the truth. It is much to be desired that any Subsidiary Standard issued in future should be accompanied by a statement of the date at which its biological activity has been directly determined, and by the value of its absorption coefficient at that date.

It is, of course, realised that the bio-assayist finds himself here in a vicious circle. If he is to be permitted to check the deterioration of his secondary standard by means of a spectroscope, there seems to be no argument against his using the spectroscope for determining the vitamin A content of the unknown, except where this is not a liver oil or concentrate.

The factor of 1,600, to be used in converting absorption coefficient to international units per gram, was based upon a large number of biological determinations in different laboratories on a limited number of oils and concentrates for which the spectrographic constants were known with some precision. The actual values for this factor obtained in the different laboratories varied very considerably, though possibly not more so than would have been expected on account of the errors of biological assay. Subsequent work[1] in a number of laboratories has confirmed the view that application of the factor 1,600 to rich oils and concentrates will give values for its vitamin A content higher than those obtained by direct biological comparison with the international standard preparation.

One of us (A.L.B.) has found in his own laboratory that various concentrates, tested against the first International Standard Preparation of carotene, gave results indicating a factor between 1,000 and 1,200, with one exception which showed a very much lower figure, probably owing to deterioration of one of the solutions used. He has also reason to believe (private communications) that similar results have been obtained in at least two other laboratories, and it is to be noted that Culhane Lathbury has put forward the view that the factor 1,600 is too high, not only for rich oils and concentrates, but also for cod liver oil[2]. There is other evidence, particularly that based upon an examination of the Subsidiary Standard cod-liver oil, that the factor is too low, and some recent American work, of which only the outlines have so far been published, bears out this view.

We are of opinion that the present position is unsatisfactory for two main reasons. In the first place, it makes it almost impossible for workers in different laboratories to compare vitamin A estimations, unless they are using practically identical methods, and makes the attempt on the part of reputable manufacturers to market products of known, constant and stated vitamin A content extremely difficult to carry out. In the second place, the confusion tends to bring discredit upon the use of the International Units and International Standard Preparations, a tendency that, in our opinion, cannot but be regarded as very grave by all who support, as we do, the attempts of the Permanent Commission to foster accurate biological standardisation.

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[1] *Biochem. J.*, 29, 1645 (1935).
[2] See also "The Standardisation and Estimation of Vitamin A", M.R.C., Special Report Series, No. 202 (1935).

The Neutrino Theory of Radiation and the Emission of β-Rays

FOLLOWING a suggestion of de Broglie, a theory has been developed by Jordan[1] and myself[2] in which an attempt is made to reduce the field of radiation with light quanta, obeying the statistics of Bose and Einstein, to a field of particles with spin, obeying the statistics of Dirac and Fermi. These particles have been tentatively identified with the neutrinos, the occurrence of which must be postulated in radioactive β-disintegrations in order that energy and angular momentum may be conserved.

For a number of β-emitters, it is experimentally certain that there is practically no γ-radiation present in addition to the β-rays. Thus for radium E the γ-radiation has an energy amounting to about one per cent of the energy of the β-particles[3]. Moreover, this radiation is in part K-radiation, excited by the passage of the β-particles through the electronic shells of the element arising from the disintegration of radium E, while the rest probably is due to the retardation of the β-particles in the field of the nucleus from which they are expelled, so that all the γ-radiation is of secondary origin.

If the neutrino theory of radiation has a physical significance, the experimental result just mentioned calls for a very particular type of interaction between the heavy particles (protons and neutrons) of which the nucleus is built up and the light particles (electrons, positrons and neutrinos) created during the β-disintegration. In fact, the interaction energy must be such that the neutrino field excited by the disintegration process is of the radiationless type, the possibility of which I have recently demonstrated[2]. Without discussing here the exact nature of the interaction energy, it may be mentioned that the forms hitherto proposed for it[4] have not the character required above. It is to be hoped that the condition of the absence of radiation, together with the postulate of relativistic invariance, will limit sufficiently the choice of the interaction energy, so as to make the problem of its theoretical determination a more definite one.

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[2] R. de L. Kronig, *Physica*, 2, 491, 854, 968 (1935).
[3] S. Bramson, *Z. Phys.*, 66, 721 (1930).
[4] E. Fermi, *Z. Phys.*, 88, 161 (1934); E. J. Konopinski and G. E. Uhlenbeck, *Phys. Rev.*, 48, 7, 107 (1935).

Selective Absorption of Neutrons by Gold

SIX small gold disks, 15 mm. in diameter and 0·5 mm. thick, were placed in a hole in a cadmium plate and irradiated by slow neutrons, by putting the whole arrangement in a cavity in a large block of paraffin wax, near a radon-beryllium source. On measuring the activities of the successive disks, it was discovered that the bottom of the lowest disk (which lay directly on the cadmium) was very much more active than the top of the same disk, and was indeed comparable in activity with the uppermost disk. All the disks decayed with the normal gold period (2½ days).

When a sheet of gold, 0·1 mm. thick, was placed below the cadmium, the effect disappeared. This shows