

SOME RECOLLECTIONS AND REFLECTIONS ON RUTHERFORD

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WHEN I attempt to recall Rutherford from my first interview in 1929/30 I seek some prompting from my incidental notes and those of others. In 1929, Rutherford was only 58 but his achievements had been great and widely acclaimed and he had been awarded the Order of Merit. We are told that Niels Bohr felt it necessary to be diplomatic when he sent George Gamow to visit him. To quote Gamow 'Bohr wanted me to go to England to show my calculations to Rutherford, but he told me I must be very careful in presenting the quantum theory of nuclear transformation to him since the old man did not like any innovations and used to say that any theory is good only if it is simple enough to be understood by a barmaid. The difficulty was that . . . to explain the decay of uranium along classical lines, Rutherford imagined that an alpha-particle during the early stages of its emission consists of four neutral protons (a polynutron, as one would say now) and thus is not influenced by the electric charge of the nucleus . . . Rutherford believed that at a certain distance from the nuclear surface the two electrons accompanying the alpha particle, like two tugs pulling a large ship out of a narrow harbour, become disengaged and return to port, while the ship continues to speed up on its own power'. Gamow concludes 'This certainly was a brilliant idea which, however, was unfortunately disposed of by the newborn wave mechanics.'

By the way, it is interesting to reflect that Rutherford's idea is not yet so completely disposed of. Nuclear physicists are still seeking to find a model for the fissioning process of heavy nuclei, in which there is a combination of the liquid drop or liquid droplet model which is like Rutherford's idea, with the shell model that helps to determine the energy levels and what may be called the tug effects at various separation distances of the fragments. Moreover, there are recent experiments also still seeking a fuller explanation in which fragments such as Oxygen-24 (that is an oxygen nucleus with six extra neutrons beyond the highest stable isotope—Oxygen-18) emerge from nuclear collisions and survive long enough to be identified.

However, Rutherford readily accepted Gamow's calculations, at least as a theoretical working hypothesis, and from the closer vantage point of the

Cavendish I would not have thought of him as an old man unreceptive to innovations.

In 1929 the usual enquiry had been put to me as a student of what I hoped to do after graduating in 1930. I had said research in physics in any subject other than radioactivity. A few months later Rutherford called me to his office and said 'I am told you understand about these wireless valves. We are just beginning to use these in our alpha-ray work so if you get through the exams all right I would like you to join my group'. I said yes with some enthusiasm.

Between then and 1933 the group did apply wireless valve technique, or electronics as we would call it today, to settle the problem Rutherford had had at heart for several years, the long-range α -rays from Radium-C' and their relation to certain energy lines in the β - and γ -ray spectra, measured by Ellis.

This work was, however, somewhat eclipsed in 1932 by the great events of the discovery of the neutron by Chadwick and the artificial nuclear disintegrations by accelerated protons achieved by Cockcroft and Walton. Soon after came the discovery of deuterium and the many disintegrations accelerated deuterons produce. All the techniques from all quarters of the Cavendish were brought to bear on these new phenomena. The cloud chamber, the electronic counters, ion sources, isotope separations, β -ray techniques and others.

So much was happening in parallel that some glimpses of Rutherford at that time may be 'of interest'—a phrase of his, to be found in many papers. The first reference to him in a journal I kept at that time records on 28 July 1930, 'The mica condensers (which I had specified) not having arrived, the old paper condensers were put back as the Professor wanted the set finished as soon as possible'. Very good in retrospect for we had very much to learn before the greater stability of the mica condensers was needed in the accurate measurements made with 'the set' which was the only high gain linear amplifier then existing in the Cavendish, designed and built by F. A. B. Ward and C. E. Wynn-Williams. That 'set' is prominent in the well-known photograph 'Talk Softly Please'.

Although one α group like Mount Everest dominated the landscape, as Rutherford put it in his recorded Göttingen lecture, it was clear that some groups had not been resolved and we needed a method with higher resolution. It was known from Rosenblum's work with the large magnet in Paris that magnetic focusing would provide this but such a costly installation was out of the question for Rutherford. By discussion with Cockcroft it seemed possible to combine our counting methods with an ingenious design of magnet that was in fact built by Met-Vick for £250. When showing it to a visitor Rutherford remarked that was 'a lot of money, as much as a research student for a year, but it will do a lot more work'. We in fact had it in operation and first saw α -particles

resolved on 21 February 1932, the day Chadwick told us at the Kapitza Club about his discovery of the neutron. In August 1933 we sent off the manuscript of the final analysis of the Radium Long Range α -particles, and at the end of that year Rutherford communicated the final paper by B. V. Bowden and myself on all the α -ray analyses with the magnet.

The sensing and counting equipment we used in all that work has for a long time now seemed incredibly cumbersome and primitive. The reason for the sign 'Talk Softly Please' was not as Eve stated in his book, although a visitor might well think so. A loud noise resulted in a rapid rattle of the 'message registers' driven by the thyratron counter, or scaler, and frequently would also cause the scaler to jam but that was the symptom, the disease was microphonic response in the ionization chamber and the long wire leading from it to the 'free grid' of the precious DEV valve chosen for its low electrical background. Nowadays with solid state detectors and fed-back amplifiers microphonics are usually well controlled.

By 1933 there were several of the Ward and Wynn-Williams type of linear amplifier in the Cavendish. The second was made by Crowe for Rutherford for his Royal Institution lecture, a convenient source of funds for more polished equipment. It was fated to be sealed in a galvanized iron box built around an old table and used in Cockcroft's counting equipment in his old HT lab. Another was used by Chadwick in his neutron work and a fourth by Rutherford and Oliphant in their disintegration studies with deuterons.