New Radioactive Isotopes Produced by Nuclear Photo-disintegration

A SEARCH has been made for new radioactive isotopes produced by (γ,n) and (γ,p) reactions in various elements irradiated with 23-MeV. X-rays from a synchrotron. Whenever possible, a chemical identification of the element responsible for the radioactivity was made. A thin-window (1·7 mgm. cm.$^{-2}$) Geiger counter was used for measuring the decay of the activities. The activities were usually too small and short-lived to permit any accurate measurement of the β-particle or positron energies.

In addition to many known radioactive isotopes, fourteen new isotopes were found. Their properties are summarized in the accompanying table.

Element irradiated	Element chemically identified	Half-life	Probable assignment
Se	As	9 min.	^{76}As
Sm	Sm	8 min.	^{143}Sm or ^{146}Sm
Eu	Eu	15 hr.	^{150}Eu
Gd	—	17 min.	^{151}Gd or ^{152}Eu
Dy	—	22 min.	^{162}Tb or ^{163}Tb
Er	—	44 min.	^{169}Ho
Yb	—	19 min.	^{172}Tm, ^{173}Tm, or ^{175}Tm
Hf	Lu	22 min.	^{176}Lu or ^{179}Lu
Hf	Lu	8 hr.	^{176}Lu or ^{179}Lu
W	Ta	48 min.	^{180}Ta
W	Ta	6 days	^{182}Ta
Os	Re	17 min.	^{189}Re or ^{191}Re
Pt	Ir	66 min.	^{190}Ir or ^{197}Ir
Hg	Au	27 min.	^{201}Au or ^{203}Au

Absorption measurements on the radiation from the 8-min. samarium showed that it is not due to α-particles.

The 44-min. activity produced in erbium has been assigned to holmium-169. The alternative assignments to erbium-163 or -165 are unlikely since no 44-min. activity has been reported in neutron-irradiated erbium. Assignment to holmium-167 is unlikely since slow neutron irradiation of holmium, in the pile, was found to produce, in addition to 27-hr. holmium-166, a new long-lived holmium isotope (half-life greater than 200 days) which is almost certainly holmium-167 produced by neutron capture in holmium-166.

Details of this work will be published elsewhere later.

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Autoradiography of Water-Soluble Tracers in Histological Sections

Two requirements for the successful preparation of high-resolution autoradiographs are the intimate contact between section and emulsion, and an emulsion-layer which is thin and of sufficiently fine grain. The stripping-emulsion technique was developed by Pelc[1] to meet these requirements, and was successfully applied to the location of iodine-131 in rat thyroid. In this technique, section and emulsion are brought into intimate contact under water. Thus it precludes the location of water-soluble tracers; moreover, the use of conventional fixing and dehydrating agents can seriously affect the concentration and distribution of water-soluble tracer in the tissue.

Scott Russell, Sanders and Bishop[2] have described a method of locating water-soluble phosphorus-32 in plant tissue. The tissue is dehydrated at −70° C. in alcoholic basic lead acetate, which precipitates the phosphate *in situ*. The tissue is finally embedded in paraffin wax, sectioned and coated with stripping emulsion by the method of Pelc[1]. Holt, Cowing and Warren[3] have compared three methods of locating water-soluble phosphorus-32. Their best results were obtained by freeze-drying the tissue at −70° C., followed by paraffin-wax embedding, sectioning and then clamping the sections to an Eastman Kodak nuclear track plate, a thin layer of 'Cellophane' separating the section from the plate. High resolution would not be expected under these conditions.

A method similar to that of Scott Russell, Sanders and Bishop[2] was tried by us for the location of water-soluble bromine-82 in the larvæ of *Calliphora erythrocephala*. Alcoholic silver nitrate was used for the dehydration and precipitation of the halide *in situ*; but there was evidence of damage to the tissue and to the stripping-emulsion afterwards applied.

We have obtained useful autoradiographs of iodine-131 in larvæ poisoned by methyl iodide by a combination of the Altmann–Gersh process[4,5,6] and a modified stripping-emulsion technique. Methyl iodide labelled with iodine-131 was prepared on the micro-mole scale by exchange with 'carrier-free' $(I^{131})^-$ in acetone, the solvent finally being precipitated as the bisulphite compound. Larvæ were exposed for 18 hr. at 27° C. to a concentration of methyl iodide of 5 mgm./litre. The larvæ were transferred to *iso*pentane at 0° C. and cooled to −40° C. Serious tissue damage sometimes occurred when the larvæ were plunged into *iso*pentane at −180° C. At −40° C. the larvæ were cut transversely into pieces small enough for dehydration (about 2 mm.) and then chilled by cooling the *iso*pentane to −180° C. They were then placed on a platform of degassed paraffin-wax (m.p. 59° C.) in a tube maintained at −20° to −30° C. The tissue was then dehydrated by pumping at a pressure of less than 10^{-4} mm. mercury until the equilibrium vapour pressure at −30° C. was less than 5 microns as measured on a Pirani gauge; in any event pumping was continued for not less than 48 hr. Moisture, volatile insecticide, etc., were trapped in the vacuum line at −180° C. The tube and contents were then gradually warmed until the wax melted and the larvæ sank and became instantaneously embedded, high vacuum being maintained. The tube was then detached from the vacuum line, the tissue blocked out and sectioned at 10 μ or more, each section being reinforced by coating the block with molten wax (m.p. 49° C.) just before each knife traverse. The sections were mounted directly on to 3 in. × 1 in. slides (previously subbed in 1 per cent gelatin) using a trace of albumin adhesive. The wax was removed in xylol and finally rinsed in 40/60 petroleum ether. A 15-mm. square of Kodak fine-grain stripping-emulsion was then cut from the plate and drawn on to each section. The square was then gently stroked with a moist camel-hair brush, or pressed with moist filter paper, when the gelatin matrix collapsed closely over the section. Each slide on completion was dried in a vacuum desiccator for a few minutes, exposed and processed in the usual way.

Figs. 1 and 2 respectively show the concentration of iodine-131 round the partly broken wall of one of the main tracheæ and part of the cuticle in median transverse sections of a *Calliphora* larva. The mean disintegration density was estimated by a Geiger–Müller counter of known efficiency to be of the order of 10^9 d./cm.^{2} of section. Sometimes the emulsion broke away from the section in small wrinkles or