they apply to all higher organisms, including man. These results are

1) High-energy irradiation produces mutations.
2) The frequency of induced mutations is directly proportional to the dosage of irradiation. There is almost certainly no threshold value below which irradiation is ineffective.
3) The effects of successive exposures are cumulative.
4) The effects are permanent in the descendants of the affected genes. There is no recovery.
5) The overwhelming majority of these mutations is deleterious—that is, they seriously affect the efficiency of individuals in later generations in which they come to expression. These deleterious genetic effects may lead to early death or to any of a wide variety of defects, often gross ones.

There is a store of such undesirable genes already present in any population. What irradiation does is to add to this store.

It follows from these facts that any large-scale increase in the amount of irradiation to which human populations are subjected is a serious matter. Even though we cannot say that a given amount of irradiation will have a quantitatively specified effect, we can say that it will have some effect. The probability of an effect on the germ cells of any one individual may be very low; but when many millions of people are being exposed, it becomes certain that some of them will be affected. There is no possible escape from the conclusion that the bombs already exploded will ultimately result in the production of numerous defective individuals—if the human species itself survives for many generations. And every new bomb exploded, since its radioactive products are widely dispersed over the earth, will result in an increase in this ultimate harvest of defective individuals. Some such defectives would be present if the bombs had never been invented; the point is that the number due to the bombs will be added to this irreducible minimum.

Under these circumstances, I have been disturbed that Chairman Strauss of the Atomic Energy Commission should state, in an official press release from the White House, on 31 March 1954

> . . . it should be noted that after every test we have had, and the Russian tests as well, there is a small increase in natural "background" radiation in some localities within the continental United States. But currently it is less than that observed after some of the previous continental and overseas tests, and far below the levels which could be harmful in any way to human beings. . . . [*Bull. Atomic Scientists* **10**, 164 (May 1954)].

Presumably this statement is intended to refer only to immediate effects on exposed individuals; but, as I have pointed out, there are important other effects, less immediately apparent. Every geneticist familiar with the facts knows that any level whatever is certain to be at least genetically harmful to human beings when it is applied to most or all the inhabitants of the earth.

I do not wish to be understood as arguing that the benefits ultimately to be derived from atomic explosions are outweighed by the biological damage they do. It may be that the possible gains are worth the calculated risk. But it must be remembered that the risk is one to which the entire human race, present and future, is being subjected. I regret that an official in a position of such responsibility should have stated that there is no biological hazard from low doses of high-energy irradiation.

Byron Cummings, Archeologist and Explorer

BYRON CUMMINGS, twice acting president of the University of Arizona and director emeritus of the Arizona State Museum, died at his home near Tucson on 21 May 1954. A teacher for more than 50 years and the organizer of two university museums, he retired from the classroom in 1938 at the age of 78 and from museum administration 7 years later. In his 94th year, he was actively engaged with the day's work until a few months previous to his death.

Byron Cummings was born at Westville, New York, 20 September 1860, youngest of the seven children of Moses and Roxana (Hoadley) Cummings. The father, a Union soldier, was killed during the Civil War. Byron was graduated from Oswego Normal School in 1885 and received his A.B. from Rutgers College in 1889. Rutgers awarded him an A.M. degree in 1892 and an honorary doctor of science in 1924. He pursued graduate studies at the University of Chicago in 1896 and at the University of Berlin, 1910–11. His devoted service at the University of Arizona was recognized with an LL.D. in 1921.

A teacher of magnetic personality, Professor Cummings began his professional career at Syracuse High School in 1887 and as an instructor in Greek and mathematics at Rutgers Preparatory School, 1889–93. In the fall of 1893 he moved to the University of Utah as instructor in Greek and Latin. Two years later he was designated full professor and head of the department, a chair he held for the next 20 years. At Utah he served also as dean of men, 1905–15, and as dean, School of Arts and Sciences, 1906–15. In the latter year, with 16 other faculty members he resigned in protest against administrative policies. While resident in Salt Lake City Professor Cummings was an active participant in church and civic affairs. He was a member of the Utah State Park Commission, 1909–15 and as a member of the managing board, School of American Research, Santa Fe, New Mexico, until 1952.

In 1915 Professor Cummings accepted an invitation from the University of Arizona to establish a department of archeology and to develop a state museum from the nucleus of zoologic and geologic specimens then on hand. He continued as head of the department and as director of the museum until he retired in 1938 with the title of director emeritus. During his 23 years on the university faculty he was also dean of the College of Letters, Arts, and Sciences, 1918–21; dean of men, 1918–21; and acting president in 1921 and in 1927–28. His tireless service in the crowded university hospital, day and night throughout the influenza epidemic of 1918, is still remembered by students of the period.

In Arizona and in Utah Professor Cummings was a leader in archeological exploration and in organization of local archeological societies. He led the Utah party that discovered Rainbow Natural Bridge on 14 August 1909 and those that discovered Betatakin, Inscription House, and other famous Arizona ruins now administered by the National Park Service. He was leader of the National Geographic Society expedition that laid bare the lava-covered pyramid of Cuicuilco, in the Valley of Mexico, 1924–25. His last major archeological contribution was at Kinishba, a great ruin on the Apache reservation, Arizona, excavation of which he began in 1931 and continued until June 1939. He restored part of the ruin and built a local museum, which he cared for until 1946 when, at the age of 86, he withdrew to give full attention to his writings. A partial bibliography appeared in *For the Dean,* a volume of essays by 22 former students then professionally engaged in anthropology, published in 1950 in recognition of his 90th anniversary. His latest book, *First Inhabitants of Arizona and the Southwest,* appeared 19 September, 1953 on the eve of his 93rd birthday.

A man of unusual warmth and understanding throughout his long career, Dr. Cummings drew people to him from all walks of life. Neighbors and faculty members, as well as university students, went to him for counsel. In a little volume, *Indians I Have Known* (1952), he reviewed a few of the friendships he had made among the Navajo and Apache. He was a fellow of the American Association for the Advancement of Science and a fellow or member of numerous other professional societies. In 1896 he married Isabel McLaury, who died in 1929. He is survived by his second wife, Ann Chatham, whom he married in 1947, and by a son of the first marriage, Malcolm B. Cummings.

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News and Notes

Some New Scientific Trends in Meteorology

A conference on the significance and possibilities of high-speed computing in meteorology and oceanography was held at the University of California in Los Angeles, 13–15 May. The conference, sponsored by the National Science Foundation was attended by about 40 scientists, including meteorologists, oceanographers, mathematicians, and fluid dynamicists. Most of the discussion of meteorological problems was concerned with the motions of the atmosphere. The fundamental laws of these motions are based on theoretical and experimental information available from fluid-dynamics studies, and they are applied with much success whenever the flow conditions are relatively simple, as is mostly the case in physics and engineering. However, in most meteorological problems, the fluid motions are extremely complicated and involve energies of relatively great magnitudes. The meteorologists have, therefore, of necessity been forced to build a new discipline, based partly on existing physical laws and partly on insight into atmospheric phenomena gained from long experience.

While the art of meteorology was thus being continually improved, important advances were being made in fluid dynamics and in pertinent mathematical techniques. Moreover, high-speed computing techniques came into being. With this newly acquired knowledge and facilities, a fundamental approach to problems of atmospheric motions has become possible. Electronic computing machines can now, within a reasonable time and without requiring thousands of human operators, apply such laws to many complicated meteorological problems. High-speed computing techniques can also be of assistance in testing those fundamental laws of physics that are not yet well established, and they can help in handling and analyzing the enormous amount of numerical data needed to describe atmospheric motions.

Numerical weather forecast, using high-speed computing equipment, is already an object of extensive studies, particularly in the United States and the United Kingdom. From known meteorological conditions over the United States, the general flow pattern can already be determined, 1 or 2 days ahead, for a large part of the country. Comparisons between the numerically determined charts and those observed 1 or 2 days later appear to be encouraging. With further scientific development, predictions of large-scale flow patterns, located correctly within, say, 200 mi will be made on a routine basis. The next step will be to connect with each flow pattern smaller scale motions combined with humidity and temperature fields and to