light itself; they are not manufactured by the photographic plates. Corresponding effects would be present were vision excited by these radiations. It is not unreasonable to suppose that any appreciable extension of the visible spectrum at the short wave-length end would impair rather than improve the clarity of the pictures we should perceive. On the other hand, we may suppose that, under more primitive conditions, life would have been rendered more precarious by the increased difficulty of observing enemies lurking in shadows, had there been any considerable shift of the mode towards longer wave-lengths.

There is another coincidence mentioned in the article which may conceivably be accidental. This is the correspondence between the diameters of the retinal cones at their bases and the resolving power of the eye. We may note in passing that close agreement between these lengths would tend to discredit the theory which refers the limit of resolution to the fineness of retinal structures, rather than support it. At least three successive cones must be involved, on this view, in the resolution of two near point images, the total energy falling on the middle cone being appreciably less than that received by either of the outer cones. If we consider curves giving the energy distribution in the diffraction pattern of two sources when resolution is just possible, such as those given by the late Lord Rayleigh, we can readily appreciate that a decided fall in intensity at the centre of the pattern from the peak values is not inconsistent with the reception by the central cone of greater total energy than by each of the outer cones on which the most brilliant parts of the image are formed.

The chief reasons, however, for hesitation in accepting this theory are, on one hand, that it is unnecessary to seek for any explanation of a limit of this angular magnitude in the structure of the retina, for it is imposed by the wave-length of the light to which the eye is sensitive in conjunction with the diameter of the pupil; and on the other hand, that experiments in which this physical limitation does not arise yield figures which suggest that the eye possesses powers of discrimination much more refined than these coarser features of the retinal structure would lead us to expect. Illustrations of these finer ocular powers are afforded by the appreciation of form, the ability to set two straight lines to form a continuous line,[1] and the judgment of distance in binocular vision. Various explanations of these effects may be offered, but the observations at least entitle us to suspend judgment on the relevancy of this coincidence until more rigorous experiments enable us to discriminate between various views in the light of fuller knowledge.

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Jan. 24.

I WAS aware of the highly speculative nature of the explanation of the apparent coincidence of the brightest part of the spectrum with the summit of the curve of radiant energy, plotted with wave-lengths as abscissæ, and I fully appreciate the validity of Mr. T. Smith's arguments. It is essentially a physical problem, and I am glad that my rash statement has aroused the attention of a physicist.

On the other hand, I dealt somewhat at length in my lectures with the problems of the *minimum separabile* and contour discrimination. I came to the conclusion that while the facts relating to the former were not inconsistent with a purely physical explanation, those relating to the latter could not thus be explained at present, but were at least rendered intelligible by physiological and psychological interpretations.

These considerations emphasise the complexity of visual phenomena, and the necessity for the co-operation of physicists, physiologists, and psychologists in their elucidation. Mr. Smith's letter is a welcome indication of the increasing interest which physicists are displaying in the physiological implications of their researches. J. HERBERT PARSONS.

[1] See "The Unaided Eye," by J. W. French. *Trans. Opt. Soc.*, 21, 127; 1919–20.

The Excitation of Spectra by High Frequency Oscillations.

IN a recent letter to NATURE (Nov. 19, p. 726), Mr. J. R. Clarke gives a brief account of some experiments he has made on the excitation of various spectra in mercury vapour. The wording of his note suggests that he attributes the phenomenon cited to the relative shortness of the wave-length of his oscillating system (300 metres). The apparatus he uses is no other than the ordinary one of electrodeless discharge of which the spectroscopic interest has been clearly shown by Prof. E. Bloch and M. L. Bloch (*Journal de Physique*, **4**, 333; 1923), whose first experiments were made with mercury in the absence of air, which is useless and even derogatory to obtaining pure spectra. This method has often been used since by these authors and others, most frequently, it is true, with damped oscillations, but M. Balasse recently employed undamped waves of about 155-880 metres (*Comptes rendus*, 1005; 1927) for the excitation of spectra of alkali metals. It may therefore be said that the method described is not merely full of promise, but also that it has already realised all these expectations.

Like the other kinds of discharges, the electrodeless discharge more or less weakens certain lines and strengthens others: in this way, in the case of mercury, the long list of arc lines given by the above-mentioned authors does not show a single line of the *mp* series, of which the strongest lines are, moreover, infra-red and red. This fact, found also by Mr. Clarke, is to be attributed to the kind of discharge employed and not to the shortness of the wave-length.

I have been studying for some time in this laboratory the emission of mercury vapour under the action of very much higher frequency waves, the period of which reaches the order of magnitude of the duration of life of the excited states of the atom. I have ascertained that a $\lambda = 1{\cdot}90$ m. oscillator, of very feeble power (20 watts max.), produces an exceedingly brilliant electrodeless discharge in a slightly warmed quartz tube which has been exhausted with great care and sealed after a drop of mercury has been introduced by distillation. The luminous efficiency of this mode of excitation seems to be very high. This tube also lights along Lecher's wires at the maxima of the electric field. I obtained ordinary electrodeless arc spectra, with one or two enhanced lines, the feeble power of the oscillator not enabling me to obtain more. The line 2537 seems to be relatively very strong, but, up to now, I have not observed in these spectra any effect that could be attributed to the shortness of the wave-length. Besides, it is to be noticed that this mode of excitation seems to be extremely sensitive to the presence of organic impurities: a tube with aluminium electrodes which has been carelessly