

Fusion in 1947?

SIR—Fleischmann and Pons¹ claim to have achieved fusion at room temperature in a glass container. I was struck by the similarity to a much earlier experiment by Rayleigh², which demonstrated that a nitrogen (or oxygen or hydrogen) atom impinging on a metal wire in a glass container releases energies ranging up to ~100 eV. At the time, no explanation of the results was advanced, although physicists found no fault with the experiment. In 1957, Burgess and Robb³ showed that in the presence of traces of oxygen (0.22–0.99 mm Hg) hydrogen atoms will cause the temperature of a metal wire to rise many times above that expected to result from the heat of recombination of H atoms on the wire; this does not, however, explain Rayleigh's results with nitrogen or oxygen. Have they been explained or can we count Rayleigh's experiment as an earlier observation of 'fusion' in a bottle?

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1. Fleischmann, M. J. & Pons, S. J. *electroanalyt. Chem.* **261**, 301–308 (1989).
2. Lord Rayleigh *Proc. R. Soc. A* **189**, 296–299 (1947).
3. Burgess, R.H. & Robb, J.C. *Trans. Faraday Soc.* **54**, 1008–1014 (1957).

Sympatric origins of *R. pomonella*

SIR—Carson raises two important questions concerning the possible recent sympatric origin of the apple infesting form of the maggot fly *Rhagoletis pomonella*¹. First, he points out that *R. pomonella* may have shifted to domestic apples (*Malus pumila*) from a native host other than hawthorns, such as endemic crabapples. Second, he postulates that different races of *R. pomonella* may exist on different species of hawthorns and that the apple race could have been derived from just one of these 'hawthorn races'. We have addressed these issues in some detail in manuscripts submitted to the journals *Evolution* and *Heredity* and we will therefore highlight only a few of the more crucial reasons why the alternative explanations are unlikely.

The most likely potential native North American hosts for *R. pomonella* other than hawthorns are several species of crabapple (*M. angustifolia*, *M. diversifolia*, *M. glabrata*, *M. ioensis* and *M. coronaria*), none of which supports populations of the fly^{2,4}. The reason for this is not clear, but O'Kane³ has suggested that fruits of native crabapple species are too acidic and ripen too late for *R. pomonella* to complete development before winter. Pree⁵ has found a correlation between larval mortality and the total phenol content of fruit from several introduced

species and varieties of crabapples, which suggests that phenolics also contribute to the unsuitability of native crabs as hosts.

Furthermore, in the highlands of Mexico, an isolated population of *R. pomonella* has independently shifted from hawthorns to domestic apples within historical times (apples were introduced into Mexico from Spain in 1522⁶). Both the apple and hawthorn fly populations in Mexico are morphologically distinct from flies in the north-east⁴. Mexican *R. pomonella* could not, therefore, have given rise to the apple race in New England. However, Mexico does not have any endemic species of crabapple⁶ (J. Beaman, personal communication). Therefore, in Mexico at least, *R. pomonella* seems to have shifted directly from hawthorns to domestic apples.

It is still possible, of course, that different races of *R. pomonella* exist on different species of hawthorns. Almost 100 different species of *Crataegus*, comprising 19 different species groups, may be endemic to North America^{7,9}. But the taxonomic status of most of these *Crataegus* species is questionable as hybridization, polyploidy and apomixis are common in the genus^{8,12}. Nevertheless, *R. pomonella* has been reported to attack only a restricted set of *Crataegus* 'species', with infestations confirmed for only 14 endemic hawthorns^{4,13-16}. In the north-eastern United States, only hawthorn species that produce relatively large, soft fruits ripening in early autumn are heavily parasitized by the fly^{2,4,13}. It therefore seems that *R. pomonella* uses only a few potential hawthorn hosts in the north-east, a trend that is not conducive to the formation of different hawthorn races.

In addition, electrophoretic analysis of *R. pomonella* populations infesting *C. punctata*, *C. brachyacantha*, *C. douglasii*, *C. mollis* and *C. monogyna* from across the United States provides no evidence for genetically differentiated hawthorn races¹⁴⁻¹⁶. Instead, we find that latitudinal allele-frequency clines exist in the eastern United States among both apple and hawthorn populations (mainly *C. mollis*) for five of the six allozymes showing host associated differentiation^{15,16}. The slopes of these allele-frequency clines differ, however, between the two races with the hawthorn race having steeper clines¹⁶. Inter-host divergence is, therefore, superimposed on north-south clinal patterns of intra-host variation such that the magnitude of genetic divergence between hawthorn and apple flies is a function of latitude. Consequently, different apple populations do not cluster together as a discrete genetic subdivision from populations attacking *C. mollis*, as would be expected if the apple race was formed from a distinct race infesting a hawthorn species other than *C. mollis*.

Instead, the electrophoretic results

suggest that differential selection (affecting development rates for the fly and related to ambient temperature conditions) and differences in host use are key factors responsible for the pattern of allozyme variation for *R. pomonella*. Although further sampling of *R. pomonella* at field sites with sympatric hawthorn species is needed to discount completely the possibility of host-specific hawthorn races, all available data indicate that hawthorn populations represent a single race displaying extensive latitudinal variation.

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1. Carson, H.L. *Nature* **338**, 304 (1989).
2. O'Kane, W.C. *The Apple Maggot* (New Hampshire Exp. Stat. Bull. 171, 1914).
3. Porter, B.A. *The Apple Maggot* (US Dept. Agric. Tech. Bull. 66, 1928).
4. Bush, G.L. *The Taxonomy, Cytology, and Evolution of the Genus Rhagoletis in North America* (Diptera: Tephritidae) (MCZ, Cambridge, Massachusetts, 1966).
5. Pree, D.J. *J. econ. Ent.* **70**, 611–614 (1977).
6. Standley, P.C. *Trees and Shrubs of Mexico* (Smithsonian, Washington, DC, 1922).
7. Fernald, M.L. *Gray's Manual of Botany* 8th edn. (American Book Co, New York, 1950).
8. Correll, D.S. & Johnston, M.C. *Manual of the Vascular Plants of Texas* (Texas Res. Fdn, Renner, 1970).
9. Muniyamma, M. & Phipps, J.B. *Can. J. Bot.* **63**, 1319–1324 (1985).
10. Muniyamma, M. & Phipps, J.B. *Can. J. Bot.* **62**, 2316–2324 (1984).
11. Phipps, J.B. *Ann. Mo. Bot. Gdn* **70**, 667–700 (1983).
12. Phipps, J.B. in *Plant Biosystematics* 417–438 (Academic Press, Toronto, 1984).
13. Wasbauer, M.S. *An Annotated Host Catalog of the Fruit Flies of America North of Mexico* (Diptera: Tephritidae) (Dept. Agric., Sacramento, California, 1972).
14. Berlocher, S.H. thesis, Univ. of Texas at Austin (1976).
15. McPheron, B.A. thesis, Univ. of Illinois at Urbana (1987).
16. Feder, J.L. thesis, Michigan State Univ. (1989).

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