It seems to me that these results disprove Prof. Gray's statement: "If they are recoil electrons, the effective wave-length of the γ-rays must be taken as about 0·008 Å.U. in order that we may account, on the quantum theory of scattering, for their observed energy." (A wave-length of 0·008 Å.U. corresponds to a maximum energy of recoil equal to about 1300 kv.)

The main values of energy deduced from my data for electrons ejected at different angles to the primary ray also account for the usually accepted value (0·02 Å.U.) of the effective wave-length. I may add that this order of value is confirmed by new measurements of Amahd and Stoner (Proc. Roy. Soc. 106, 17, 1924), who found 0·019 Å.U. as the upper limit of effective wave-length.

It may be hoped that the direct counting of β-rays, and the measurement of their velocity, will give a distribution of intensity in the γ-ray spectrum which differs from that obtained by the usual method. By intensity is here meant the number of elementary quanta of γ-rays, and not, as is usual, their energy.

Ellis (Proc. Camb. Phil. Soc. 22, p. 374, 1924) obtained the γ-ray spectrum of radium-C, where the most intense line (in the above meaning) seems to correspond to a wave-length of 0·02 Å.U. A strong line E34, lying near the limits of the spectrum ($\lambda = 0{\cdot}00867$ Å.U.), is twice less intense, and, according to Compton's theory, much less effective as to the production of recoil electrons.

As to my disagreement with Prof. Gray, I may state the following. The method used by me has the advantage of making it possible to observe the undisturbed spectrum of secondary β-rays, which are produced directly in the gas. In the case of a screen being the source of secondary β-rays, the distribution of velocities will be altered owing to the absorption of the rays in the screen itself; if we want to observe an undisturbed spectrum by the usual method, we ought to have β-rays excited in very thin layers of matter, which may be impossible so far as light elements are concerned.

On my photographs there may be seen not only the tracks of the β-rays produced in the gas, but also the tracks of those rays which take their origin in the 2 mm. thick wall of the chamber; in this case, we observe the secondary corpuscular radiation of the wall which is "hardened" by the wall itself, and the photographs show the presence of a comparatively larger number of swift electrons (most of these photographs show tracks of particles the velocities of which approach 1000 kv.).

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Further Spectra associated with Carbon.

DR. R. C. JOHNSON, in an article with the above title which has just appeared (Proc. Roy. Soc., A, 108, 343, June 1925) has given in his Table IV. a set of six new double-double headed bands, degraded to the violet, and associated with the comet-tail spectrum, which is also double-double headed, but degrades to the red. I find that these new bands have the same set of initial vibration states as the first negative group of carbon, and this, in connexion with the relation stated in my letter of June 8 to NATURE, published in the issue of August 1, that the set of final states of the first negative group and of the comet-tail bands is the same, leads to relations of considerable importance in the quantum theory of band spectra.

In the first place, the final states of the new bands must be identical with the initial of the comet-tail bands. This is in fact the case, using the assignment of vibrational quantum numbers given in the letter just quoted. This proves the correctness of that assignment and shows that the weak λ5281 band omitted in that assignment, as well as the weak λ5764 and λ6354 bands, are not a part of the regular group. The values of the vibrational quantum numbers n'-n'', for Johnson's six bands, in the order listed by him, are 0-1, 1-2, 0-0, 1-0, 2-0, 3-0. Secondly, the frequency of the "origin" of the new Johnson group must equal the difference in frequency of the origins of the other two groups. This also is accurately true, provided one uses Baldet's (*Comptes rendus*, 180, 820, 1925) series interpretation of the comet-tail bands, and Blackburn's (Proc. Nat. Acad. Sci., 11, 28, 1925) of the first negative group.

More generally, from measurements of the frequencies of the individual lines of the comet-tail and first negative group bands, one can calculate immediately the frequency of *every line* of every band of the new group, *provided* the structure of the bands of the various groups has been properly interpreted, in working out the systems of energy levels. It is this last fact which makes the above relations of such importance, for there is at the present time a sharp difference of opinion concerning the interpretation of a number of vital points in connexion with the series structure of complex bands such as these. A fine structure analysis of Johnson's new bands should allow a definite decision on a number of these points.

Without any further data, however, it is possible to decide definitely that the comet-tail bands have a *double* electronic level in the initial state, of spacing $\Delta\nu = 126$. Each of these bands has a double "origin" given by the heads of the two Q branches, according to Baldet's (*loc. cit.*) analysis, thus confirming this analysis in contradiction to Blackburn's (*Phys. Rev.*, 25, 888, 1925) quite different interpretation. Similarly the new bands each have a double origin with the same spacing ($\Delta\nu = 126$). This double origin is the second and fourth "head," counting from the *red*, while in the comet-tail bands it is necessarily the second and fourth head, counting from the *violet*. As might be expected, the theoretically inconsequential spacing of the first and second heads, second and third, etc., in each band is not at all the same for the two groups, but the spacing of these two Q branch heads ("origins") is precisely the same.

Other points at issue relate to the application of the combination principle to the rotational energy levels, the question of one-half versus one-quarter values of electronic momentum, the numerical magnitude of the moment of inertia, etc. They cannot be discussed in a brief communication like this, but Dr. R. S. Mulliken, in an article just sent to the Proc. Nat. Acad. Sci., mentions some of the difficulties of interpretation in the case of these particular band groups.

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On the Theory of the Zeeman Effect.

IN his letter to NATURE of June 27, p. 978, Prof. W. M. Hicks points out that the theory of the Zeeman effect on the application of Larmor's theorem is no explanation, and concludes that the theory of the Zeeman effect on the quantum basis yet remains to be given.

I may say that the classical theory can still demonstrate the Zeeman and Stark effects. In the Proceedings of the Pont. Academy of Sciences (March 1923) I