Disintegration of Light Atomic Nuclei by the Capture of Fast Neutrons

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ABOUT thirteen disintegrations of neon nuclei have been obtained in 3,200 pairs, and approximately 100 disintegrations of nitrogen nuclei in 7,600 pairs of photographs of a Wilson chamber through which neutrons were passing. The source of the neutrons consisted of beryllium powder intimately ground with a mixture of mesothorium and thorium-X. The neutron source used was on the average more powerful in the experiments with neon than with nitrogen. If all the factors are taken into account, it is found that with identical atomic concentrations of neon and of nitrogen in the chamber, the neon nuclei are disintegrated much less often than those of nitrogen.

The average energies of the neutrons which have been found to disintegrate light nuclei are, in millions of electron volts, 5·8 for nitrogen, 7·0 for oxygen, and 11·6 for neon. Here the value for oxygen is taken from the work of Feather. The mass data indicate that the energy needed to supply mass increases in just this order, and is respectively $-1{\cdot}4\times10^6$, 0 and $+2\times10^6$ electron volts, if the mass of the neutron is assumed to be that given by Chadwick, 1·0067, which is probably too high. Obviously the value assumed does not affect the differences between the energy values.

In a gas, ethylene, which consists of hydrogen and carbon, three disintegrations were obtained in 3,200 pairs of photographs. If carbon (12) is disintegrated by capture of the neutron the reaction is

$$C^{12} + n^1 \rightarrow C^{13} \rightarrow Be^9 + He^4$$
$$12{\cdot}0036 + 1{\cdot}0067 \longrightarrow 9{\cdot}0155 + 4{\cdot}00216$$

or, if the mass assumed for the neutron is correct, $\Delta m = 0{\cdot}0074$, which is equivalent to $6{\cdot}9\times10^6$ electron volts.

This corresponds to a velocity of $3{\cdot}6\times10^9$ cm. per sec., so only neutrons of a velocity higher than this should be effective in disintegrating carbon of mass 12. The smallness of the yield of disintegrations which we have obtained with carbon is thus to be expected, especially since probably less than one-fifth of the neutrons have velocities higher than this.

A remarkable relation which has been found to hold without exception is: in disintegrations by capture of a neutron the kinetic energy almost always decreases, is sometimes conserved, but in no case increases.

It has been pointed out previously by Harkins that the values for the energy which disappears suggest definite energy values for the γ-rays into which this energy is converted, but the accuracy of the work is not yet sufficient to prove that this is true.

It may be assumed that the neutrons in the stars are scattered by the atomic nuclei and thus take part in the temperature distribution of velocities of the atoms. If the neutrons of higher velocity are captured much more often than those of lower velocity, the distribution will be affected. Our experiments give no information concerning the capture of neutrons without disintegration, but only for those cases in which the capture is revealed by the accompanying disintegration.

It is of interest in this connexion to consider the minimum energy of the neutron which has been found to give a disintegration. The values, in millions of electron volts, are 1·9 for nitrogen, and 7·8 for neon. The corresponding maximum values are 16·0 and 14·5, the lower maximum for neon being due to the smallness of the number of disintegrations which have been obtained in this gas. An energy of $1{\cdot}9\times10^6$ corresponds to a mean temperature of the order of 10^{10} degrees, but at 10^8 degrees a considerable number of neutrons should have this energy, and a moderate number even at 10^7, so it is not unreasonable to suppose that nitrogen nuclei are disintegrated by this process in the stars.

A part of this work was presented by Harkins on June 23 at a symposium on nuclear disintegration under the auspices of the Century of Progress Exposition, Chicago. Other papers were presented by Cockroft, Lawrence and Tuve, and a general discussion of the theory was given by Bohr.

Third International Congress for Experimental Cytology

THE Third International Congress for Experimental Cytology, which was held in Cambridge on August 21–26, under the presidency of Prof. Th. Huzella, of Budapest, was attended by more than two hundred members from all parts of the world. Some seventy papers were read, grouped under the headings of cell respiration and metabolism, electrophysiology, secretion and digestion, tissue culture, *Entwicklungsmechanik*, and virus cultivation.

One of the main impressions left by a most interesting Congress is the successful use of the technique of explantation and tissue culture by cytologists, embryologists, and medical research workers for the study of problems of the most diverse nature. This note was struck by Prof. Huzella, in his presidential address on tissue culture in relation to the problems of biology and medicine, and it constantly recurred in the papers read to the Congress. Another feature of modern biological research which was well brought out was the emphasis on the study of cell functions as they actually occur *in vivo*, rather than by examination of fixed and stained preparations, and the variety and ingenuity of the methods that have been evolved for this purpose. The proceedings also showed how wide a 'no-man's-land' there still is between experimental cytology, which is limited by the resolving power of the microscope, and biochemistry and biophysics, which deal with the phenomena of the cell on a molecular scale. It was a specially valuable feature of the Congress that cytologists and biochemists and biophysicists were able to learn one another's points of view, and to hear of some of the progress being made towards linking up physiological with physico-chemical events. Lastly, mention must be made of the moving pictures, which showed what a valuable instrument of research is provided by the speeded-up micro-cinematograph film.