obtained a similar result. It is likely that some condition of resonance of the partition explains the fact of minimum reflection and maximum transmission at the intermediate thickness.

In materials generally used for sound absorption, such as hair-felt, the sound is transmitted mostly through pores; but the late W. C. Sabine, on finding that the absorbing power of some felts was *a maximum for certain frequencies*, thought it possible that the felt absorbed partly by the dissipation of the waves in its pores and partly by the yielding of its mass as a whole. In an interesting paper on the transmission of sound through hair-felt by Davis and Littler (*Phil. Mag.*, **3**, 177; 1927) the thickness-transmission ratio curves showed not much sign of curvature to indicate any condition of partition resonance at the frequencies used in the experiments; but the authors point out that such is the result only for porous material, and that probably the case would be different with partitions transmitting "an appreciable fraction of the incident sound by diaphragm-like vibration."

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The Evidence for Hybrid Vigour in Insects.

IN several reports on the introduction of *Aphelinus mali* into New Zealand and its colonisation, Dr. R. J. Tillyard has stated that by crossing three different strains from America he has produced a more vigorous strain which is now established over the greater part of New Zealand. To quote from one of his articles—"The story of how the three strains of *Aphelinus* were crossed, producing the very vigorous strain which is now being distributed all over New Zealand, is too long to tell in detail here, but the main points may be mentioned."

This aspect of applied ecology or biological control is of great importance to entomologists, and therefore it is necessary to examine the evidence upon which this statement is founded.

Turning to Dr. Tillyard's reports, we find that he received six boxes of parasitised aphis from America, two from Washington State, two from Connecticut, and two from Arkansas. These three consignments were placed together in one breeding box and eighteen specimens hatched. By his own account only five specimens, two females and three males, which hatched out between Feb. 6 and Feb. 15, formed the parents of all his future colonies used in establishing the insect in New Zealand, where they have multiplied and spread and been of great benefit to the country.

The fact that insects are collected from three places, although considerable distances from one another, does not carry with it the fact that they are distinct strains. It is necessary to show some slight biological difference between them. As all the material received was placed in the same breeding box, it is impossible to say whether the eighteen specimens hatched from only the material from one or from two or from all three localities. It is quite possible that they hatched from material from the same locality, and even that they represent one family, being brothers and sisters. Any superiority that might be observed might then be due to an unconscious selection of a superior genetic mutation.

Is there any superiority in the present New Zealand strain, or is their flourishing condition only due to the same factors as caused their host (the woolly aphis) to flourish, namely, congenial climatic conditions, abundance of food, and absence of enemies? Judging by our work in the Hawaiian Islands, I should say that it was so. The idea which underlies this subject is hybrid vigour, and it would be of importance to establish by proper experiments how far this applies to insects. The evidence we have in Hawaii is more in the negative than in the affirmative. In the case of certain Coccinellidæ, inbreeding in captivity has led to reduced fertility, but here we are not quite sure how much of this is due to inbreeding and how much to the conditions of confinement. In a number of cases a small colony has been received from one locality and the insect established in the islands; after many years (some more than twenty) they are as vigorous as ever and show no signs of failing. In certain cases of small parasitic Hymenoptera the insect has carried on generation after generation parthenogenetically, only one or two males ever having been seen out of many hundreds of thousands of individuals. Our examples are not confined to Hymenoptera, but include Diptera, Coleoptera, and Neuroptera.

Most insects that become established in a new country and become a pest are introduced as small colonies from one locality, and in most cases are only introduced once, so that there must be a great amount of inbreeding in a few years. Unfortunately they show no lack of vigour.

The question of hybrid vigour in insects therefore stands in an uncertain condition, and any statement must therefore be supported by evidence for the species in question; no general conclusion can be laid down. In the case in point the necessary evidence is lacking.

While it may be a good policy to get several consignments from different localities when trying to introduce and establish an insect, this is not often possible. Also, the dangers which cannot be entirely eliminated when bringing in a colony are thereby increased. For the latter reason we have always tried to establish our introductions in Hawaii from a single small colony which can be handled more easily. Unfortunately this cannot always be done.

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The Radiation from Explosions of Carbon Monoxide and Oxygen to which Hydrogen has been added.

THE speed of explosion of mixtures of carbon monoxide and oxygen is accelerated by the addition of water or substances containing hydrogen, as was shown by Dixon. The acceleration of the speed is invariably accompanied by a reduction in the emission of radiant energy and vice versa (Garner and Johnson, *Phil. Mag.*, **3**, 97; 1927). The radiant energy emitted from these explosions consists mainly of two bands with maxima at $2{\cdot}8\mu$ and $4{\cdot}4\mu$, which are the emission and absorption bands of carbon dioxide. The emitters of this radiation are the molecules of carbon dioxide which have been set in vibration and rotation by the chemical energy liberated during the explosion.

Experiments by Johnson (unpublished) have shown that about 10 per cent. of the total chemical energy of the explosion is emitted as radiation when a mixture of dry carbon monoxide and oxygen is exploded in a long cylindrical bomb 1 inch in diameter. This is reduced to 2·5 per cent. when 1·9 per cent. of water is present. Since the flame of the moist gases is hotter than that of the dry gases, the radiation cannot be entirely black body. At least 7 per cent. of the chemical energy of the dry gases is emitted as chemiluminescence.

Further experiments on dry explosive mixtures to which varying percentages of hydrogen are added, have thrown light on the nature of the effect. The