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Serendipity in Research

One of the popular misconceptions concerning research is the importance of serendipity. The public has come to think that the successful scientist is one who has "a gift for finding valuable or agreeable things not sought for." A few examples, such as Perkin's discovery of an artificial dye, have dramatic value and hence are overemphasized. Perkin's discovery, while important to the course of development of chemistry at the time, plays only a minor role in the structure of science today. Organic chemistry, one of man's greatest intellectual triumphs, was built as a cumulative result of answers to a series of closely directed questions. Occasionally a chance observation has led to unexpected enlightenment. In general, however, progress has come because experimenters were seeking it.

Consider advances in another field—nuclear physics during the 1930's. This was an area where, to the highest degree, a kind of serendipity entered in. The discoveries of the neutron, artificial radioactivity, and uranium fission were unexpected. Yet in each instance the experimenters involved were extraordinarily competent. They had posed clear-cut questions. Chadwick in 1932 was attempting to study the physics of interaction of alpha particles on beryllium when he noticed that a "hard" gamma ray accompanied the reaction. On exploring the matter further he found that he was dealing not with gamma rays but with neutrons. The Joliot-Curies were studying the reaction of aluminum with energetic alpha particles. They observed that when the source of particles was removed, the aluminum target continued to emit radiation.

The most unexpected and far-reaching discovery in nuclear physics was that of uranium fission, reported by Hahn and Strassmann in 1939. In this case the discovery was more a result of careful work than anything else. Earlier, Fermi and his group had irradiated uranium with neutrons, and they thought they had discovered transuranic elements. Hahn and Strassmann were following up this work and found what they believed might be radium, presumably arising from neutron-stimulated emission of alpha particles from uranium. A first step in the isolation of radium is coprecipitation of radium and a barium salt. Later the mixture is recrystallized and the two elements can be separated. But in the products from uranium the radioactivity precipitated with the barium could not later be separated from it. When this was confirmed, Hahn and Strassmann were forced to conclude that they had produced barium from uranium. In a sense the discovery involved luck, but only in part. The experimenters had posed an interesting, clear-cut question, "Is radium a product of irradiation of uranium?" They devised an appropriate set of experiments to answer the query. The result was certain to be important, whatever it was. If they had proved that radium was a product, the result would have been considered very important, though not so significant as what they actually found.

Other developments in nuclear physics, such as the discovery of carbon-14 and other radioactive tracers, were sought, as was the understanding of nuclear forces. Indeed, most of the structure of nuclear physics is a product of carefully planned research rather than a series of happy incidents. In general, the research worker gets no more from his experiments than he puts in by way of thought, preparation, performance, and analysis. Serendipity is a bonus to the perceptive, prepared scientist, not a substitute for hard work.—P.H.A.