Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Inner Conversion in X-Ray Spectra

MORE than ten years ago, Coster[1] reported that he had carried out experiments with heavy elements for tracing X-ray characteristic lines due to the transition $L_1(2s) \leftarrow L_{2,3}$ ($2P_{1/2}$, $^2P_{3/2}$), but got no positive results. During the last ten years, a number of other investigators[2] have also reported negative results.

These failures have remained rather mysterious for the transition $L_1 \leftarrow L_{2,3}$ ($\Delta n = 0$) is not forbidden by quantum mechanics and actual calculation based on wave mechanics shows that the expected line should be quite intense. A recent search by one of us (J. B. M.) for the expected line of W ($L_1 - L_3$; $\nu/R = 139{\cdot}5$; $\lambda = 6{\cdot}4$ A.) also yielded no positive result though both the excitation and exposure were more than sufficient. A search into the current literature shows that though these lines ($L_1 \leftarrow L_3$) have not been obtained, a number of lines of heavy elements (73 Ta to 81 Tl) due to the transitions between N-levels ($N_{4,5} \leftarrow N_{6,7}$) have been obtained by Thibaud[3], del Rosario[4], Magnusson[5], Prins and Takens[6], while the last two workers report lines due to the transitions ($M_{2,3} \leftarrow M_{4,5}$) of a number of elements. Since in all these lines, $\Delta n = 0$, the failure to obtain the lines due to the transition ($L_1 \leftarrow L_3$) was remarkable.

It appears to us that the failure to obtain the ($L_1 \leftarrow L_3$) line is to be completely ascribed to the inner conversion of such lines in the M-levels of the elements. A scrutiny of the L-level values of the elements shows that from 92 U to 68 Er the ($L_1 - L_3$) values are greater and very close to the M-level values; for example, in W, the ν/R value for ($L_1 - L_3$) is equal to 139·5 while $M_4 = 137{\cdot}5$, $M_5 = 132{\cdot}9$.

An application of a modified form of the formula for inner conversion given by Miss Swirles, Taylor and Mott, and Hulme[7] shows that the ($L_1 - L_3$) lines should be completely converted in such cases. It is only in 68 Er that the ($L_1 - L_3$) ν/R value is just less than any of the M-level values and much larger than N-level values. But this situation persists only up to 55 Cs; from iodine again, $L_1 - L_3$ becomes just larger than some M-values, so that it is expected that only elements from Er to Cs are capable of showing lines due to ($L_1 \leftarrow L_3$) transitions. This conclusion has not yet been tested.

It appears that the phenomenon of inner conversion is responsible for many of the intensity anomalies which are observed in the line spectra of X-rays, as was suggested some years ago by Wentzel.

M. N. SAHA.
J. B. MUKERJIE.
Physical Laboratory,
University of Allahabad.

[1] Coster, *Phil. Mag.*, **44**, 945; 1922.
[2] Idei, NATURE, **123**, 643; 1929.
[3] Thibaud, *Phys. Z.*, **29**, 241; 1928.
[4] del Rosario, *Phys. Rev.*, **41**, 136; 1932.
[5] Magnusson, *Z. Phys.*, **79**, 161; 1932.
[6] Prins and Takens, *Z. Phys.*, **75**, 743; 1932. *Z. Phys.*, **77**, 795; 1932.
[7] Swirles, *Proc. Roy. Soc.*, **116**, 491; 1927. Hulme, *Proc. Roy. Soc.*, **138**; 1933. Taylor and Mott, *Proc. Roy. Soc.*, **138**; 1933; and **142**; 1933.

Disintegration of the Separated Isotopes of Lithium by Protons and by Heavy Hydrogen

THE two known isotopes, Li^6 and Li^7, have been separated in quantities of the order of one microgram by two separate methods depending on the passage of several microamperes of lithium ions through electric and magnetic fields. The separate isotopes were collected on metal discs cooled with liquid nitrogen, and after fixation by exposure to hydrochloric acid gas, were bombarded by protons and by diplons in an apparatus already described[1]. It was possible to observe several hundred disintegration particles each minute from the Li^7 targets and about half that number from the Li^6 targets arranged to contain about the same number of atoms. The results are summarised in the accompanying table.

Bombarding Particles	Lithium 6	Lithium 7
Protons	α-particles of 11·5 mm. range	α-particles of 8·4 cm. range
Diplons	α-particles of 13·2 cm. range Protons of 30 cm. range	α-particles up to 8 cm. range Neutrons

The purity of the separate samples was apparent from the very small number (less than 1 per cent) of the 8·4 cm. particles obtained from the Li^6 target, and the total absence of 13·2 cm. particles from the Li^7 target.

It may be seen from the table that observations have been made not only on the α-particles but also on the protons and neutrons liberated from lithium by heavy hydrogen. Owing to the absence of the much more abundant Li^7, the Li^6 targets show very clearly the presence of the very definite range of doubly charged particles previously reported[1] at 11·5 mm. The mica window through which the particles escaped into the detecting chamber had an absorption equivalent to 6 mm. of air, so that the origin of the shorter 7·5 mm. range group also found previously could not be determined.

These observations are in complete accord with the assumptions made in previous papers[1]. Details of the isotope separation will be published elsewhere.

M. L. OLIPHANT.
E. S. SHIRE.
Cavendish Laboratory, B. M. CROWTHER.
Cambridge.

[1] *Roy. Soc. Proc.*, A, **141**, 722; 1933; and references given there.

Dehydrogenation of Œstrin

THE chemical constitutions of ketohydroxyœstrin and trihydroxyœstrin are now largely established, mainly by the investigations of Butenandt, Marrian, and their collaborators. There remain, however, certain features of the molecular structure which have not yet been experimentally proved, but depend upon the assumption that the hormones are biological degradation products of cholesterol. The experiment now recorded was undertaken as a preliminary step in an attempt to obtain confirmation of some of the structural details which are still in doubt.

Although Butenandt[1] has shown that trihydroxyœstrin may be transformed into 1 : 2-dimethylphenanthrene by selenium dehydrogenation of the dicarboxylic acid arising by fission of the five-membered ring IV, the dehydrogenation of the hormone itself, with the tetracyclic system still intact, has given very unsatisfactory results. The only pure