6) The theory predicts the observed effects of prolonged or "instantaneous" exposure of experimental animals to ionizing radiation.

7) The relative deleteriousness (D) of various national environments can be calculated. They have been found to differ by approximately 50 percent. We have been unable to make an independent test of these relative values.

8) Despite the fact that it is derived for a homogeneous population the theory is shown to be not inconsistent with individual variability within a population.

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20. The present theory is expressed in terms of energy fluctuations arising internally or externally. This dimensional system is chosen because: (i) death undoubtedly cannot occur without the occurrence of a change in structure or physiological state, which change is the result of energy expenditure; (ii) death will occur if the capacity of the system to restore conditions necessary for life is exceeded; (iii) this restoration of original conditions requires the expenditure of energy of a certain kind at a certain minimum rate. Thus, an organism lives or dies according to whether its maximum power output in the challenged modality is sufficient to overcome the disruptive influence of the challenge. It is also clear that any parameter exhibiting an inverse logarithmic relationship between magnitude and frequency (coupled with a linearly decreasing resistance thereto) would be sufficient to generate the observed mortality behavior. Such a functional relationship would result from the square of any variable that exhibits a Gaussian distribution—for example, molecular velocity. Thus, the agreement between prediction and observation does not "prove" the validity of the energy analogy. However, attempts to postulate and measure underlying variables other than energy or its equivalent have thus far not been successful. For the above reasons we have emphasized the energy analogy as being the most appropriate one at present.
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Roy Chapman Andrews, Explorer

Some sixty years ago Roy Chapman Andrews, the son of a rural druggist in southern Wisconsin, chanced upon *A Handbook of North American Birds* by Frank M. Chapman of the American Museum of Natural History. The book, and the author of that book, were to influence most profoundly the life of Roy Andrews, just as decades later the writings of Andrews were to cast their spell over the lives of many boys entering into manhood. Young Andrews had a burning desire to meet Chapman, and eventually he did meet him, in the summer of 1906.

Andrews had at that time just completed his undergraduate career at Beloit College, and he faced the world with restless energy. To him, a young man fond of the outdoors and a veteran of numerous camping trips in his native state, the American Museum of Natural History and Frank Chapman were the two poles of a magnet that attracted him with irresistable force to New York. It is an oft-repeated tale, how he approached the director of the Museum and asked for employment, how he was told that there were no staff openings available, and how he took a menial job as general attendant and handyman in the department of preparation, where he mixed clay and scrubbed floors.

His enthusiasm for his work and for the museum were immediately apparent, and he very quickly advanced within the institution. In 1908 he went to British Columbia to make field studies of whales, an endeavor that set the pattern of his life for the next 8 years, which he spent in active and diverse field work on Pacific whales. As a result of these studies he published two monographs and several short papers on the Cetacea, and these were in essence the totality of his research publications.

It became apparent to him early in his career that research was not his major interest; rather, he developed an overwhelming desire to carry on field work and exploration. This was in part the result of his youthful camping days

in Wisconsin, in part an expression of his restless spirit and his active body. It was not easy for him to sit still, for he was not the contemplative type but a lover of action and of the out-of-doors. He wanted to go to the far places of the earth, not for the sake of going, but for a definite purpose—to conduct scientific explorations in little-known lands.

So it was that in 1916 he turned his eyes toward Central Asia. He became obsessed with the idea of exploring what was then the mysterious land of Mongolia, to search for scientific treasures that were buried in that almost unknown country. Undoubtedly he was stimulated in this interest by the theories of William Diller Matthew, who regarded Central Asia as the center of origin for most of our mammalian orders, and of professor Henry Fairfield Osborn, who believed this region to be the birthplace of primitive man. Consequently, in the years just before 1920 he went on two very modest reconnoitering expeditions in areas adjacent to Mongolia, to feel his way toward a larger goal.

Then, with the beginning of the third decade of our century he entered into the planning and the arduous work that were to come to fruition in the famous Central Asiatic Expeditions of the American Museum of Natural History. Those were the days before large foundation and government grants, and money had to be raised individually and privately. Andrews had the talent to do this. By the end of 1921 he had amassed a fund sufficient to begin work in Central Asia on the scale that he envisaged.

It was to be no ordinary trip by two or three trained scientists and their retainers. Andrews planned and put into the field a large and elaborate expedition, staffed by outstanding authorities in geology, paleontology, zoology, botany, and anthropology, with technicians and numerous field assistants. He had the very original concept of operating with a contingent of motor cars supported by a large camel caravan. The camels crossed the Gobi on a predetermined course, loaded with containers

Roy Chapman Andrews

full of gasoline and oil. At stated places supply dumps were established, and these were visited by the motor fleet. It was a complex problem in logistics and in what might be called land navigation, and it was nicely solved. With the cars the scientific staff could range far and wide across the Gobi, covering vastly more ground in a season than had ever been covered before by scientific explorers working under similar conditions.

The first expedition, in 1922, was eminently successful and was followed by other expeditions, in 1923, 1925, 1928, and 1930. Andrews and some of his staff spent the intervening winters in Peking. The results of these expeditions have been published in many scientific contributions, and researches are still continuing on the collections that were made during those years. The expeditions did not discover the earliest men (years later such beings, the australopithecines, were to be found in Africa) but they did find many fossil reptiles and mammals, including some spectacular discoveries of dinosaurs, the first association of dinosaurs with their eggs, the first finds of placental mammals in the Cretaceous deposits along with the dinosaurs, various important Cretaceous and Tertiary vertebrate faunas, and archeological sites of importance. In addition, the expeditions made zoological and botanical collections, as well as an important series of topographic and geologic maps of Mongolia.

There were no more trips after the expedition of 1930; unrest in Asia made further work in Mongolia impossible. Thus Andrews, who had been in Asia almost continuously for a decade, returned to New York. The field work in Mongolia had revealed Andrews' ability to supervise large projects and to work with men, so it was no surprise when in 1933 he was made director of the American Museum of Natural History. He served in this capacity until 1941, when he retired.

After his retirement he lived for several years in Connecticut and subsequently in California, spending much of his time in writing. What he wrote had to do largely with exploration, and of this he wrote superbly. Many of his books have become classics and are still widely read all over the world. Indeed, one of Andrews' most important contributions is to be found in the influence of his books upon young people. There can be no doubting the fact that some of our leading paleontologists and zoologists, now in their thirties and forties, were at least in part attracted to their respective fields by reading *Ends of the Earth*, or *On the Trail of Ancient Man*, or *This Amazing Planet*, or *Under a Lucky Star*.

Andrews was the recipient of many honors, including several honorary degrees and medals, and recognition by various scientific societies. His reputation as an explorer was world-wide, and he was much in demand for public lectures.

As a man, Roy Andrews had a cheerful and ebullient personality. His energy seemed to be boundless. He had a supreme zest for life, and he lived life to the full all his days. He died on 11 March 1960, in his 76th year, at Carmel, California, where he had spent the last years of his life. He is survived by his widow, Wilhelmina Christmas Andrews, and by two sons, George Borup Andrews and Roy Kevin Andrews, by his first wife, Yvette Borup.

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