In this work a new double-focusing mass spectrograph was used to separate the ions of the different isotopes. The ions were produced in the type of source developed by Dempster, in which an oscillating spark between nickel electrodes 1.5 mm in diameter is used. A collector system consisting of a pair of Faraday chambers whose apertures were large enough to collect all the ions of one mass was used. The separation of the collectors could be varied so that they would simultaneously collect the current caused by a pair of isotopes. The currents to the Faraday chambers were measured by two electrometers, with a null method of comparison in which the collected charges were balanced out by induced charges. This method reduces errors caused by leakage, makes the measurement less dependent on electrometer sensitivity, and reduces errors caused by fluctuations of source intensity.

The ratio of abundance of Ni^{61} : Ni^{64} was determined by setting the collector separation for three mass units and comparing the currents carried by the ions at the mass numbers 61 and 64. Then the collectors were set to a separation corresponding to two mass units and the ratio of the current at 59 and at 63 to the current at 61 was determined. This enables one to estimate the strength of the scattered background of ions at 61 due to 60 and 62, since the ratio of Ni^{58} to Ni^{60} has been determined. The corrected ratio of Ni^{61} : Ni^{64} was found to be 1.3. A more extended report of this work is to appear in the near future.

[1] F. W. Aston, Proc. Roy. Soc. **149**, 396 (1935).
[2] J. de Gier and P. Zeeman, K. Akad. Amst. Proc. **38.8**, 810 (1935).
[3] W. A. Lub, K. Akad. Amst. Proc. **42.3**, 253 (1939).
[4] A. J. Dempster, Phys. Rev. **50**, 98 (1936).

Production of He^3

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Since no He^3 is known to be evolved naturally it seems feasible that its presence[1] in the atmosphere may be explained by means of transmutations involving cosmic rays. Of these reactions, it would appear that the Li^6 slow neutron reaction is the most probable. An estimate of the He^3 yield by this reaction has been made as follows.

The number of neutrons which would have been captured by Li^6 in the earth's crust has been calculated from the expression:

$$\frac{f\rho SAT}{k}\left(1+\frac{e^{-kX_0}}{kX_0}-\frac{1}{kX_0}\right) \quad \text{where} \quad f=\frac{\sigma_{Li^6}N_{Li^6}}{\Sigma\sigma N},$$

σ and N being the relative capture cross sections and relative abundances of the various atoms in the earth's crust, ρ the density of crust, S the area of the continental land, A the number of neutrons per g per sec. produced at the upper surface of crust by cosmic rays (it is assumed that the neutrons do not diffuse great distances from their place of production), T the period over which the He^3 atoms have collected on the earth, k the absorption coefficient of the neutron-producing cosmic rays and X_0 the depth of denudation during the time T. These quantities have the following estimated values: $f\sim 3\times10^{-3}$ (thermal neutrons), $\rho=2.7$ g cm^{-3}, $S\sim 1.5\times10^{18}$ cm^2, $A\sim10^{-4}$ g^{-1} sec.$^{-1}$ at sea level,[2] $k\sim 1.8\times10^{-2}$,[2] $X_0\sim 2\times10^4$ cm, $T\sim 2\times10^9$ yr.* Since kX_0 is large, the number of Li^6 atoms disintegrated is $f\rho SAT/k\sim 4.5\times10^{30}$. Assuming a He^3/He^4 ratio of 10^{-7},[1] the number of He^3 atoms observed to be present in the air is $\sim 4\times10^{31}$.

While this estimate of the production of He^3 appears to be slightly too low, it may be possible to explain a higher yield as caused by a higher intensity of neutrons. The value of A is probably larger on account of (1) a distribution of land having altitudes greater than sea level (2) the depth of the atmosphere being significantly less throughout the earth's age than it is today. The absorption of Li atoms present in sea water can give only a slight increase in He^3 yield because of the large capture of thermal neutrons by hydrogen and chlorine.

According to the present explanation of the existence of He^3, the lower concentration of He^3 in gas-well helium[1] may be a consequence of its evolution mainly in the upper layers of the earth's crust.

[1] L. W. Alvarez and R. Cornog, Phys. Rev. **56**, 379, 613 (1939).
[2] S. A. Korff, Rev. Mod. Phys. **11**, 211 (1939); Bethe, Korff and Placzek, Phys. Rev. **57**, 573 (1940); C. G. Montgomery and D. D. Montgomery, Rev. Mod. Phys. **11**, 255 (1939).

* *Editorial Note.* In connection with the choice of the value of T, Dr. H. Goldhaber to whom the author sent this letter for criticism remarks that a better value might be 3×10^7 years. As was first recognized by Jeffreys, the amount of He^4 in the atmosphere is much smaller than might be expected from the amount generated through α-particle decay during 2×10^9 years. This has been ascribed to loss of helium atoms at the top of the atmosphere, presumably through collisions of the second kind. (See H. N. Russell, *The Solar System and Its Origin* (New York, 1935), p. 76.) The average time which a helium atom spends in the atmosphere has been estimated to be about 3×10^7 years.

It would appear that this value, rather than the age of the earth, should be inserted for T in Mr. Hill's formula. This would lead to a still smaller value for the He^3 content of the atmosphere. However, an estimate of this type must necessarily remain somewhat uncertain, since several of the values appearing in the formula, as well as the He^3 content of the atmosphere, are only roughly known at present.

Correction: Isotope Shift in Boron

(Phys. Rev. **58**, 879 (1940))

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A mistake was made in quoting Mrozowski's[1] results on the shift of the line λ3451 of B II. In his plates this line was actually fully resolved, so that the shift was measured directly and not by decomposition into two Doppler curves as in the cases λ2497, 2498 of B I. Numerical data on breadths of the components of λ3451 are not given in Mrozowski's paper, but he has kindly informed me by letter that the observed separation of the components (0.877 cm^{-1}) was about $4\frac{1}{2}$ times their half-widths. The half-widths thus amount to 0.2 cm^{-1}, or about 6 times the predicted spread due to nuclear spin of 0.031 cm^{-1}; the conclusion as to the unobservability of the latter thus remains valid.

[1] S. Mrozowski, Zeits. f. Physik 112, 223 (1939).