As to the mechanism of the action of this nitrophenol, nothing can at the moment be said. On the other hand, the experiments lead us strongly to the view that normal tissues, even when saturated with oxygen, have their respiration limited by the oxygen-transfer catalysts and not by the substrate-activating enzymes.

The action of dinitro-*o*-cresol on tumour tissue, that is, tissue with defective carbohydrate oxidation, is still under investigation.

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[1] *Ann. Physiol.*, **8**, 1; 1932.
[2] *Biochem. J.*, **25**, 973; 1931.
[3] *Lancet*, Aug. 12, 1933, p. 352.
[4] *J. Exp. Med.*, **52**, 447; 1930.
[5] *Naturwiss.*, **20**, 171; 1932.

Conservation Laws and β-Emission

THE recent development of Dirac's theory of the electron has made it possible to compare the radioactive β-transformation with a process in which a pair of differently charged electrons is produced in the neighbourhood of the nucleus, the positive of which is captured in order to increase the nuclear charge by one unit. In addition to an investigation on this kind of process, which has already been described[1], a more general application of the conservation laws, characteristic for the theory, may now be described.

If A be a mechanical quantity for which a conservation law is expected to hold, and $\triangle A$ the difference of the respective quantities referring to the initial and the final state of the nucleus being transmutated by β-decay; let A refer to the negative, and A to the positive electron assumed to be produced in the process; then the conservation law takes the form

$$\triangle A = A\,(+)\,A' \qquad (1)$$

(1) corresponds, however, only formally to a conservation law. The quantity A' corresponding to the positive electron assumed to be captured by the nucleus is lost. (It has been suggested that the quantities A' be ascribed to an unknown particle which it is proposed to call a 'neutrino'. There is, however, at present no need to assume the real existence of a neutrino, and the assumption of its existence would even be an unnecessary complication of the description of the β-decay process.) Applying (1) to the energy relation, then

$$\triangle E = W + W' \geqslant 2\,mc^2, \qquad (2)$$

where the energy W and W' of the negative and positive electrons is understood to include the rest energy mc^2, and $\triangle E$ represents the energy difference of the two nuclei. (2) evidently describes a continuous spectrum of the energy W, varying between the limits mc^2 and $\triangle E - mc^2$. It is easily seen, from the relation $W' \geqslant mc^2$, that in every process an energy loss takes place which is greater than the rest energy of an electron.

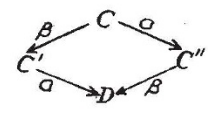
Applying (1) to the momentum balance of the process, we obtain

$$\vec{\triangle p} = \vec{p} + \vec{p'} \qquad (3)$$

Thus the momentum relation is violated by the quantity $\vec{p'}$ in every process. Taking into account that the wave-lengths of the electrons assumed to be produced are comparable with the dimensions of the region where the production takes place, it is seen, without detailed calculation, that the angle between $\vec{p}$ and $\vec{p'}$ will be statistically distributed uniformly in all directions.

It may be noticed that (1) applies even to the change of statistics occurring during the β-decay process if A is understood to symbolise the statistical character of the particles in question.

(2) can be checked with the experimental data available for both sides of a radioactive branch:



According to (2), we obtain for both sides of the branch

$$(W + W' + E_a)_{CC'D} = (E_a + W + W')_{CC''D} \qquad (4)$$

Though the energy set free by the $CC'D$ and the $CC''D$ transmutation will as a rule be different, the same value would be expected on both sides of the branch, if the upper energy limits of the respective β-spectra are introduced. The experimental data for the thorium branch have been recently discussed by Ellis and Mott[2] and have been found to agree with (4). For the other branches the upper energy limits are not all measured, but can be roughly obtained from the rates of decay by extrapolation of the two curves measured by Sargent[3] and taking into account the favourable case of the two possibilities.

Radium-branch:			
Ra C → Ra C'	$= 3{\cdot}2\times10^6$	Ra C → Ra C''	$= 5{\cdot}5\times10^6$
Ra C' → Ra D	$= 7{\cdot}8\times10^6$	Ra C'' → Ra D	$\cong 5{\cdot}0\times10^6$ *
	$11{\cdot}0\times10^6$ e. volts		$10{\cdot}5\times10^6$ e. volts
Actinium-branch:			
Ac C → Ac C'	$\cong 0{\cdot}4\times10^6$ †	Ac C → Ac C''	$= 6{\cdot}7\times10^6$
Ac C' → Ac D	$= 7{\cdot}5\times10^6$	Ac C'' → Ac D	$= 1{\cdot}5\times10^6$
	$7{\cdot}9\times10^6$ e. volts		$8{\cdot}2\times10^6$ e. volts

* Extrapolated from Sargent's second curve (Ra E, etc.)
† Extrapolated from Sargent's first curve (Ra B, etc.)

This agreement can be regarded as an argument in favour of the relations (1) and (2), though our relations are more general than the usual form of the conservation laws. In order to obtain, however, the shape of the continuous β-spectra, a more detailed investigation is required, which has been given in the theory quoted above and also gives an interpretation of Sargent's curves.

Applying (2) to the β-branch of uranium X_1, suggested by several authors, we find a striking disagreement of the energy values on both sides of the branch. This seems to confirm the view that uranium Z may not be a branch product, but a derivative of a still unknown isotope of uranium.

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Nov. 13.

[1] Beck and Sitte, *Z. Phys.*, **86**, 105; 1933: Beck, *Z. Phys.*, **83**, 498; 1933: Sitte, *Phys. Z.*, **34**, 627; 1933.
[2] *Proc. Roy. Soc.*, A, **141**, 502; 1933.
[3] *Proc. Roy. Soc.*, A, **139**, 659; 1933.