

Letters to the Editor

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Artificial Production of Fast Protons

A HIGH potential laboratory has been developed at the Cavendish Laboratory for the study of the properties of high speed positive ions. The potential from a high voltage transformer is rectified and multiplied four times by a special arrangement of rectifiers and condensers, giving a working steady potential of 800 kilovolts. Currents of the order of a milliampere may be obtained at a potential constant to 1-2 per cent.

Protons from a discharge in hydrogen are directed down the axis of two glass cylinders 14 in. in diameter and 36 in. long, and accelerated by the steady potentials of the rectifier. They are then passed into an experimental chamber at atmospheric pressure through a mica window having a stopping power of about 1 mm. air equivalent. Luminescence of the air can easily be observed.

The ranges of the protons in air and hydrogen have been measured using a fluorescent screen as a detector. The range in air at S.T.P. of a proton having a velocity of 10^9 cm./sec. is found to be 8.2 mm., whilst the corresponding range for hydrogen is 3.2 cm. The observed ranges support the general conclusions of Blackett on the relative ranges of protons and α -particles, although the absolute values of the ranges are lower for both gases. The ranges and stopping power will be measured more accurately by an ionisation method.

The maximum energy of the protons produced up to the present has been 710 kilovolts with a velocity of 1.16×10^9 cm./sec. and a corresponding range in air of 13.5 mm. at S.T.P. We do not anticipate any difficulty in working up to 800 kilovolts with our present apparatus.

J. D. COCKCROFT.
E. T. S. WALTON.

Cavendish Laboratory,
Cambridge, Feb. 2.

Structure of Normal and Mutant Eyes in *Gammarus chevreuxi*

NUMEROUS mutant types of eye have been found in *Gammarus chevreuxi* by Sexton, and their genetic behaviour analysed by her and various other workers.¹ We have now examined the structure of some of these, and find certain surprising results. The normal or wild type eye is of the usual structure,² with hypodermis, crystalline cones, rhabdomes, and reticular cells. Prolongations of the reticular cells surround the rhabdomes and the base of the cones, and are the seat of both the red and black pigments of the eye. In addition, between the rhabdomes and cones are to be seen interstitial cells, which contain the interommatidial white pigment characteristic of so many gammarids.

The albino mutant is a simple recessive (*ccW*, as against *CW* for wild type, where *C-c* is the gene controlling the appearance of red and black pigments). It lacks both red and black pigment; the eye is irregular and entirely white. Sections (Fig. 1) show that the crystalline cones are present, but irregularly spheroidal and situated at various levels instead of conical and at a constant level; the bulk of the eye consists of interstitial cells, much hypertrophied in size and possibly increased in number. There is a total absence of retinula. No connexion exists between eye and brain, and the optic ganglion also appears to be absent. In most cases the eye in section is of a fairly regular flattened cake-like shape, but sometimes irregular prolongations of the interstitial tissue extend somewhat into the interior of the head.

The colourless eye is the product of two recessive genes (*ccww* in genetic constitution, where *W-w* is the gene controlling the appearance of white pigment). In sections, colourless eyes are in general similar to albino eyes. But the crystalline cones are usually increased in number, and may be irregularly fused with each other in a very peculiar way, while the interstitial tissue may be somewhat reduced, and may show signs of degeneration (abnormally staining nuclei, and crystalline inclusions in the cells).

In both albino and colourless eyes a peculiar large-celled spongy tissue pervades much of the head; the origin and nature of this has not yet been satisfactorily determined. It might possibly be a modification of the connective tissue found surrounding



FIG. 1.—Sections of normal and mutant eyes of *Gammarus chevreuxi*. A, normal eye; B, albino eye; C, colourless eye. *b*, brain; *c*, crystalline cones; *h*, hypodermis, with overlying cuticle; *i*, interstitial tissue; *o.g.*, optic ganglion; *r*, reticular tissue; *rh*, position of rhabdomes (and interstitial cells in normal); *s*, spongy tissue (in mutants).

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Disintegration of Lithium by Swift Protons

IN a previous letter to this journal¹ we have described a method of producing a steady stream of swift protons of energies up to 600 kilovolts by the application of high potentials, and have described experiments to measure the range of travel of these protons outside the tube. We have employed the same method to examine the effect of the bombardment of a layer of lithium by a stream of these ions, the lithium being placed inside the tube at 45° to the beam. A mica window of stopping power of 2 cm. of air was sealed on to the side of the tube, and the existence of radiation from the lithium was investigated by the scintillation method outside the tube. The thickness of the mica window was much more than sufficient to prevent any scattered protons from escaping into the air even at the highest voltages used.

On applying an accelerating potential of the order of 125 kilovolts, a number of bright scintillations were at once observed, the numbers increasing rapidly with voltage up to the highest voltages used, namely, 400 kilovolts. At this point many hundreds of scintillations per minute were observed using a proton current of a few microamperes. No scintillations were observed when the proton stream was cut off or when the lithium was shielded from it by a metal screen. The range of the particles was measured by introducing mica screens in the path of the rays, and found to be about eight centimetres in air and not to vary appreciably with voltage.

To throw light on the nature of these particles, experiments were made with a Shimizu expansion chamber, when a number of tracks resembling those of α -particles were observed and of range agreeing closely with that determined by the scintillations. It is estimated that at 250 kilovolts, one particle is produced for approximately 10^9 protons.

The brightness of the scintillations and the density of the tracks observed in the expansion chamber suggest that the particles are normal α -particles. If this point of view turns out to be correct, it seems not unlikely that the lithium isotope of mass 7 occasionally captures a proton and the resulting nucleus of mass 8 breaks into two α -particles, each of mass four and each with an energy of about eight million electron volts. The evolution of energy on this view is about sixteen million electron volts per disintegration, agreeing approximately with that to be expected from the decrease of atomic mass involved in such a disintegration.

Experiments are in progress to determine the effect on other elements when bombarded by a stream of swift protons and other particles.

J. D. COCKCROFT.
E. T. S. WALTON.

Cavendish Laboratory,
Cambridge,
April 16.

¹ NATURE, 129, 242, Feb. 13, 1932.

Isotopic Constitution of Lead from Different Sources

THANKS to the generous co-operation of Dr. v. Grosse and other chemists in supplying me with the requisite rare materials, I have been able to repeat and amplify my analyses of lead from different geological sources. During these experiments, which I hope to extend, technical improvements were effected so that, in spite of the difficulties inherent in the problem, results have been obtained upon which considerable reliance may be placed.

The effect of the presence of hydrides due to the methyl compounds has been measured and can be allowed for. Under the particular conditions used, it amounts to 2.3 per cent. Thus in the lightest lead (II) though the line 207 had an apparent intensity of 9.5 (line 206 = 100), its true relative abundance is estimated to be 7.2 ± 0.3 , in good agreement with the value 7 assumed by Lord Rutherford¹ for his calculations on actino-uranium. Several rare isotopes previously suspected in ordinary lead² have now been confirmed but their abundances are too small to be certain. The percentage analyses are as follows:—

Chemical Atomic Weight	I	II	III	IV
	207.22	206.048	206.195	207.90
203	(0.04)	..	..	..
204	(1.50)	..	..	..
205	(0.03)	..	..	..
206	27.75	93.3	85.9	4.6
207	20.20	6.7	8.3	1.3
208	49.55	(0.02)	5.8	94.1
209	(0.85)	..	..	..
210	(0.08)	..	..	..
Mean Mass Number	207.19	206.067	206.20	207.895

- I. Ordinary lead.
II. Lead from Katanga pitchblende (Hönigschmid and Birkenbach, *Ber. Deutsch. Chem. Gesell.*, 56, 1837; 1923).
III. Lead from Wilberforce uraninite (Baxter and Bliss, *J. Amer. Chem. Soc.*, 52, 4851; 1930).
IV. Lead from Norwegian thorite (Fajans, *Sitz. Heidelberger Akad. Wiss.*, 3; 1918).

The packing fractions of the leads will be very difficult to ascertain, but appear to be in the region 0 to +1. They will tend to cancel the correction (still uncertain) to the chemical scale, so that the mean mass-numbers should show agreement with the chemical atomic weights, which is the case. It is noteworthy that the quantities of 206 and 207 in (IV) do not correspond to those expected from ordinary lead present as an impurity.

F. W. ASTON.

Cavendish Laboratory,
Cambridge,
April 12.

¹ NATURE, 123, 313, March 2, 1929.
² NATURE, 120, 224, Aug. 13, 1927.

Oxygen and Everest

ON the interesting subject of the need for oxygen on Mount Everest, Prof J. Barcroft has made the remark, before Section I of the British Association, that the whole matter is now merely "an engineer's problem": the problem of designing a light and efficient oxygen breathing apparatus. This point of view is ably supported by Prof. Margaria.¹ There is, however, something more: namely, the disadvantage of acclimatisation in a man using such apparatus. If it is one of the 'open circuit' type, acclimatised breathing causes a huge waste of oxygen and adds correspondingly to the difficulty of transportation. Yet a man dare not relinquish this physiological condition, even if he could. For if he relinquished it, he would die of asphyxia as soon as he took the apparatus off.