When the excitation is produced by $D_1$, the ratio of intensities of the two resonating lines $D_2$ and $D_1$, which is very small when the temperature and density are low, rapidly increases to its normal value 2 with the number of atomic collisions per second. This number is thus given statistical significance. Until now there has been no strong evidence (Wood, 1914) as to its invariability at higher temperatures and pressures.

Special investigations on this subject made in 1915 and 1917, and published in Russia, appear to be unknown abroad. The dispersion of the vapour of alkali metals was studied in 1915. For all the first doublets of Na, K, Rb, and Cs the same value 2 was obtained, and it remained constant in spite of a hundredfold density variation; for the second doublets the numbers are simple, but different: 2 (?), 2, 2·5, 4. The numbers 3 and 7 (?) were measured for the third doublets of Rb and Cs. Mr. Touroverow (1917) found the same number 2 for the first sodium doublet at the temperature of the arc. There is, therefore, no doubt now as to the constancy of all the above numbers. The experiments on resonance thus show that the statistical value in question first grows rapidly with the temperature and approaches a limiting value, essentially constant. This behaviour has a certain analogy to that of specific heat as caused by departure from equipartition.

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March.

## The Resonance Theory of Hearing.

THE discussions which appeared in NATURE in 1918 (vol. cii., pp. 124, 164, 184) on the theory of hearing showed that the opinion has been gaining ground lately that the resonance theory can no longer be regarded as unassailable. The following observation, which is readily explicable if there are resonators in the internal ear, would appear to be inexplicable if there are not:

If the phase of a continuous musical note be suddenly altered by suitable means by $\pi$, then the observer hears the sound rapidly die away, to return a moment later with its former intensity. The experiment was performed as follows:

A De la Tour siren was so modified that the wind-chest could be given suddenly a small rotation about the same axis as that of the siren disc. The rotation was limited by fixed stops, so that the angle turned through was equal to one-half the angle between two of the air-holes. In the writer's instrument there were eighteen holes arranged on the circumference, *i.e.* 20° between two of the holes, and the wind-chest was therefore arranged to rotate through 10°. If, then, this rotation is suddenly effected with the siren in action, a change in the phase of the note of $\pi$ will be introduced; since, if the rotation of the wind-chest be in the same direction as that of the disc, the time-interval between the puffs of wind through the disc will be $1\frac{1}{2}$ times as great as the normal, because the disc has to rotate through $20° + 10°$; if, on the other hand, the rotation of the wind-chest be in the opposite direction to that of the disc, the time-interval will be one-half the normal, since the disc has to rotate through $20° - 10°$. Each time, then, that this change of phase of $\pi$ is brought about by rotation of the wind-chest of the siren the observer hears a beat in the musical note. The sound intensity first falls to a low value, then rapidly rises somewhat above the original level (possibly due to successive contrast), and then returns and stays at the normal intensity. To show that the beat is not of mechanical production the following tests may be applied:

(*a*) No beat is produced if the wind-chest is rotated slowly.

(*b*) No beat is produced if, with the disc in rotation, the air-supply be quickly turned off and the wind-chest then rotated suddenly in either direction.

(*c*) The beat can be heard as clearly at a considerable distance from the instrument as it can quite near to it.

(*d*) If the rotation of the wind-chest is less than that required to change the phase by $\pi$, the beat or temporary waning of the note is correspondingly smaller in intensity.

This temporary waning of the note is readily explained by the resonance theory, because the change in phase will put the later vibrations exactly out of step with those that preceded, and therefore the resonators of the internal ear which are set in vibration by the note will on change of phase first be brought to rest and then be set going again. The temporary waning of the note is therefore readily explained on the resonance theory. Can any of your readers advance an explanation on any of the displacement (*e.g.* Wrightson's) hypotheses of hearing?

H. HARTRIDGE.

King's College, Cambridge, March 21.

## Sexual Organs of Phytophthora.

ATTENTION was directed in NATURE of April 30, 1914 (vol. xciii., p. 226), to the discovery of a rather remarkable mode of development of sexual organs which occurs in certain species of Phytophthora, and was first found in *P. erythroseptica* and then in *P. infestans*, the "potato-blight" fungus. Several other species of the genus are now known to produce sexual organs in this novel fashion, in which the oogonial incept penetrates the antheridium at an early stage, traverses it, emerges, and then swells to form the oogonium proper within which the oospore ultimately develops. It was suggested then that those previously well-known species (such as *P. cactorum*, etc.) in which the antheridium and the oogonium lie side by side, and penetration of the latter by the former occurs laterally, should be excluded from the genus Phytophthora and be placed in a new one, Nozemia. A species (from decaying apples) has now been isolated by Mr. H. A. Lafferty, working here, in which the sexual organs are developed mainly according to the Nozemia type, but occasionally and simultaneously in the same individual according to the Phytophthora type, with amphigynal antheridia. This species, therefore, forms a connecting link between the two groups; and it would seem no longer necessary or desirable to retain the generic name Nozemia.

The object of this letter is to suggest to the various mycologists who are now working with Phytophthoras that they should keep a very careful look-out in cultures of species of the *Cactorum* or *omnivora* (Nozemia) type for the occasional occurrence of sexual organs with amphigynal antheridia; for it seems quite possible that these may be present in such species and have merely been overlooked by previous observers owing to their relatively infrequent occurrence.

I should be very grateful for sub-cultures of any species of Phytophthora that mycologists who have them could spare for further study of this point, and happy to send any I possess in exchange if desired.

GEO. H. PETHYBRIDGE.

Royal College of Science, Dublin, April 7.