and will remain substantially constant (except for radioactive decay) until at t_{max} the upper level activity is also exhausted. Therefore, Eq. 4 may be split into two parts:

$$N = N_1 + N_2 \quad (6a)$$

$$N_1 = 5V_1 \int_0^T a(t)\, t\, dt \quad (6b)$$

$$N_2 = 5V_2 \int_T^{t_{max}} a(t)\, t\, dt \quad (6c)$$

The dosage R resulting from N_1 alone is that given in Fig. 2. For $t > T$, the relationship of Eq. 1 holds in the form

$$a(t)\ t^{1.2} = a(T)\, T^{1.2}$$

and Eq. 6c becomes

$$N_2 = (50/8)\, V_2 a(T)\, T^2 \left[(t_{max}/T)^{0.8} - 1\right] \quad (7)$$

The time it takes to clear the lower atmosphere is given by $T = h_1/V_1$. The time required to exhaust both the upper and lower regions is

$$t_{max} = \frac{h_{max} - h_1}{V_2} + \frac{h_1}{V_1}$$

or, if $V_2 << V_1$ and $h_{max} = 3h_1$, then

$$t_{max} = 2h_1/V_2.$$

Using these relationships, Eq. 7 may be written

$$N^2 = (50/8)\, a(T)\, T\, h_1 \left\{\frac{V_2}{V_1}\left[\left(2\frac{V_1}{V_2}\right)^{0.8} - 1\right]\right\}. \quad (8)$$

The quantity between the braces in Eq. 8 differs from unity by a factor of less than 3 for all V_1/V_2 between 1 and 10,000. It may therefore be neglected for the purposes of this calculation.

Figures 3 and 4 suggest that the experimental value for T was about 100 days, and the average observed air concentration $a(T)$ was 21 disintegrations per cubic foot, per day. With h_1 as 40,000 feet, the number of disintegrations per square foot for all time then becomes

$$N_2 = 5.3 \times 10^8.$$

Therefore from Eq. 5, the total infinity dosage at Washington, D.C., due to fallout from the upper level would be about 2×10^{-4} roentgen. This is, of course, a very small addition to the dosages given in Table 1.

Summary and Discussion

It has been assumed that the fission product conglomerate emits one gamma ray per beta particle throughout its lifetime. The fallout velocities are not accurately known, and in some cases the detonation and response times have been approximated. For these reasons, the dosages reported in this paper can be accurate in order of magnitude only. With these reservations, an infinity dose of 0.2 roentgen or less due to all explosions between January 1951 and May 1955 is reported for Washington, D.C. Therefore, it is probable that the total fallout from all weapons tests that have so far been conducted will produce only a fraction of the lifetime dosage due to natural radioactivity and cosmic radiation (*6*).

Most of the dosage comes from the Nevada tests, and only a small part from the Pacific thermonuclear tests (*7*). Fission products contained in that part of the cloud of a thermonuclear explosion which extends above the level of precipitation is found to contribute only very slightly to the dosage at great distances. No analysis was carried out for air activity data taken at other locations, but their qualitative similarity to those taken in Washington suggests that infinity doses in most other locations in the northern hemisphere will not be greatly different.

Present results are in essential agreement with two other measurements that have been reported. Eisenbud and Harley (*8*) have measured fallout deposited on gummed papers (*9*) at various locations in the United States and have found an average dose of 0.001 roentgen per year. Stewart, Crooks, and Fisher (*10*) have measured the activity of air, rainwater, and ground deposits in England and report an infinity dose of 0.055 roentgen. This somewhat lower figure may result from their greater distance from Nevada, which appears to be the source of most of the fallout in the United States.

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R. C. Archibald and Mathematics Libraries

Raymond Clare Archibald was born in Colchester County, Nova Scotia, on 7 October 1875, the son of Abram Newcomb and Mary Mellish Archibald. When he was a small boy, his father died, and Raymond was brought up by his mother. During his youth she held a position as teacher in the Mount Allison Ladies College at Sackville, New Brunswick, and Archibald was himself graduated from Mount Allison University when still but 18 years old. At this time he received an A.B. degree with first class honors in mathematics and a teacher's diploma in violin. Presently he continued his studies at Harvard University, where he was awarded a second bachelor's degree in 1896 and a master's degree in 1897. After one more year of graduate study there, he went to Germany for 2 years. The first was spent at the University of Berlin and the second at the University of Strasbourg, from which he received his doctor's degree in 1900. Later on (1909–10) he studied for a year at the Sorbonne and still later (1922) for a short time at the University of Rome.

During the years 1894–95 and 1900–07 he taught in the Mount Allison Ladies College. Some of his duties were in mathematics, but in later years he used

to refer more often to his teaching of the violin during this period. He was also given responsibilities in the library, which he "developed from nothing to 12,000 volumes and catalogued by writing 30,000 cards by hand."

After a year as professor of mathematics at Acadia University in Wolfville, Nova Scotia, he was brought to Brown University as instructor in 1908. He now felt that he must banish music almost completely from his life and devote all his energies to mathematics in order to make a success of his work.

When, as a freshman in Brown University in 1915–16, I first came to know Archibald, he was my teacher. Then he was in the prime of life and full of energy. He was striking in appearance, his hair wavy and beginning to gray, worn a little longer than was generally the custom; his eyes large and expressive. Always carefully groomed, he wore a high starched collar and stiff detachable cuffs. Often a white edging on his waistcoat gave an added touch of elegance to his dress. To me he was an impressive figure among the Brown faculty.

Archibald firmly believed that the relationship between teacher and student should be personal and friendly and close. It was his custom to make appointments with each student in his classes for one or two half-hour conferences each semester. Thus I came to know him outside the classroom, and in these conferences he gave me encouragement in my work and fostered the growth of my interest in mathematics.

In 1908 the mathematical library at Brown, though well selected, was of small proportions. It was not difficult, after Archibald's introduction to library work at Mount Allison, to enlist his interest in developing and enlarging the mathematical library here. He threw himself into this task with a will and in the course of 10 or 15 years brought the library to a position of excellence. By the 1940's it had become generally recognized as one of the half-dozen best in America. During the period 1920–40 Archibald, without doubt, knew more about mathematical books and their values than anyone else in this country. Frequently he went to Europe for the summer, always provided with funds to spend for mathematics books for Brown. He carried on a flourishing correspondence with scientific booksellers throughout the world, and if a dealer offered an item for sale at less than it was worth he was on occasion quick to recognize the bargain and to cable an order for purchase.

During these same years he was devoting himself with great success to the upbuilding of two other libraries. From 1921 to 1941, as librarian of the American Mathematical Society, he supervised the growth of the society's library, which was developed largely through exchange of publications. The other library that received his constant and affectionate attention during these years and in the later years, after his retirement from teaching in 1943, is the Mary Mellish Archibald Memorial Library (of English and American poetry and drama) at Mount Allison University. This remarkable collection, his gift to Mount Allison, now contains "about 27,000 volumes, 2,700 gramophone records, and 70,000 songs with piano accompaniment."

Archibald was the author of a number of books including *Carlyle's First Love, Margaret Gordon, Lady Bannerman* (1910); *Euclid's Book on Division of Figures with a Restoration* (1915); *Klein's Famous Problems of Elementary Geometry,* revised edition (1930); and *A Semicentennial History of the American Mathematical Society, 1888–1938* (1938). His *Outline of the History of Mathematics* (1932) is widely used in courses in this subject throughout the United States and was successively revised up to the sixth edition in 1949. He contributed a number of articles to the *Encyclopaedia Britannica* and to the *Dictionary of American Biography* and a valuable bibliography of Egyptian and Babylonian mathematics to the edition of the *Rhind Mathematical Papyrus* published by Chace, Bull, and Manning (1929). At one time or another he served on the editorial boards of half a dozen periodicals and in 1919–21 was editor-in-chief of the *American Mathematical Monthly,* official organ of the Mathematical Association of America.

All his life he had a special interest in mathematical tables, and in 1939 the National Research Council made him chairman of a committee to study and report on the general situation with regard to tables. His committee found that the usual kind of report, ending this matter once and for all, would fall far short of the present-day needs of the scientific community, and that these needs could best be met by publishing a periodical that would constantly advise workers everywhere of new developments in this area of science. This led to the founding of the journal *Mathematical Tables and Other Aids to Computation,* with Archibald as its editor and a strong group of younger men as associates. Since World War II the tremendous expansion of interest and activity in high-speed computing machines, electronic and otherwise, has brought to this new journal an ever-increasing field of usefulness and significance.

With the passage of the years, many well-deserved distinctions came to Archibald from institutions on both sides of the Atlantic. Honorary degrees, memberships in academies of science and foreign mathematical societies, all paid tribute to the high regard in which he was held by friends everywhere and in many cases acknowledged services generously performed and freely given. He was president of the Mathematical Association in 1922, vice president and chairman of Section A, Mathematics, of the American Association for the Advancement of Science in 1928, and in 1937 was vice president and chairman of Section L, History and Philosophy of Science.

Archibald was both a scholar of the old school and a gentleman of the old school as most of us now regard it. He was brought up in the classical tradition with much emphasis on Latin and Greek. He had a very remarkable memory, and he carried with him at all times an enormous store of factual information in the fields of his interest. His death on 26 July 1955, in Sackville, brought to a close the life of a man who will long be remembered for his kindness, his unwillingness to compromise his standards, and his deep devotion to Brown University.

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The real problem in the years ahead is one of making the most efficient use of all our national resources—and not the least of these resources is our intelligent youth.—GEORGE A. SLOAN.