density of the material) for the soft set being approximately four times that for the hard.

(2) For each set of rays the value of λ/Δ is constant, and practically independent of the nature of the absorbing material with which λ is measured, provided that in the case of the soft rays secondary effects be excluded.

(3) Secondary γ radiation appears on both sides of a plate which is penetrated by a stream of γ rays. There exists a marked lack of symmetry between the amount of secondary radiation which proceeds from the two sides.

(4) A lack of symmetry exists in the case of some substances between the quality of the radiation on the two sides.

(5) The last results seem very difficult to reconcile with a pulse theory. On the "material" theory propounded by Prof. Bragg no such difficulty arises.

(6) The secondary γ radiation appears to be derived from the primary by a process of scattering, this process generally involving a reduction in the subsequent penetrating power of the ray affected.

(7) There appears to be reason to believe that the distribution of the scattered radiation depends to some extent upon the hardness of the radiation which is scattered, also upon the nature of the material in which the scattering is produced. The softer radiation appears to be turned back to a somewhat greater extent than the hard. Materials of high atomic weight seem to be able to produce more complete scattering than those of lower atomic weight.

(8) The absorption of γ radiation which has already passed through a thickness of one substance by screens of a different substance may not in all cases give a true measure of the absorption of the original radiation which has been effected by the first screens.

J. P. V. MADSEN.

University of Adelaide, October 1.

[As there are few opportunities in Australia for an investigator to place his views quickly before a scientific public, we print the above letter, but with it the correspondence must cease. The subject is more suitable for discussion in special journals devoted to physics than in our columns.—ED. NATURE.]

The Origin of Spectra.

THE very interesting observation of the anomalous dispersion of luminous hydrogen in the neighbourhood of the Hα line recorded by Messrs. R. Ladenburg and Stanislaw Loria in NATURE of November 5 (p. 7), and the known absence of the phenomena in ordinary hydrogen, show conclusively that *the spectrum lines of a substance are not free periods of the atoms in their normal state, but only of those systems produced somehow by the agency which gives rise to the spectra.*

The figure 1/50,000 as the number of electrons per atom of course means that in the gas under experiment only one atom in 50,000 was emitting the Hα line at any one time. The very important remark is made that the anomalous dispersion in the neighbourhood of the other lines of the hydrogen series "is expected to be much smaller than that at the Hα line." If this be so, it will show that at any given time different numbers of atoms are producing the different lines, that is to say, that the spectrum is not produced *in toto* by each atom. Each atom (or rather the system emitting the lines) may, for instance, only be emitting one line at a time. These results are the same as those I have deduced from Prof. R. W. Wood's work on the anomalous dispersion of sodium vapour. Sodium vapour shows anomalous dispersion in the neighbourhood of all the lines of the principal series, which "is very strong at D, feeble at the first pair of ultra-violet lines λ 3303, and almost imperceptible at λ 2852." It is also, Wood states, stronger at D_2 than at D_1. This shows that the number of atoms emitting D_2 at any time is greater than the number emitting D_1, and both these are much greater than the numbers emitting the higher members of the series. We note that there is no anomalous dispersion in the neighbourhood of the lines of the subordinate series of the sodium spectrum showing that heat alone does not produce those systems which vibrate with the periods of the subordinate series, which agrees with the facts that these series do not appear in the absorption spectrum of sodium vapour or in the Bunsen flame spectrum of sodium.

It thus seems probable that different series of lines in a spectrum are produced by entirely different vibrating systems, while any system possibly only emits one line at a time of its own particular series, depending upon the manner in which it has been struck. It is evident that the different vibrating systems obtained, and their relative proportions, may be expected to vary with the nature of the electrical discharge producing the spectra, and hence the variation of the spectra under different conditions. This may, perhaps, on the modern views, be regarded as the same idea put forth many years ago by Sir Norman Lockyer in his dissociation hypothesis.

I make these observations in order that those working on the subject from the theoretical side may the better see the phenomena to be explained, which are quite different from ordinary dynamical vibrating systems.

In conclusion, I should like to direct attention to the importance of extending Messrs. Ladenburg and Loria's work. By examining every line in the spectrum of an element we could, for instance, say whether a line was faint because very few systems were emitting it, or whether its faintness must be attributed to the fact that the vibrations producing this line have only a very small amplitude.

ALBERT EAGLE.

Imperial College of Science and Technology, London, November 9.

A Gall-producing Dragon-fly.

WHEN looking through Dr. C. Houard's new work on galls ("Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée," tome i.), I was surprised to find on p. 249 an entry:—"Minime borselette *Q. ped. Lestes viridis*, Van der Lind."

A gall-producing dragon-fly was quite new to me, but on looking up the subject I found a series of very important observations on the oviposition and larva of the species in question by the Abbé Pierre and M. de Roequigny-Adanson, in the *Revue scientifique du Bourbonnais et du Centre de la France*, xv. and xvi. (1902–3), and the *Annales et Bulletin de la Société entomologique de France* for 1904. As these seem to have been entirely overlooked in England, I think it may be useful to epitomise them as briefly as possible.

The eggs of *Lestes viridis* are laid on the branches of a great variety of deciduous trees and shrubs, but always close to, or overhanging, water, and therefore probably most often on alders or willows. These result in the production of small galls, which are sometimes extremely abundant, and which are thus described by Pierre:—

"Un bourrelet mesure de 1 mm. ½ à 2 mm. de longueur, sur ½ ou 1 mm. de largeur. Deux bourrelets sont associés en chevron et forment un angle d'à peu près 90°, ouvert vers le bas du rameau. Le sommet de l'angle présente une pellicule corticale plus ou moins arrondie, formant clapet au dessus de l'ouverture par laquelle de 1 à 4 œufs ont été insérés sur chaque bourrelet. Enfin les chevrons distants de 2 mm., sont associés en série longitudinale, de telle façon qu'une même génératrice du rameau soit sensiblement bissectrice de tous les angles."

The emergence from the eggs and the structure of the larva are equally curious. The new-born larva, or "pro-larve," as Pierre calls it (*Ann. Soc. Ent. de France*, 1904, pp. 477–84, pl. iv.), resembles a coleopterous pupa, being enclosed in an outer membrane which leaves it only the power of leaping. If these young larvæ do not fall into the water on emerging from the egg, they leap about, sometimes for several hours, until they succeed in reaching it. After reaching the water the pro-larva rests on its back for two hours, and then casts the skin, a process occupying from three to thirteen minutes. The larval development of *Lestes viridis* has been compared by M. Giard to that of the crickets. A similar structure of the newly emerged larva has also been noticed in *Epithera bimarulata*, another dragon-fly.

I may remark that *Lestes viridis*, though common on the Continent, is an insect of great rarity with us, and not firmly established in the list of British species.

W. F. KIRBY.