Observer	Red curve			Luminosity curve		
	0·650	0·550	0·455	0·650	0·550	0·455
Author	12	100	5	12	100	5
N.	13	100	4	12	115	12
G.W.N.	12	100	5	12	166	—
B.	11·5	100	5	12	160	16
G.	12	100	–	12	220	—

(*b*) Further evidence for Helmholtz's theory is given by the following experiments. We determined the sensitivity curves of the red-receptors of five persons, by the new method already described by me[3]. Some of the results are given in the accompanying table.

It is seen that the red curves of these persons show only small differences, which are probably within the limits of error. Intentionally I have chosen three persons whose luminosity curves differed very much from my own curve.

The complete results for three observers are brought together in the accompanying graph.

The luminosity curve of G.W.N., represented by open circles, was determined for the same (rather high) brightnesses at which the red curve was measured, and therefore it was not possible for normal eyes to get very accurate results with the flicker-photometer. (For my own eyes, the measurements were very accurate.) The luminosity curve of B. was determined more accurately at a lower brightness level. The difference between his red curve and the luminosity curve, given by △, is the luminosity curve of protanopes. This curve is nearly identical with the green curve of normal trichromats. Indeed we have determined B.'s green curve from colour-mixture experiments, and the agreement with the curve shown was satisfactory.

These results are all in agreement with Helmholtz's theory. For the author's deuteranomalous eyes the contribution of the green receptors has nearly the same spectral distribution as that of the red-receptors (see ref. 3). Therefore here the red-curve and the luminosity curve coincide. For other observers the sensitivity in the green region is higher (not lower!).

Assuming the contribution of a certain type of receptor to be proportional to the number of receptors present, and taking into account the shape of the green curve, we find that the height of the luminosity curve is 160 if equal amounts of green and red receptors are active; the height becomes 220 if the ratio is equal to 3 : 1.

The colour-mixture apparatus used in these experiments was constructed in the workshop of our laboratory by permission of Prof. D. Coster. Furthermore, my thanks are due to all the observers who have assisted in the measurements.

Note added in proof. I would direct attention to reports of R. Granit in the *Acta Physiologica Scandinavica* (1941–44). The measurements and Granit's theory are given there in more detail, and they seem to be in good agreement with the measurements reported above.

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March 6.

[1] Granit, R., *Nature*, **151**, 11 (1943).
[2] Judd, D. B., Research papers, Nat. Bur. Stand., **33**, 407 (1944).
[3] de Vries, Hl., *J. Opt. Soc. Amer.*, **36** (Feb. 1946).

Planck's Radiation Formula

In a recent communication[1], Prof. H. Dingle has obtained Planck's radiation law in the form

$$f(\psi\,;\,\nu) = \frac{A\nu^3\psi^{-1/4}}{\exp(B\nu\psi^{-1/4}) - 1}$$

as a solution of the equation

$$\int_0^\infty f(\psi\,;\,\nu)d\nu = \int_0^\infty f(\psi/\psi_1\,;\,\nu\psi_1^{-3/4})d\nu, \qquad (1)$$

subject to the conditions (i) $f(\psi;\,\nu)$ independent of ψ_1, (ii) $f(\psi\,;\,\nu)$ not decomposable as a product $g(\psi)\,h(\nu)$, and (iii) the integrals must converge.

Initially, Dingle conjectured that his equation might admit of only the one solution, but later[2], he showed this not to be so. It is possible to transform (1) into an equivalent relation with a more immediate physical interpretation. If we write

$$\nu\psi_1^{-3/4} = \nu'\ ,\ F(\psi) = \int_0^\infty f(\psi\,;\,\nu)d\nu,$$

the equation becomes

$$F(\psi) = \psi_1^{3/4}\,F(\psi/\psi_1),$$

or

$$F(\psi) = k\psi^{3/4},$$

on putting $\psi_1 = \psi$. Thus (1) is equivalent to the statement

$$\int_0^\infty f(\psi\,;\,\nu)d\nu = k\psi^{3/4} \quad (k \text{ a constant }), \qquad (2)$$

which must correspond to Stefan's law in Dingle's theory.

Since (2) contains no information on the manner in which the total radiation is distributed between the different frequencies ν, it is clear that it will not be possible to establish Planck's formula (nor even the Wien displacement law) by any argument based on (1), unless some essentially new idea is introduced.

I should like to thank Prof. Dingle for kindly allowing me to see an advance copy of his second letter.

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April 24.

[1] *Nature*, **157**, 515 (1946).
[2] *Nature*, [**157**, 556 (1946)].

I HOPED that my first letter on this subject would draw from some mathematician a statement on the uniqueness of the condition mentioned therein, and I am grateful to Mr. Kendall for responding and also for his kindness in sending me an early copy of his letter. From the physical point of view the position remains, I think, as stated in my second letter. The thermal relativity theory requires that the radiation formula shall satisfy a certain condition, which in fact it does. The theory is thus to that extent supported. The condition, however, is much less restrictive than I at first thought possible, and does not itself demand the Planck formula.

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Stefan's Radiation Law

IT is stated in some text-books on heat that Stefan discovered the fourth power of the temperature law of radiation in this wise. He found, in one of John Tyndall's published researches, the statement that the radiation from a piece of heated platinum foil was 11·9 times as great when the foil was white-hot as when it was red-hot. Estimating these centigrade temperatures as 1,200° and 525°, and remarking that Nature worked in simple ways, he put

$$\left(\frac{1{,}200 + 273}{525 + 273}\right)^x = 11{\cdot}9,$$

and solved for x. The value is 4·05, whence he said x is obviously 4·0. Can anyone give me the reference in Tyndall's work to the above result? I have scanned Tyndall's books in vain.

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Biology in Italy

I HAVE had occasion to read lately in *Nature* two letters concerning the study of biology in Italy, one by Dr. A. Buzzatti-Traverso, in an article written by Dr. Julian Huxley[1], and the other by Mr. L. C. Beadle[2]. Since I fear that the character of the first letter is liable to generate an erroneous interpretation of biological activities in Italy, I wish to clarify some points, being myself a young biologist, and also in recognition of the friendships I made during my stay at the Zoological Department of Cambridge in 1937.

Dr. Buzzatti-Traverso states that: "Italian biology was not good even before the War", and that "... many professors of biology are wholly out of sympathy with modern ideas in this subject, and unlikely to be removed from their posts". He, and also Prof. Baldi, believe that modern institutes of biology in Italy should be developed outside the universities, like the Hydrobiological Institute at Pallanza and the Stazione Zoologica in Naples. I read with pleasure that Mr. Beadle found in Padua a well-equipped and up-to-date institute of biology; but there are others in Italy to-day still working actively. The War has certainly lowered to a considerable extent the potential possibilities of many institutes: but these consequences of the tragedy which has stricken our country would be light compared to the loss that would follow if modern biologists had really abandoned Italian universities!

I have here the last volume of Dr. J. Needham's "Biochemistry and Morphogenesis" (Univ. Press, Cambridge). This covers a very modern branch of biology and, of some 2,300 authors mentioned, about 150 are Italian. The great majority of these are university research workers, because there is a tradition in Italy that, for the most part, science is practised and studied in the universities.

The Stazione Zoologica at Naples is an example of the big institution on an international basis. It is not, and does not purport to be, a centre of studies in competition with the universities; its function is to furnish material and the means to study it. Here will be found both university and non-university research workers, not only Italians but of all nationalities.

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[1] *Nature*, **156**, 576 (1945).
[2] *Nature*, **157**, 79 (1946).