in the mobility of the ions. Eve returned to this subject a year later, in a paper published in May, 1910: A. S. Eve "The Effect of Dust and Smoke on the Ionization of Air." *Phil. Mag.*, Ser. 6, 19 (1910): 657-673. In this paper, which includes a diagram of Ebert's apparatus, Eve suggests that the apparent excess of positive over negative ions is due, at least in part, to the fact that negative ions rapidly combine with particles of smoke, dust or mist and pass through the testing vessel undetected.



PHYSICAL LABORATORIES,
THE UNIVERSITY,
MANCHESTER.

Jan 30. 1909

My dear Eve.

I shall be
delighted to be sponsor
a god-parent for your
radioactive offspring
provided you do not
expect me to accept
the religious obligations.
I do not know what
my duties are but
I shall expect to be

Your results re β rays
I have found are
interesting and different
to explain. You will see
in a recent Proc Roy Soc
Tinnend has found something
which may prove analogous.
We are far from knowing
all about these things yet.

The University here give
me a dinner on Feb 9th.
"San Joseph" comes up to discuss
my health & selections of city
scientific magnets are
wanted. It is very good
The University is rather
alarmed for me.
With kind regards to
Mr. Eve the H. A. Am.
What's his name in the eye
I don't think you have met
it. Yours ever
E. Rutherford

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

Figure 3. First and last pages of letter (R-8 in present series)
written by Ernest Rutherford to Arthur Eve on 30 January 1909.

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

R-8

The first and last pages of this letter are reproduced in Figure 3.

Physical Laboratories
The University
Manchester
Jan 30 1909

My dear Eve,

I shall be delighted to be sponsor or god-parent for your radioactive offspring¹ provided you do not expect me to accept the religious obligations. I do not know what my duties are but I shall expect to be primed by you beforehand. I recognise that I am in excellent company & am flattered by your selection of such an unreligious person as myself.

As to myself, I was kept to the house for a week with water in the knee. I am now myself again and am in excellent form. I have just been investigating the variation of condensation point of the Ra Eman[ation] with pressure. I purify my 1/20 cubic mm of emanation available & press it up into a minute capillary. The experiment works like a charm. I have already got from -150°C to -100° and have not yet got to atmospheric pressure. It looks to me as if the boiling point at atmospheric pressure will be about that of CO_2 .² I have seen the drops of liquified emanation with the aid of a microscope! I feel quite pleased of myself for I thought it would prove a forlorn hope when I tackled it.

Your results re γ rays & paper funnel are interesting and difficult to explain.³ You will see in a recent Proc. Roy Soc Townsend has found something which may prove analogous.⁴ We are far from knowing all about these things yet.

The University here gives me a dinner on Feb. 9th.⁵ "Sir Joseph"⁶ comes up to propose my health and selections of city and scientific magnates are invited. It is very good of the University but rather alarming for me.⁷ With kind regards to Mrs. Eve and the He. atom.⁸ Whats his name by the bye – I don't believe you have settled it.

Yours ever

E. Rutherford

R-8 Notes

1. See letter E-8. As mentioned in Note 1 of letter R-7, Rutherford liked to quip on the subject of radioactivity.

2. Rutherford reported the results of these experiments in a letter to *Nature* published less than three weeks after writing this letter to Eve: E. Rutherford "The Boiling Point of the Radium Emanation." *Nature*, 79 (18 Feb. 1909): 457-58. A more detailed report appeared three months later: E. Rutherford "Condensation of the Radium Emanation." *Phil. Mag. Ser. 6*, 17 (May 1909): 723-29. Rutherford found the boiling point of the emanation (radon) to be about -65°C at atmospheric pressure, a value which (as predicted to Eve) is fairly close to that of carbon dioxide, -78.5°C . Rutherford noted that the boiling point of the emanation, as determined experimentally, agreed well with the expected value for a noble gas of atomic weight 222, on the basis of the known variation with atomic weight of the boiling points of other noble gases such as argon, xenon and krypton.

3. See letter E-8, especially note 5.

4. In 1895 John S. Townsend (1868-1957) became one of J. J. Thompson's first research students at the Cavendish Laboratory in Cambridge. (Rutherford joined the laboratory in the same year.) In 1900 Townsend was appointed Wykeham Professor of Physics at Oxford, a position he held for the remainder of his life. Townsend is considered to be the founder of the kinetic theory of ions and electrons in gases and he obtained the first value of the elementary electric charge. The paper referred to by Rutherford is: J. S. Townsend "The Charges on Ions in Gases, and the Effect of Water Vapour on the Motion of Negative Ions." *Proc. Roy. Soc.*, 81A (1908): 465-471. Eve referred briefly to this work in his letter to *Nature* discussed in Note 5 of letter E-8.

5. The dinner was given by Manchester University for Rutherford to celebrate the award of the 1908 Nobel Prize in Chemistry: see letter R-6.

6. Sir Joseph J. Thompson: see Note 2 of letter R-6.

7. "Rather alarming for me." Rutherford was not usually so modest – indeed, all the evidence indicates that he positively enjoyed occasions such as a University dinner given in his honour.

8. "He. atom." A reference to Eve's newly born son: see Note 1 of letter R-7.

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

R-9

17 Wilmslow Road
Withington
Manchester
May 6 1909

My Dear Eve,

I am glad you have got the christening of "Richard Stewart" over without any assistance although I gather he promises to make himself heard in the world.¹ As an humble contribution from an ungodly god-father, to Richard Stewart, I am sending on by separate parcel a silver rattle and chewing ring. He will early find that the transformation and digestion of silver is not so easy as some have thought.

As to W. R.,² I give him up. He has lost caste tremendously the last year & I don't believe any but his most admiring friends believe in him at all.

You will have seen he now finds it convenient to repeat what I do & publish it with details a little earlier if possible than my first paper.³ The method is original & interesting as an index of Ramsay's attitude. He must occasionally get something right for the look of the thing.

By the way, the radium emanation is devilish funny stuff. We get any rate of decay we want out of it within limits. We believe we are likely to get some interesting results the next few days. We are getting the rate of decay of solid emanation in liquid air. It appears to slow up considerably but time will tell if we are right.⁴ Geiger⁵ is hard at it & is making good progress. Boltwood⁶ comes over in August & works with me for 9 months or so. I am looking forward to a lively time!

I got a cable from Peterson⁷ which indicates they are trying H. A. W.⁸ as Cox's⁹ successor. Do come to the B. A.¹⁰ if possible. Kind regards and best wishes to the "Missis" and the young 'uns.

Yours ever

E. Rutherford

P.S. Have just returned from a month in Italy – sunshine galore.

R-9 Notes

1. The opening sentence of this letter clearly implies the receipt of a letter or letters from Eve, subsequent to E-8 written in January, 1909. However, no such letter survives and we can only surmise that Eve had given Rutherford an account of the christening of "Richard Stewart," the event being judged a success in spite of the absence of one of the god-parents. Rutherford's description of himself as 'ungodly' was apt, since there is no indication that he took any interest in religion throughout his adult life.

2. William Ramsay: see Note 3 of letter R-3. Rutherford's antagonism to Ramsay is frequently vented in correspondence with friends and colleagues such as Eve and Boltwood. (See Note 6 below.) Indeed, in a letter to Boltwood dated 21 July, 1910, Rutherford is more scathing than in any correspondence with Eve. Badash (see p. 222 of Introduction Note 9) quotes Rutherford as follows in this letter: "You will be interested to see the latest communication of the great chemist in *Comptes Rendus* [11 July 1910, pp. 126-28] apropos of density of the emanation for which five concordant numbers differing by only a few percent are given & a final value 222. It is great. There are no details of weighings but the paper is mostly taken up to say I, Ramsay, determined the volume, the spectrum, the everything of the emanation & I give it the name "niton" – shining – with my fatherly blessing. It is the most admirable piece of boom I have seen for some time. You remember of course the maximum volume of emanation dealt with is 1/10 cubic mm. – a truly great piece of work." It should be added that Rutherford was careful not to adopt this tone in public or in print, in which the decorum of polite society was strictly maintained.

3. Again we turn to Badash (p. 214 of Introduction Note 9) for an explanation. Rutherford made the same complaint in a letter to Boltwood written just before (1 May, 1909) letter R-9 to Eve. Badash quotes as follows: "You will have seen my paper on the emanation in the *Phil. Mag.* ["Condensation of the radium emanation," May, 1909. See Note 2 of letter R-8] & how Ramsay & Co tried to cut in before the publication of my paper." In a footnote Badash comments: "As reported in *Nature*, 80 (20 May, 1909), 347-48, Ramsay exhibited liquefied radium emanation at the Royal Society's semi-annual *conversazione*, 12 May, 1909. The *conversazione* was a scientific social event at which members attempted to display striking

features of their work to colleagues and their ladies." Perhaps, however, Rutherford was a little too harsh in his judgement, since he had already established his priority in this matter in a letter to *Nature* published in March, 1909 (see Note 2 of letter R-8), even though his definitive paper in *Phil. Mag.* did not appear until a week or so after the Royal Society conversazione.

4. Rutherford had already presented a short note on this subject at a meeting of the Manchester Literary and Philosophical Society on March 23, 1909 (E. Rutherford and Y. Tuomikoski "Differences in the Decay of the Radium Emanation." *Memoirs of Manchester Lt. & Phil. Soc.*, IV, 53, No. 12, 1909: 1-2) In this paper, Rutherford reported that the half-life of the emanation increased from 3.58 days in the first five days after preparing a pure sample, to 3.85 days in the period 20-40 days after preparation. He also noted that different samples of emanation showed different rates of decay, and suggested that emanation was a "non-homogeneous chemical substance." Rutherford seems to have dropped this topic for some time, because his next paper on the subject appeared two years later, in the Proceedings of the Vienna Academy of Sciences of March, 1911. (E. Rutherford "Untersuchungen über die Radium emanation: II. Die Umwandlungs geschwindigkeit." *Berich. de Kaiserl. Akad. Wissenschaften in Wien, Math. - Naturw. klas.* 70, Abt. Ila (March, 1911): 303-12.) In this paper Rutherford refers to his earlier work and suggests reasons for the observed variations. At any rate, he now reports improved methods of measurement which confirm the half-life obtained by Mme Curie in 1910: 3.85 days. There is no longer any question of "inhomogeneity." On the contrary, the half-life of the emanation is found to be independent of physical or chemical processes and is the same at room temperature and at the temperature of liquid air.

5. Hans W. Geiger (1882-1945) was a German physicist who became an assistant to Arthur Schuster at Manchester University in 1906. When Rutherford succeeded Schuster in 1907, Geiger was persuaded to stay on and work in the field of radioactivity. He remained in Manchester until 1912 when he became Director of the Laboratory for Radium Research at the Physikalisch-Technische Reichsanstalt in Berlin. Geiger is probably best known for the "Geiger counter" which he developed (with Rutherford) in 1908 (see note 7 of letter R-5), but his other

work in Manchester was of equal importance, especially that relating to the scattering of α -particles - experiments which were an important precursor of the nuclear model of the atom. The first paper on this subject was published later in 1909: H. Geiger and E. Marsden "On a Diffuse Reflection of Alpha Particles." *Proc. Roy. Soc. A*, 82 (1909): 495-500. Rutherford's comment in this letter, that "Geiger is hard at it," was fully justified.

6. Bertram Boltwood (1870-1927) was a chemist by training, but held (since 1906) the post of Assistant Professor of Physics at Yale University. At the time of this letter, Boltwood was preparing to come to England to spend the academic year 1910-11 in Rutherford's laboratory. He returned to Yale in 1911, was promoted to a full professorship in radiochemistry and remained at Yale for the rest of his life. For further details, see Badash *Rutherford and Boltwood*: 12-19.

7. William Peterson (1856-1921) was Principal of McGill University (also Professor of Classics) from 1895-1919. It was Peterson who, together with John Cox (see note 9 below), recruited Rutherford for McGill University in 1898. Peterson was knighted in 1915.

8. Harold A. Wilson (1874-1964) was Professor of Physics at King's College, London, from 1905 to 1909, when he was appointed Macdonald Professor of Physics at McGill. It is clear from Rutherford's letter that Wilson was a serious candidate for the Directorship of the Physics Laboratories, since Cox (see note 9 below) was due to retire from this post in April, 1910. In the event, Wilson was *not* appointed Director and the post went instead to Howard T. Barnes (1873-1950), who had progressed from the post of Demonstrator of Physics on Rutherford's departure in 1907. Barnes had earlier collaborated with Rutherford in experiments relating to the heat output of a radium source, and four joint papers on this subject were published in 1903-05. Barnes remained at McGill until 1919, but Wilson stayed only three years: in 1912 he was appointed Professor of Physics at Rice Institute in Houston, Texas, where he remained (except for a year at Glasgow University, 1924-25) until his retirement in 1947.

9. John Cox (1851-1923) was Professor of Physics at McGill from 1890 (when the Macdonald Physics Building was opened) until 1901 when he became Director of the Physics

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laboratory. It was Cox who had recruited Rutherford for McGill in 1898.

10. The British Association for the Advancement of Science held its 1909 annual meeting in Winnipeg, Manitoba, Canada, August 26-September 1. Rutherford was present and gave the opening address in the Mathematics and Physics Section on August 26. Rutherford's subject was "Atomic theory" and, while he was not yet ready to speak openly of the atomic nucleus, the trend of his thoughts is clear. (Rutherford's talk is given in full in *Nature*, 81 (1909): 257-63.) Eve was also present at the meeting and read a paper on secondary radiation produced by γ rays in different metals. However, no reference to a meeting of the two men in Canada appears in their correspondence.

R-10

17 Wilmslow Road
Withington
Manchester
Oct 28 1909

My Dear Eve,

I intended writing earlier but I have been up to my neck in work.¹ I don't know whether you heard that Dr. Boltwood's mother who was with him died of heart failure without warning when they had been here a week or so.² It was a very sad case for they had lived together all their days & were unusually devoted.

Boltwood has knuckled down to work again and we are in the midst of a determination of the rate of production of He[lium] by radium.³ We have all been well and flourishing but I have been kept going.

Sorry to hear your radium source turned out a puzzle. It is extraordinary how fellows get fooled on a photographic plate.⁴

Re the mortgage, I have decided on mature reflection that there is too much risk for one not on the spot in mortgages on "town" property.⁴ I have come to the conclusion that 4 percent & good sleep is better than 10 and restless nights. Sorry to have troubled you but I find my sense of prudence develops rapidly when I get in this land.

I am glad of and like Wilson.⁶ Give him my kind regards.

There is not much news to record here but the suffragettes and the budget keep us from falling asleep. Give my kind regards to the Pitcher's⁷ & to Mrs. Eve.

Yours ever

E. Rutherford

R-10 Notes

1. It is unclear whether or not this letter is in reply to a letter from Eve no longer extant. The two men had met two months earlier at the British Association meeting in Winnipeg (see Note 10 of letter R-9) but Rutherford's comment on Eve's radium source (Note 4 below) gives the impression that Eve had written in the interval.

2. Bertram Boltwood (see Note 6 of letter R-9) spent the 1909-10. academic year with Rutherford in Manchester. The date of his arrival in England is unclear, but it must have been early in August 1909, before Rutherford departed for the British Association meeting in Winnipeg which opened on August 26 (see Note 10 of letter R-9). (In a letter to Boltwood, date 1 July 1909, Rutherford apologizes for his inability to accommodate the Boltwoods on their arrival, because other guests were due to stay at the Rutherford home at the time. See Badash. *Rutherford and Boltwood*, p. 219.) Presumably Boltwood's mother died *after* Rutherford had left for Canada, otherwise Eve would have heard about it directly from Rutherford. In an editorial comment Badash (*Badash. Rutherford and Boltwood*, p. 200) states that "Boltwood's mother died a few months after their arrival in England" but this appears to be in error. Rutherford's direct statement to Eve "they had been here a week or so," must be more accurate.

3. A short paper on this subject was read to the Manchester Literary and Philosophical Society in the autumn of 1909: E. Rutherford and B. B. Boltwood "Production of Helium by Radium." *Manchester Lit. & Phil. Soc., Mem.*, IV, 54, 6 (1909): 1-2. The rate of production of helium was found to correspond to 163 mm³ per gram of radium per year. However, the definitive papers on helium production were not published

until 1911, well after Boltwood had returned to Yale: B. B. Boltwood and E. Rutherford "Die Erzeugung von Helium durch Radium." *K. Akad. Wiss., Wien, Sitzungsberichte*, 120, 2a (1911): 313-36; E. Rutherford and B. B. Boltwood "Production of Helium From Radium" *Phil. Mag. Ser. 6*, 22 (1911): 586-604. Using more accurate measurement techniques than in the earlier experiments, the rate of production of helium from 1 g of radium, in equilibrium with its decay products, was amended to 158 mm³ per gram per year. This value agreed well with the figure of 156 deduced by Rutherford and Geiger by counting the number of α -particles emitted by radium.

4. The meaning of this statement is unclear. Its interpretation depends on whether we accept the date of Eve's next letter, E-9, as February 1910 or – as seems more probable, see Note 1 of E-9 – alter the date to February 1911. In the former case, the reference here is to a misunderstanding in the summer of 1909, when Eve had presumably written from England to his colleague Howard Barnes in McGill, requesting the latter to send a particular radium source to Manchester so that its strength could be determined in Rutherford's laboratory. Presumably this was done and the result transmitted to Montreal – with the startling conclusion that the source strength was only about one-tenth of its expected value. The solution to this puzzle was given later, in February 1910 if we accept the written date for letter E-9. If, however, E-9 was actually written a year later, then this explanation of Rutherford's present comment breaks down and we have to postulate another problem with one of Eve's radium sources, perhaps mentioned in a missing letter to Rutherford written in September 1910, after the latter had returned to England following his visit to Canada in August. Whichever date we accept for letter E-9, however, there is no explanation of Rutherford's reference here to a photographic plate.

5. A memorandum in Eve's handwriting, dated 6 December, 1937, at the bottom of a letter of Eve to Rutherford, written in 6 December 1925, begins as follows: "E. R. bought 21,000 sq ft on slopes of West Mountain, Cedar Crescent, Cote des Neiges, Montreal meaning to build a house here; but he moved to Manchester and I bought the land and had a mortgage on it \$2500 at 5%." The land area quoted by Eve in his 1937 memo was in error. In letter E-12 Eve states explicitly that Rutherford bought 24,000 sq ft at 15

cents/ft², or \$3600 in all. Côte des Neiges at that time was well outside the City of Montreal, although it has long since become part of Metropolitan Montreal. This purchase price agrees with that stated by Rutherford in letter R-11. Nowadays, Cedar Crescent links with Queen Mary Road, a main east-to-west thoroughfare. Eve's 1937 memo implies that Eve bought the land at the time of Rutherford's departure from Montreal in 1907, but this was not the case. At the time of letter R-10, October 1909, Rutherford still owned the land but was obviously thinking of selling it. It seems that he had two practical alternatives: either to find a private buyer, such as Eve, and to provide the buyer with a mortgage; or to sell to a property company in the expectation that the resulting income would be higher. Hence the dilemma expressed in this letter. However, Eve does not appear to be a prospective buyer at this time and, indeed, the sale to Eve was not made until June or July 1911. A significant part of the subsequent correspondence between Rutherford and Eve in the next two years, as set out in the present article, is concerned with the sale of Rutherford's property in Côte des Neiges and the related financial problems, with Eve acting as the "man-on-the-spot" providing advice when so requested.

6. As stated in Note 8 of letter R-9, Harold A. Wilson had recently been appointed Macdonald Professor of Physics at McGill. Rutherford is here expressing his satisfaction with the appointment, and this sentence carries a further implication (see Note 1 above) that Rutherford is replying to a "missing" letter from Eve.

7. The Pitchers were Eve's sister-in-law Harriet and her husband; Rutherford knew both very well; see Note 11 of letter R-1.

E-9 Eve to Rutherford

McGill University
The Macdonald Physics Building
6 February, 1910¹

This brief letter is concerned almost entirely with the problem of one of Eve's radium sources which had earlier been measured at Manchester. This source may have been the subject of Rutherford's comment three months earlier in letter R-10: the source had "turned out a puzzle."² Eve now states that, in an earlier letter

written from England, presumably during the summer of 1909, he had given misleading instructions to his colleague Howard Barnes at McGill. As a result, Barnes had sent the wrong source to Manchester: "He sent *one* of the tubes which Bronson³ cooked up and I meant him to send the other; sorry my fault. In my book I have it as .26 mg and you say it is .264, so it is most satisfactory. I had meant to send 2.7 mg."

The letter concludes with a short warning, relating to Rutherford's land near Montreal (see Note 5 of letter R-10): "N.B. don't sell your lot for *less than 50¢ a foot cash, this year.*"⁴

E-9 Notes

1. This letter is designated E-9 and is placed in this position in the series because the date in Eve's handwriting is clearly 6 February 1910. However, a strong (albeit not conclusive) case can be made for believing that '1910' was a 'slip-of-the-pen:' Eve should have written 6 February nineteen-*eleven*. The case for re-assigning the letter to 1911 is as follows:

- a) Eve wrote to Rutherford on 5 January 1911 (letter E-14 in this article) enquiring about a radium source sent to Manchester from Montreal by Dr. Barnes during the summer of 1910. It is unlikely – but not of course impossible – that the circumstances (Eve in England arranging the source transfer with Barnes in Montreal) were repeated exactly, two years in succession.
- b) The dates of letters E-14 (5 January), R-13 (21 January, E-9) 6 February) and R-14 (15 February) are consistent with the known transit time for mail between the two cities (see Note 1 of letter R-12), if each man replied to the other within two or three days, which is likely in view of the subject matter of the correspondence. Indeed, in letter R-13, Rutherford states "I received your letter yesterday."
- c) Rutherford's opening statement in letter R-14, "I am glad the measurements of the small standard check up very well with the old values," makes good sense if he is replying to E-9 *written nine days earlier*. Similarly, Rutherford's comment at the end of R-14, referring to the rise in value of his

property in Montreal and "I trust that your remark at the end of your letter will be realised," makes perfect sense in relation to Eve's advice in E-9, "don't sell your lot for less than 50¢ a foot," but no sense at all in relation to E-14, written on 5 January, 1911. To explain R-14 we have to postulate a missing letter between E-14 and R-14; E-9 fits this role perfectly.

- d) Eve's note to Rutherford about the value of his land is surprising if written in February 1910. It is true that, in October 1909 (R-10) Rutherford refers to the question of mortgaging his property and, in September 1910 (R-11), to Eve's statement of "some time ago" concerning the rising value of the land. Nevertheless, by February 1910 there had been virtually no discussion of this problem in the Rutherford-Eve correspondence. A curt, single sentence admonition therefore seems out of place at this time. However, the correspondence in the autumn of 1910 (E-11 to 13, R-11 to 13) is full of this problem, so that a short reference to the matter in February 1911, is entirely in context.

2. The possible link with letter R-10 applies only if the 1910 date of E-9 is accepted. If, however, E-9 was written in February 1911, as suggested in Note 1 above, then Rutherford's October 1909 comment in R-10 is no longer relevant and another explanation must be sought. There is no evidence in Eve's letters or published papers of a problem with a radium source in 1909, specifically in connection with a photographic plate (see Note 4 of R-10), but it could have been a minor difficulty which did not merit a written record.

3. Howard L. Bronson was a physicist who joined Rutherford's team at McGill in 1904, after obtaining his PhD at Yale. He published a number of papers on various aspects of radioactivity but failed to achieve a lasting reputation. Bronson left McGill in 1910 to become a Professor of Physics at Dalhousie.

4. However, when Eve himself purchased the land from Rutherford in 1911, the price was considerably below 50 cents: see letter E-18.

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

R-11

17 Wilmslow Road
Withington
Manchester
Sept 30 1910

My dear Eve,

Just a short letter to you on a business matter. I have received an offer for my section¹ through Baillie from an unknown client (whom I guess is Hyde) for \$6000 stock in the Pine Avenue Apartments² which has so far paid 5% on the stock.

You told me some time ago that property about my section was rising steadily in value. I would be very much obliged if you give your opinion on the offer. You remember I paid about \$3600 for the property. It is very difficult for me to form any idea of the value of the stock mentioned. 5% does not seem to me much of a yield on new property of that type. Would it be possible at any time to realise on such an investment without a great sacrifice?

I know it will give you a good deal of trouble but if you can collect information* on the subject, I would be greatly obliged.

I have written to Baillie without giving a definite decision but rather indicating that I don't care much for the stock proposition but would like an alternative.

I returned to Manchester in a foul state with bad cold & a face with a bulge so that my wife hardly recognised me. Fortunately, I have got rid of my ailments rapidly. I expect the strain of the Congress³ was more than my constitution could stand.

Work starts in full swing next week. I go up to Dundee next week to open a new Electrical Laboratory.⁴ It impresses the fact on me that I am now regarded as elderly and respectable.⁵ Give my kind regards to Mrs. Eve and hope my god-child flourishes. Give me a reply as soon as you can.

Yours ever

E. Rutherford

* Note added in margin opposite asterisk: I have received statement of receipts and

expenditure for the last three years. It seems sound as far as it goes.

R-11 Notes

1. "My section" refers to the land owned by Rutherford on Cedar Crescent, Côte des Neiges (see Note 5 of R-10). I am unable to identify either Baillie or Hyde.

2. Pine Avenue Apartments. This is a block of about 30 apartments, still in existence, on Pine Avenue West, between Durocher Street and Oxodon Street (now Aylmer) quite close to the McGill campus. *Lovell's Directory of Montreal* for 1910 gives the street number as 276 but it has since been renumbered as 456.

3. The Congress referred to was the (First) International Congress of Radiology and Electricity, held in Brussels, 13-15 September, 1910. Both Rutherford and Eve participated in the Congress; indeed Rutherford played a very active role, as is clear from the report in *Nature*, 84 (Oct. 13, 1910): 478-79 contributed by Walter Makower, a physicist in Rutherford's laboratory in Manchester. Another formal report was given by Boltwood in *Science*, 32 (2 Dec. 1910): 788-91. However, of more interest, and certainly more revealing of the dissatisfaction of the participants with the poor organization of the Congress, is Rutherford's informal account in a long letter to Boltwood dated 27 September, 1910: Badash. *Rutherford and Boltwood*. pp. 224-28.

Probably the most important outcome of the Congress was the setting up of an International Radium Standards Committee chaired jointly by Rutherford and Mme Curie. The Committee was charged with defining a unit of radioactivity and preparing an International Radium Standard (see Figure 2 of this article.) Rutherford outlined the tasks of the Committee in a separate report: E. Rutherford "Radium Standards and Nomenclature," *Nature*, 84 (Oct. 6, 1910): 430-31. Eve was a member of the Committee, representing Canada, but was unable to attend the second meeting in Paris in March 1911.

4. The laboratory referred to was the Peters Electrical Engineering Laboratory at University College, Dundee, Scotland.

5. "Elderly and respectable." Rutherford celebrated his 39th birthday a month before writing this letter!

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

E-10/E-11/E-12 Eve to Rutherford

Montreal,

8 October, 1910 (E-10)

10 October, 1910 (E-11)

16 October, 1910 (E-12)

These three letters, written within a span of nine days, will be considered together.

In the first letter (E-10) Eve mentions that, after an excellent summer in England, he and his family are moving into a new home in Outremont.¹ He asks Rutherford for a testimonial to support his application for the Chair of Physics at Bristol University.² Eve then makes a passing reference to the Brussels conference, i.e. the International Congress on Radiology and Electricity.³ He found that "...the conference, and the meeting so many interesting men, have had a refreshing and stimulating influence."

The second letter (E-11) is concerned entirely with the question of the value, and possible sale, of Rutherford's land on Côte des Neiges. Eve notes that land values have risen remarkably since he left Montreal for England in May and that "Gordon⁴ is selling land on the mountain above yours but nearer the city⁵ at 50 cents a foot. I think yours will be worth 50 cents in 2 or 3 years time." Eve advises Rutherford not to accept less than 25 cents a (square) foot, paid in cash. He also advises against the Pine Avenue stock offer (letter R-11), which he considers to be worth no more than \$4500. Eve then offers to buy the property himself, for \$4500, "cash down."⁶

Eve mentions that he and his family have settled in their house in Outremont and "we all like it very much. Unfortunately, we have only a sure lease for 1 1/2 years." Eve adds that land at Outremont is 70-75 cents now, and "Montreal is going to be a desparate [*sic*] place for professors to live in."

Letter E-12 is entirely concerned with the sale of Rutherford's land. Eve states that C. Gordon⁷ had given him some information (derived from Baillie) about the Pine Avenue Apartments Company. The shares are worth 75% of their par value and shareholders receive 5%. Eve advises Rutherford to ask for \$8000 Pine Avenue stock or \$6000 cash. "If you get that, he [Gordon] says sell now....My own view is that a road will get through and in a few years it will be worth 50

cts (\$12,000). Gordon was not quite so sanguine."

E-10/E-11/E-12 Notes

1. Outremont is the area (now a separate municipality within the Montreal Urban Community) lying to the north-east of the "mountain" (Mont Royal) which gives Montreal its name. In the period under consideration, Outremont was being developed as a highly desirable suburb – hence the high price of land, as Eve notes in letter E-11.

2. Eve did *not* obtain the desired appointment. The Bristol post is discussed further in Note 4 of letter R-13.

3. See Note 3 of letter R-11.

4. The identity of 'Gordon' is uncertain. The C. Gordon referred to in letter E-12 (presumably the same person) may well have been a relation of the G. Blair Gordon who features in Eve's memo (referred to in Note 5 of letter R-10) as follows: "The mortgage was in due course paid off and the land sold by me to Lady Gordon whose son G. Blair Gordon has built a beautiful house upon it."

5. "Land above yours but nearer the city." Rutherford's lot was located on the northern slopes of "West Mount," the hill to the west of Mount Royal, with the city of Montreal lying to the south-east. Hence the land to the south of Rutherford's could well be higher in elevation but nearer the city.

6. Eve's offer of \$4500 is puzzling, because he has just advised Rutherford not to accept less than \$6000, i.e. 24,000 ft² x \$0.25/ft².

7. See Note 4 above.

R-12

17 Wilmslow Road
Withington
Manchester
Oct 20 1910

My dear Eve,

I received your letter about the Bristol post.¹ I shall send you a testimonial in a day or two as soon as I get time to attend to it and will in any case write to the Bristol people to say that I am willing to give them any information they require about you, in case your testimonials are late. I thought the time of entry had closed long ago but from what you say apparently not. I will send you a reference that can be used by you generally for any post for which you apply.

I am wondering whether you received a letter written about three weeks ago by me and addressed to Hutchinson St.² I wanted your opinion as to an offer I received from Bailey for my Côte de Neige³ property. The offer is \$6000 stock in the Pine Avenue Apartments which he included documents to show had been paying 5% for the past three years. I wrote to Bailey to ask for an alternative cash offer but I would like your opinion on the matter. The difficulty is of course that I know nothing of the Pine Avenue Apartments & whether their stock is a good investment. Have you any idea of its selling value? I gather indirectly that Hyde is Barclay's client,⁴ which makes me wonder a little. I shall be very much obliged if you will give me your mature opinion on the matter in relation to the probable value of my property in the immediate future. Please regard this as confidential.

Yours ever

E. Rutherford

R-12 Notes

1. See letter E-10, written 12 days earlier on October 8. It is clear that the mail service between Montreal and London, by surface carrier, was quick and efficient.
2. See letter R-11 (30 September 1910).
3. Both Baillie and Côte des Neiges are misspelt.
4. I am unable to identify Barclay.

E-13 Eve to Rutherford

860 St. Catherine Road,
Côte des Neiges, Montreal
4 November, 1910

Eve begins by thanking Rutherford "for the excellent testimonial [for the Bristol chair] which you were kind enough to send me." However, Eve professes that, whatever the verdict in "the Bristol affair" he will be content.

The rest of this short letter is concerned with Rutherford's property on Côte des Neiges. Eve says that he has visited the area (the "West Mountain") and found that roads have been cut over Gordon's property there. "He has already sold half his lots at \$ 50 a sq. foot." Eve thinks that Rutherford's land is worth 35 to 40 cents, "and I can't see why it is not worth as much as that on the top of the mountain a few yards behind yours." He predicts that, once a road gets past Rutherford's lot, the land will be worth 50 cents and should then be sold, "for things are apt to stick there."

Eve concludes by remarking that he and his wife like their new home (in Outremont) and wish they were owners, not tenants.

E-14 Eve to Rutherford

McGill University, Montreal,
The Macdonald Physics Building
5 January, 1911

Eve begins by referring to a "specimen" (presumably a radium source) which had been sent to Manchester from McGill during the previous summer. He enquires whether Rutherford has been able to compare the McGill source with the Manchester radium standard and, if so, if the source could now be returned.

Most of this letter comprises a discussion on secondary γ rays. Eve refers to the recent paper by Florance,¹ a member of Rutherford's group in Manchester. Florance showed that the secondary radiation (i.e. scatter) produced when γ rays interact with matter show a gradual softening (decrease in penetration power) as the angle of deflection from the original source increases.² Eve notes that Florance's secondary rays were more penetrating than his own,

“working with a small quantity of Ra. I may have got some β rays mixed with my secondary γ . It must have been a relatively easy game with 200 mg.”³

Eve goes on to wonder “if he [Florance] did not find results more simple than they really are,” and quotes some of his own experimental results with γ rays transmitted through sheets of iron or lead and then through a reversible lead-aluminum filter. The intensity of the transmitted radiation depended on the direction of the filter, i.e. Pb-Al or Al-Pb.⁴

Eve goes on to say that he is “trying to verify or upset Bragg’s view that γ rays do not ionize directly, they produce β rays which do the ionizing.”⁵

Finally: “Matters are going well at McGill except that they are hard up for cash,” and “I have heard nothing as to the Bristol appointment, they don’t seem in haste.”

E-14 Notes

1. D. C. H. Florance, “Primary and secondary γ rays,” *Phil. Mag.* Ser. 6, 20 (Dec. 1910): 921-938.

2. Florance’s results (Note 1 above) were quite correct. This was, in fact, the first observation of “Compton scattering,” named after Arthur H. Compton (1892-1962), the American physicist who studied the production of secondary radiation by X rays and in 1922-23 proposed a quantum theory to account for the observed effects. Compton acknowledged the correctness of Florance’s earlier observations, which in 1910 could not be adequately explained. (For an excellent biographical sketch of Compton, see del Regato. *Radiological Physicists*.)

3. Eve’s experiments were carried out with about 14 mg of radium bromide.

4. A. S. Eve, “Primary and Secondary Gamma Rays.” *Trans. Roy. Soc. Canada*, Ser. III (1909): 36-47 *Phil. Mag.* Ser. 6, 19 (Aug. 1909): 275-91. (See also letter E-3.) Unfortunately, Eve’s experiments were set up in such a way that he was simultaneously observing three different effects – absorption, scattering and production of secondary characteristic radiation. It is no wonder that his results were difficult to interpret.

5. William Henry Bragg (1862-1942) was referred to earlier (letter E-3, 24 Nov. 1907) in connection with his theory that γ rays comprised a “neutral pair,” i.e. a β -particle associated with an α -particle. At that time Bragg was Professor of Physics at the University of Adelaide in Australia. In 1909 Bragg was appointed Cavendish Professor of Physics at the University of Leeds in England. He is best known for his pioneering work in X-ray crystallography, for which he was awarded the Nobel Prize in Physics in 1915, jointly with his son William Lawrence Bragg.

The theory to which Eve now refers was put forward by Bragg in September 1910: W. H. Bragg “The consequences of the corpuscular hypothesis of the γ and X rays, and the range of β rays.” *Phil. Mag.* 5, Ser. 6, 20 (1910): 385-416. Bragg has modified his earlier theory and now regards X and γ rays as particles having the same mass as the electron but zero charge. Bragg states that this view is based on the theory of J. Stark [*Phys. Zeit.*, 10 (1909): 902-16; 11 (1910), 24-31 and 179-87] that an X ray is “a bundle of energy travelling without alteration of form.”⁴ Stark’s theory, in turn, was based on Max Planck’s quantum theory of energy, developed in 1900. Bragg’s 1910 paper attempts to demonstrate no less than eight consequences of the corpuscular hypothesis of X and γ rays, one of which is the inability of these rays to ionize directly, the real agents being the “secondary cathode and β rays.” Bragg was right: ionization by X and γ rays is indeed an indirect effect arising from secondary electrons. However, nowadays the “bundle of energy” (called a *photon*) is considered to have zero mass as well as zero charge. The energy of the photon is proportional to the frequency of the radiation concerned, as determined by experiments in which the behaviour of the radiation can be interpreted on a wave theory.

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

R-13

Letter handwritten by an amanuensis, probably Mrs. Rutherford

17, Wilmslow Road
Withington
Manchester
Jan 21st 1911

My dear Eve,

I received your letter yesterday, and will send on your radium preparation very soon.¹ I had it ready to send three months ago; but the book with the final number in has been mislaid, and we probably will have to measure it again.

I have heard nothing definite about Bristol for some time. It is a funny business altogether, and I am not taking any part in it. They picked four men out of the candidates some four months ago, and then decided that none of them were good enough for them. Since then they have been trying some more senior people, and I think they have been unsuccessful and go back to their first discard. I wrote to them to say that I would be glad to give any further information they required in regard to yourself; but they never even bothered to ask. Bragg² tells me they did not reply when he wrote. Altogether the whole business seems to be run in a funny manner, and I have heard wierd stories as to their way of interviewing candidates. I think it quite likely they may take Porter³ of University College, London, after all.⁴

As to other matters I had an offer or two for my property in Montreal; but I did not think they were good enough, and I prefer to hang on for a bit.

Matters scientific are going on quietly. We have several interesting pieces of work which I hope will soon be completed. I may tell you confidentially (for the paper is not yet published) that Simpson and Wright (Scott's Expedition) on their voyage to New Zealand have found the active deposit over the ocean in the neighbourhood of the Equator was very small compared with that on land, and there were rapid variations with the latitude. This is exactly what we all expected if we could get well away from land. He still got quite a considerable ionisation in the air; but I do not lay very much stress on that. I daresay the R[oyal] S[ociety] will

publish the paper before long.⁵

Among other things I have been interesting myself in devising a new atom to explain some of the scattering results.⁶ It looks promising, and we are now comparing the theory with experiments.

You, no doubt, have seen Mme Curie's book.⁷ It is quite good and sound but rather much of it and no Index, so that it is very difficult to find things. They have asked me to review it in *Le Radium*.⁸

I am glad you like your new quarters round the mountain. I saw McBride⁹ a day or two ago in London and he gave me some Montreal news. Bovey¹⁰ was at the R[oyal] S[ociety] meeting. He looked thin; but I understand is very much the same as he was last year, and keeps fairly well if he does not work.

I will get the radium compared accurately and send it along as soon as possible.

Yours ever

E. Rutherford

P.S. added by Rutherford in his own handwriting. Give my remembrances to your wife & my own responsibility whom I hope does justice to his god-parent.

R-13 Notes

1. Rutherford is replying to E-14, written by Eve 16 days earlier. However, there is some doubt as to the identity of the radium preparation: it was probably the source to which Eve refers in letter E-9, assuming that this letter was written in February 1911 in spite of its nominal date, February 1910 (see Note 1 of E-9.)

2. Bragg: see Note 5 of letter E-14.

3. Alfred W. Porter was an Assistant Professor of Physics at University College, London at the time. His specialty was the physics of fluids and fluid flow. He was *not* appointed to the Bristol post: see Note 4 below.

4. Rutherford was right to describe the appointment process as a "funny business." In fact, nothing further was to be heard of this matter for over two years. Then, on March 20, 1913, *The Times* of London reported that a

question had been asked the previous day in the House of Commons concerning the Chair of Physics at Bristol University, which had been vacant since 1910. The questioner suggested that the Chair had been offered to physicists of repute, all of whom had declined on the ground that the post offered insufficient security of tenure. The following day (Mar. 21) *The Times* carried a letter from Sir Isambard Owen, the Vice-Chancellor of Bristol University, refuting this allegation: "There is not the smallest foundation for such a suggestion.... Our chair of Physics is at present held vacant for reasons which I need not enter into.... It has neither been offered to nor refused by anyone."

This, however, was not the end of the matter. Two weeks later, on April 3, 1913, *The Times* published a long letter from Maurice A. Gersthwohl dealing with various aspects of the governance and administration of the University. One paragraph was devoted to the vacant Chair of Physics. Gersthwohl stated that the post had been advertised in the autumn of 1910 at a salary of £600, as a result of which numerous applications had been received and considered by Senate. The Senate subsequently informed the [largely lay] University Council that it was unable to recommend an appointment since no candidate of sufficient merit had applied. The Vice-Chancellor had subsequently requested Council to raise the salary to £800 and to allow him to negotiate with individual physicists, both of which proposals were denied by Council. The writer accepted Sir Isambard's statement that the Chair had not been formally offered to anyone, but challenged the Vice-Chancellor to deny that "at least one London physicist of repute was approached and sounded as to the terms on which he might be induced to consider the Chair." Gersthwohl stated that one of this candidate's main conditions for acceptance was exemption from the 2-year probationary period attached by Bristol University to all academic posts. This was what was meant by the lack of security of professional tenure. The correspondence ended on April 5, when the Vice-Chancellor denied Gersthwohl's allegations in a brief and uninformative letter. Thereafter *The Times* maintained silence on the subject of the Chair of Physics at Bristol University.

5. G. C. Simpson and C. S. Wright "Atmospheric Electricity Over the Ocean," *Proc. Roy. Soc.*, 85A (May 10, 1911): 175-99.

6. This is an early reference by Rutherford to his new theory of the nuclear atom. It is not, however, the *earliest* reference since Rutherford had written to Boltwood on this subject on 14 December, 1910 (Badash. *Rutherford and Boltwood*, p. 235). Rutherford gives the impression in these early letters that it will be months, if not years, before the new theory can be announced publicly. In fact, however, within a few weeks he had outlined the theory to members of the Manchester Literary and Philosophical Society at a meeting on March 7, 1911. [*Proc. Manchester Lt & Phil. Soc.* IV, 55 (1911): 18-20] and the definitive paper was published in May 1911: E. Rutherford "The Scattering of Alpha and Beta Particles by Matter and the Structure of the Atom," *Phil. Mag.* Ser. 6, 22 (1911): 621-29. However, it was not until 1913, when Neils Bohr gave the theory a strong mathematical basis, derived from quantum theory, that the nuclear model of the atom became firmly established.

7. Marie Curie, *Traité de radioactivité* (Paris: Gauthier-Villars, 1910), 2v.

8. Rutherford's review of Mme Curie's book appeared very soon after this letter to Eve: *Le Radium*, 8 (Feb. 1911): 94-95. Rutherford published a similar review of the book in *Nature*, 86 (2 March, 1911), 1-3. As usual, Rutherford's most critical comments on the book were reserved for a letter to Boltwood, dated 14 December, 1910 (Badash. *Rutherford and Boltwood*, pp.233-37).

9. A. E. McBride was a professor of zoology at McGill. He had come to Canada from England on the same ship as Rutherford and, indeed, the two men had shared a cabin. Early in his stay in Montreal, Rutherford, McBride and Walker (a professor of chemistry at McGill) took rooms with breakfast at a house on Union Avenue, close to the McGill campus.

10. Henry Bovey was the former Dean of Applied Science at McGill. Rutherford had stayed with him on his arrival in Montreal in September, 1898, and the two men had jointly undertaken some contract research in Montreal in November 1898. In 1908 Bovey left McGill to become Rector of the Imperial College of Science and Technology in London, but retired a year later. Rutherford's concern for Bovey's health was timely: Bovey died in 1912.

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

R-14

Letter handwritten by an amanuensis, probably Mrs. Rutherford

17, Wilmslow Road
Withington
Manchester
Feb 15th 1911

My dear Eve,

I am glad that you find the measurements of the small standard check up very well with the old values. I had an idea that they must be one of the original small standards you employed.¹

You will have seen Bragg's R[oyal] I[nstitution] lecture in 'Nature.'² It is quite interesting and, like all Bragg's things, very clear. I see a good deal of him in these days and find him a thoroughly good fellow.

You will be interested to hear that my general theory of scattering is working out very well; but I will not publish it for some time so as to get experimental verification. I think I shall be able to show that Crowther's paper in the [Proceedings of the] R[oyal] S[ociety] is completely wrong.³ It reads like gospel; but I find I can explain the great majority of his results in a very different way, and one that I think is physically far more important. I will let you know as soon as I get the material in shape. Geiger is hard at work verifying some of the theoretical points which are really very interesting.⁴

I wrote to Baillie a short time ago to tell him that I was on the look out for a rise in the value of my property, and I trust that your remark at the end of your letter will be realised.⁵ I feel it is somewhat of a blessing that Canada has not a tax on unearned increment.

Yours sincerely

E. Rutherford

R-14 Notes

1. This statement is meaningful only if Rutherford is replying to a letter of recent origin relating to a particular radium source. Letter E-9 fits this role if, as suggested in Note 1 of E-9, we postulate that it was actually written on

6 February 1911.

2. W. H. Bragg "Radio-Activity as a Kinetic Theory of a Fourth State of Matter," *Nature*, 85 (9 Feb. 1911): 491-94. In this semi-popular discourse, originally delivered at the Royal Institution, London, on 27 January 1911, Bragg examines the properties of α , β , γ and X rays and their interactions with matter. He concludes that they are all corpuscular in nature and mentions his theory (see Note 5 of E-14) that γ and X rays are un-charged β particles. The lecture ends on a prophetic note: "Many insist that my neutral corpuscle is too material, and that something more ethereal is wanted, for it appears that ultraviolet light possesses many of the properties of X and γ rays." However, Bragg draws back from this precipice, since he is unwilling to sacrifice the explanations of interference and diffraction provided by the wave theory. This was, of course, before von Laue's discovery of X-ray diffraction in 1912 and Planck's quantum theory had not yet been accepted in the field of radiation.

3. J. A. Crowther "On the scattering of homogeneous β rays and the number of electrons in the atom." *Proc. Roy. Soc.* 83A (15 Sept. 1910): 226-47. James A. Crowther (1883-1950) was a Fellow of St. John's College, Cambridge at the time, and later (1912) became a demonstrator and lecturer at the Cavendish Laboratory. Crowther's main appointment (1912-24) was that of Professor of Physics at the University of Reading. In the present paper, Crowther measured the scattering of a homogeneous pencil of β rays by various materials and concluded that (i) the ratio of the number of electrons in an atom to the atomic weight is approximately 3.0 for all elements and (ii) the positive electricity in the atom is distributed fairly uniformly through the atom. Both conclusions were wrong, as Rutherford makes clear.

4. This is, of course, a reference to Rutherford's nuclear model of the atom; see Note 6 of R-13.

5. As discussed in Note 1c of letter E-9, this comment is meaningful if the letter referred to is E-9 and we postulate that E-9 was written a year later (6 February, 1911) than the nominal date. Rutherford's comment certainly does not refer to letter E-14, (5 Jan. 1911) which is nominally Eve's previous letter.

E-15 Eve to Rutherford

This letter is undated and has hitherto been assigned to September 1911. It is number E-43 in the Cambridge University Collection, i.e., between E-42 (28 August 1911) and E-44 (17 October 1911). However, the evidence reviewed below¹ points to an earlier date, either late April or early May 1911. In any case, however, there is evidence that some correspondence, or other form of communication, must have occurred in the period between February 1911 (E-9, redated) and April-May 1911.

Apart from Eve's offer of \$4500 in letter E-11 (11 October 1910), which Rutherford must have rejected, we have no record of negotiations between the two men leading to the agreed sale which is clearly implied in this and subsequent letters.

McGill University, Montreal,
The Macdonald Physics Building,
April (?) 1911

The letter opens with a statement that Eve has given Vaughan instructions "to go full steam ahead," presumably with the purchase of Rutherford's land. "I shall borrow £1000 at 4 or 4 1/2 per cent in England." Eve then asks whether Rutherford wants the £1000 to be paid in England, on the basis of £1000 = \$4860 (in which case Eve would send an additional \$140), or "do you want the money (\$5000) all paid to your account in Montreal?" Eve adds that he does not mind which method is adopted, but "it does not pay to send money twice across the Atlantic."

The letter continues with a brief account of Eve's experiments for finding the attenuation coefficient of β rays "for thin Al foil with active deposit of RaC on it at 30 to 80 cm from a thin walled electroscope (see Note 1c below for references.) Eve gives a short table of values of μ (the attenuation coefficient) for various distances between the radium and the electroscope, but the dimensions of μ (e.g., cm^{-1}) are not stated and the numerical values are 10 times larger than those quoted in the postscript to the published paper, e.g. 0.13 (letter), 0.013 cm^{-1} (published). In any case, Eve concludes that "RaC must have a lot of slow β rays, easily cut off by glass." He adds that "there is a lot of work to be done with thin

walled electroscopes." Eve ends the letter by stating: "I am publishing half of my work, and reviewing the second half, with some checking experiments."

E-15 Notes

1. The evidence for assigning this letter to April, rather than September, 1911 is as follows:
 - a) This letter contains details of Eve's intention to buy Rutherford's land in Montreal. The brief statement in letter E-16 (8 May 1911), "My brother has £1000 ready... for me in England" makes more sense if it follows, rather than precedes, the broader statement in the present letter.
 - b) This letter includes a brief description of Eve's measurements of the absorption in air of β rays from radium C, using a thin aluminum foil with an active deposit on it. This work is described in a postscript, dated May 1911, to a paper published by Eve in July 1911 (see 1c below). There would have been no point in describing this work to Rutherford in September when it had already been published.
 - c) At the end of the letter, Eve mentions that he will publish only half his work immediately since the other half requires further checking. This fits Eve's statement at the beginning of the next letter, E-16 (8 May 1911), that he has written two papers, and "I am quite content with my value for the total number of ions due to β rays." The paper on this topic was dated April 1911 and published in October 1911: E. S. Eve "On the Number of Ions Produced by the Beta Rays and by the Gamma Rays from Radium C," *Phil. Mag.*, Ser. 6, 22 (1911): 551-62. The other paper, referred to in Note 1b above, was published earlier, July 1911, although presumably submitted a little later: E. S. Eve "On the Coefficient of Absorption of Air of the Beta Rays from Radium C." *Phil. Mag.*, Ser. 6, 22 (1911): 8-17. The same text (minus only a diagram of the electroscope) was published in the *Transactions of the Royal Society of Canada*, Sec. III (1911): 59-67.

E-16 Eve to Rutherford

McGill University, Montreal
The Macdonald Physics Building,
8 May 1911

Eve announces that he has written up his work [on the properties of β rays] in the form of two papers.¹ He says that he is "quite content with my value for the total number of ions due to β rays."² Nevertheless, Eve suggests that "If one of your men is wanting an experiment he could do it better than I can, if you let him have an intense active deposit of radium on very thin Al foil."³ Eve then briefly describes the principle of the experiment, which involves varying the distance between a radium C source and a thin-walled electroscope. He concludes this section on an apologetic note: "However perhaps you have other things on hand."

Eve gives the news that two colleagues and their families have sailed this week, presumably to spend the summer in England. The Eve family, however, will remain in Canada since "My mother is on the Atlantic and we are going to meet her at Quebec on Friday, and we are looking forward to her summer visit."

In the concluding paragraph Eve makes an indirect reference to his purchase of Rutherford's land in Côte des Neiges: "My brother has £1000 ready, or nearly so, for me in England, and I am awaiting instructions from you and Vaughan. No hurry."⁴

E-16 Notes

1. See Note 1c of letter E-15.
2. Eve concludes that the value of K , the number of ions per cm^3 per second at a distance of 1 cm from a curie of radium C, in air at atmospheric pressure, is 1.3×10^{11} . Hence the *total* number of ions produced in air by the β rays is approximately 4.0×10^{14} and the average number of ions made by one particle in an average flight from radium C in the atmosphere is about 1.2×10^4 . This number is of the right magnitude but rather too small. The average energy of the β particles emitted by radium C (bismuth-214) is approx. 1.09 MeV and the average energy expended in creating an ion pair is 34 eV. Hence we would expect about

3.2×10^4 ion pairs for each β particle. The corresponding figure for the β particles from radium B (lead-214) is about 0.7×10^4 and it seems, therefore, that Eve made an insufficient correction for the radium B present in his source.

3 This is not the first time that Eve has stated that his experimental work is hampered by the low intensity of the sources available to him: see also Note 3 of letter E-14.

4. Eve's brother, Frank Eve, resided in England and clearly assisted in business matters in that country. To my knowledge, no correspondence between the two brothers dating from 1910-11 has survived, but there are two or three letters of a later date from Frank to "Stew" (short for Stewart, A. S. Eve's second name) which indicate a warm relationship. It is not clear whether Eve was to borrow the £1000 *from* his brother, or whether Frank was merely acting as an intermediary in securing the loan. It may also be noted that, at no point in this correspondence, is the total purchase price of the property explicitly stated. In his 1937 memorandum (see Note 5 of R-10), Eve speaks of a \$2500 mortgage and it is also clear that Eve paid \$5000 in cash, most of it borrowed in England (see above and letter E-15.) Hence the total price was \$7500, which works out at 31.25 $\text{¢}/\text{ft}^2$. The mortgage was apparently for a 20-year term at a fixed rate of 5 percent. One of the last letters from Eve to Rutherford, date 2 June 1930, encloses the standard \$62.50 half-yearly interest payment and states "we hope to sell that lot in a year or two." On the other hand the cash loan was probably short-term and carried a lower rate of interest, 4 or 4 1/2 percent (see letter E-15).

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

R-15

Letter typed, but with several corrections and additions in Rutherford's handwriting

17, Wilmslow Road
Withington
Manchester
June 14th 1911

My dear Eve,

I received yesterday the cheque from your brother for the full amount, and am writing to Vaughan to close the transaction.¹ I think it likely you will probably make a good thing out of it if you are intending to speculate on it; but I was quite pleased to have got my share. As I wrote you, I was in no hurry about the matter of payment; and told your brother so; but it seemed to me that he was not aware that the transaction could not be completed until arrangements were made.

Geiger and partly myself have just made rather an interesting discovery. We find that the emanation of actinium has two α ray products, the second of which breaks up with a period of about 1/500 of a second.² Thorium emanation shows the same but with period considerably longer. We have got a number of experiments going to determine the period, and also on the question of the distribution of active deposit. I think we shall explain Russ's experiments quite simply on actinium.³ The new products are charged to travel to the cathode. It is pretty certain that they are analogous to radium A in radium, and there is then a great similarity between the three active deposits. I have designed several interesting lecture experiments to show the effects.

I am going to Birmingham next week as External Examiner, and then to London to attend the Coronation⁴ and Spithead Review.⁵

With kind regards
Yours very sincerely

E. Rutherford

R-15 Notes

1. This refers to the sale of Rutherford's land near Montreal to Eve: see letter E-15.

2. Geiger's work on the emanation of actinium was published shortly afterwards and had probably already been submitted at the time of this letter. [H. Geiger "The Transformation of the Actinium Emanation," *Phil. Mag.* Ser. 6, 22 (July 1911: 201-04.) Nowadays we would say that radon-219 (actinium emanation) decays by α -emission to polonium-215 (actinium A) with a half-life of 3.9 s (Geiger stated 4 s) and this in turn decays to lead-211 (actinium B), also by α -emission with a half-life of 1.83 ms (Geiger stated about 1/500 s, or 2 ms). Hence, two α -particles are emitted apparently simultaneously (actually in rapid succession), as Geiger had observed.

3. S. Russ "The diffusion of actinium and thorium emanations," *Phil. Mag.* Ser. 6, 17 (1909): 412-22. Sidney Russ was a Demonstrator in Physics in Rutherford's laboratory. His 1909 paper was concerned with the discrepancies in the various experimental measurements (based on gaseous diffusion) of the molecular weights of the emanations of radium, thorium and actinium. In 1901 Rutherford and Harriet Brooks had obtained a value between 40 and 100. Since then other workers had deduced values from 70 to 235, but mostly around 100. The theoretical value, on the disintegration theory, is about 220 for all three emanations. Russ compared the diffusion coefficients of the actinium and thorium emanations in air, under similar experimental conditions, and concluded that the molecular weight of thorium emanation was 1.42 times that of actinium emanation. This result was, however, quite wrong, the correct values of molecular weight being 220 (Th) and 219 (Ac), a ratio of 1.0046.

4. The Coronation of King George V and Queen Mary took place on June 22, 1911.

5. The Spithead Review took place on June 24, 1911, when the newly-crowned King reviewed the Royal Navy at Spithead Sound near Portsmouth on the south coast of England.

E-17 Eve to Rutherford

McGill University, Montreal,
The Macdonald Physics Building,
19 June 1911

This short letter is concerned with two subjects. The first topic is the purchase by Eve of Rutherford's land near Montreal. Eve says that he has received a copy of his brother's letter to Rutherford and it now seems that the £1000 needed to complete the deal (see letter E-16) was not available immediately: "... I imagined that it was more liquid than his letter indicated." Eve asks Rutherford if he minds waiting and offers to sell some C.P.R. [Canadian Pacific Railway] stock if Rutherford needs the cash quickly, but "I expect you have fixed it up with my brother by now."

The second part of the letter refers to several papers in the recent literature, including that of Gray, a member of Rutherford's Manchester group, on " γ rays producing β rays." However, this must be a mistake on Eve's part, because Gray's 1911 paper, and one which followed early in 1912, are both concerned with the opposite effect, i.e. β rays producing γ rays.¹ Eve comments "It is quite an interesting point cleared up." Eve also commends Rutherford's new model of the atom:² "Your inside of the atom is very engaging.... I expect it is a tremendous wirligig affair really and not statical at all."

The letter concludes by noting that "Tory³ is here today, looking prosperous" and "we are ... enjoying my mother's visit."

E-17 Notes

1. J. A. Gray "Secondary γ rays produced by β rays," *Proc. Roy. Soc. Lond.*, 85A (1911): 131-39.
2. See Note 6 of letter R-13.
3. H. M. Tory, formerly a Professor of Mathematics at McGill, was Principal of the University of Alberta in Edmonton (see letter E-3).

E-18/19/20 Eve to Rutherford

Montreal,
28 Aug. 1911 (E-18)
17 Oct. 1911 (E-19)
1 Nov. 1911 (E-20)

These three letters, written by Eve in the last months of 1911, will be taken together. There are no interleaving letters from Rutherford.

In E-18, Eve encloses a scientific note for publication, "if you think [it is] ... of sufficient public interest." Eve requests Rutherford to send the note to *Nature*, *Le Radium*, "or some such," adding "your blessing or opinion, or none, as you like." Eve comments that, while there is nothing original in the note, "the log. way of plotting makes matters clear."¹ However, seven weeks later, in letter E-19, Eve said he is glad that Rutherford did *not* forward the note for publication, since "it would have proved very flat compared with Geiger's full and interesting investigation."²

Continuing E-18, Eve refers to "the wonderful ionization experiments" of C. T. R. W. which indicate that β rays move through air "absolutely straight."³ Eve states that his own experiments, which he illustrates with a sketch, show that β rays "go round a lead block all right ... of course they may be secondary not scattered, but in either case one would have expected evidence of one or the other in C. T. R. W.'s work."

To conclude E-18, Eve mentions that his mother is still in Montreal and he has taken her to visit New Brunswick and other parts of Atlantic Canada. Finally, "shall I pay Vaughan or send you a draft for interest half-yearly? It is \$62.50 1 Nov. and 1 June."⁴ Rutherford evidently chose the second option, since in letter E-20, dated 1 November 1911, Eve encloses a draft for \$62.50, being "1/2 year's interest at 5% on \$2500. Please send me a receipt to make sure of its safe arrival."

In letter E-19, after commenting on the fate of the scientific note which he had sent to Rutherford in August (letter E-18), Eve congratulates Rutherford on the "number & excellence of the papers from Manchester in the Oct. Phil. Mag."⁵ He adds: "Please send me a copy of each paper, if you can remember about it, because they are so useful in preparing lectures, instead of running to the Library to the bound Phil. Mags."

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

Eve then comments on one of the October *Phil. Mag.* papers, contributed by Rutherford and Geiger, on the nomenclature of the radioactive emanations:⁶ "I am glad that you have boldly altered the nomenclature to get the active deposits in line. In a short time things ought to be in fair shape for a more or less permanent account of radio-activity in your third edition."⁷ There follows a more general comment: "The chief trouble in Physics seems now to reconcile the concentrated energy of γ or X or ultraviolet rays with electromagnetic theory and wave theory of light."⁸

E-20 is a very brief letter, no more than a covering note for the half-yearly interest payment due to Rutherford on 1 November (see above). Eve adds: "Am I not brave? I am going to lecture to the Chemical Soc[iet]y this afternoon on the extraction of the radioactive elements from ore."

The letter concludes on a note familiar to all Montrealers, (especially since two weeks earlier, in letter E-19, Eve stated that they were "revelling in an Indian Summer"): "Summer has fled and winter fairly jumped at us."

E-18/19/20 Notes

1. The note was never published and we do not know its title or nature. However, since Eve directly compares his paper with that of Geiger (Note 2 below), we may assume that the subject matter was an extension of, or related to, Eve's work on the number of ions produced by β rays from radium C (See Note 1c of letter E-15). The reference to "the log. way of plotting" presumably refers to the fact that an exponential absorption or transmission curve transforms into a straight line when the logarithm of the intensity of the radiation is plotted against the absorber depth or thickness.

2. H. Geiger and A. F. Kovarick "On the relative number of ions produced by the β particles from the various radioactive substances," *Phil. Mag.* Ser. 6, 22 (Oct. 1911): 604-13.

3. C. T. R. Wilson "On a method of making visible the paths of the ionising particles through a gas," *Proc. Roy. Soc. London*, 85A (June 1911): 285-88. Charles T. R. Wilson (1869-1959) was a Scottish physicist who was a Lecturer in

Physics at Cambridge University. This short paper described the first functional "Wilson Cloud Chamber" (illustrated by a plate showing the passage of β rays through air), although the genesis of the invention dates back to 1896 when Wilson observed that dust was unnecessary for the condensation of water droplets in air since charged particles (ions) could act as nuclei for the condensation process. Wilson received the Nobel Prize in Physics in 1927.

4. From this statement we may conclude that the sale of the land was completed on 1 June, 1911.

5. The October 1911 issue of the *Philosophical Magazine* contained no less than five papers from Rutherford and his colleagues in Manchester. Rutherford was joint author of two of these papers: with Boltwood on the production of helium from radium (see Note 3 of letter R-10) and with Geiger on the nomenclature of radioactive emanations (see Note 6 below). Geiger contributed two other papers, on the ions produced by β particles (with A. F. Kovarich, see Note 2 above), and with J. M. Nuttall on the ranges of α particles from various radioactive substances (pp. 613-21). Finally there was a paper by H. G. J. Moseley and K. Fajans on radioactive products of short life (pp. 629-38). (Henry Moseley was one of Rutherford's most brilliant young physicists. His death on active service in Gallipoli in 1915 was a tragic loss to science.)

6. E. Rutherford and H. Geiger "Transformation and nomenclature of the radioactive emanations," *Phil. Mag.* Ser. 6, 22 (Oct. 1911): 621-29.

7. The "third edition" to which Eve refers is that of Rutherford's book *Radioactivity*, the first edition of which was published in 1904 by Cambridge University Press. A second and much larger edition appeared in 1905. The third edition was published in 1913 under the title, *Radioactive Substances and their Radiations*. According to Eve (*Rutherford*: 216) the change in title was necessary in order to "avoid certain difficulties about rights for translation."

8. Eve was right: this was indeed a major problem in the physics of the period. The reconciliation was achieved by the quantum theory of radiation. (see also Note 2 of letter R-14.)

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 photocopies of the letters from Eve to Rutherford; to the Syndics of Cambridge University Library for granting permission to quote from these letters; and to Dr. Robert Michel, of the McGill University Archives, for help in locating material. Finally, I wish to thank Professors Leo Yaffe and Fred Hedgcock for reading the manuscript of this article and making helpful suggestions.