testing the ability of both honeybees (*Apis mellifera*) and bumblebees (*Bombus terrestris*) to taste the three most commonly used neonicotinoids — clothianidin, imidacloprid and thiamethoxam. When hungry worker bees could choose to collect from feeders containing either a solution of neonicotinoid-treated sugar water or an untreated solution, neither species avoided the treated food, which contained neonicotinoid concentrations comparable to those found in the nectar and pollen of treated crops. Surprisingly, the bees in fact preferred the treated solution in the imidacloprid and thiamethoxam tests, which the authors suggest arises from the pharmacological action of these insecticides on receptors in the bees' brains. The authors corroborated their behavioural results with neurophysiological measurements showing that bees are unable to taste neonicotinoids in sugar water.

Scaling up from the laboratory, Rundlöf *et al.*[16] (page 77) undertook an ambitious study to assess the impacts of neonicotinoid exposure on bees placed near fields of treated oilseed rape (also known as canola). The experiment — the largest of its kind so far — involved 16 fields across southern Sweden: 8 fields were planted with seeds treated with the systemic insecticide clothianidin, the pyrethroid insecticide β-cyfluthrin and the fungicide thiram, and 8 control fields were treated solely with thiram. Like Kessler *et al.*, these researchers studied both honeybees and bumblebees, but followed entire colonies rather than individuals. Furthermore, they monitored nests of a species of solitary bee (*Osmia bicornis*), as well as surveying wild bees in field margins.

In treated fields, Rundlöf and colleagues found fewer wild bees and observed reduced growth rate and reproduction of bumblebee colonies (which produced fewer males and fewer new queens — consistent with previous semi-field and field studies[14,17,18]) compared to control fields. They also found that none of the solitary bees that emerged from nests placed next to treated fields came back to their natal nest to build new brood cells, whereas emergent females successfully produced brood cells in six of eight untreated fields. By contrast, there was no significant difference in honeybee colony growth between treated and control fields. However, the authors' power analysis indicated that they would only have been able to detect a minimum effect size of about 19% for honeybees.

These studies provide timely data to address calls for further evidence about the environmental risks of neonicotinoids. The insecticides tested by the authors are currently subject to a European Union moratorium for use as seed treatments on crops attractive to bees, but this usage restriction will be reviewed before December 2015. It is hard to say whether the preferences observed by Kessler and colleagues for nectar containing imidacloprid and thiamethoxam residues would occur in a more complex field setting, where many variables could interfere with foraging decisions. However, their study does imply that foraging bees are unlikely to avoid seed-treated crops in the field, and supports previous reports of honeybees and bumblebees bringing back nectar and pollen from treated fields[9–12,16]. If the preference for treated food does apply in the field, these findings suggest that we could be underestimating the exposure risk to bees from treated crops.

Both studies also highlight the fact that different bee species vary in their responses to exposure. Current pesticide registrations rely on ecotoxicological testing of just one species, the honeybee, when assessing risks for all insect pollinators. Yet Rundlöf and colleagues found negative effects of neonicotinoids on solitary bees and bumblebees in the field, but not on honeybees, suggesting that a single species might not represent the responses of other pollinators. Potential explanations for these apparent differences could include a variable affinity of neuronal receptors for binding neonicotinoids; differences in detoxification capacities; and divergent foraging behaviours, which influence levels of exposure (Fig. 1). Differences could also result from variation in social organization and life-history strategies. Even the smallest perennial honeybee colonies contain a queen and several thousand workers that overwinter as a group, whereas annual bumblebee colonies rarely contain more than a queen and a few hundred workers. Each solitary bee is responsible for its own foraging and reproduction during its few weeks of adult life. The sheer number of workers in the honeybee colony may better enable buffering of stress over long periods, whereas the more severe pinch points that bumblebees and solitary bees experience could render them more susceptible to environmental pressures[19,20].

If field experiments to assess exposure are deemed so important, why have so few been carried out? Limiting factors include the scale of such studies, the levels of replication required to achieve appropriate statistical power, and human and budgetary resources. Even with 16 fields, Rundlöf and colleagues' study had relatively low statistical power and, as with other field studies, many environmental factors probably varied among their sites and could not be standardized. Such studies can provide only correlational evidence of impacts, whereas controlled-exposure studies, such as that of Kessler *et al.*[15], are better suited to determining causative relationships through manipulative experimentation. The complementarity of these two approaches needs to be considered by policy-makers and for future research planning.

Although the two latest studies contribute to our understanding of the risk neonicotinoids pose to bees, knowledge gaps remain. For example, we need further evidence about how neonicotinoid exposure might affect

50 Years Ago

'The sign of the constant of gravitation'. By Prof. W. H. McCrea — A speaker in a recent broadcast asserted that, were the gravitation-constant negative instead of positive, Newton's apple would have soared away into the sky instead of falling on Newton's head. However, had that happened, Newton also would have soared away and there would have been no legend to record. In fact, there cannot be a world for which gravitation is not attractive … We shall see that the sign of the gravitation constant is essentially a matter of convention.
From *Nature* 8 May 1965

100 Years Ago

It may be remembered that the Royal Commission on Whisky, which in 1908–9 gave a lengthy consideration to the matter, did not find a very satisfactory answer to the query "What is whisky?" The Government of Western Australia … issued regulations under which certain chemical standards for "pure pot-still whisky" were proposed for adoption. The proposals met with some criticism. It was alleged, in fact, that many pot-stills employed in Great Britain could not produce whisky which would comply with the requirements … the proposals, as now modified … are that, as regards Scotch whisky, it shall have been distilled at a strength not more than 35 degrees above proof and matured in wood for not less than two years; and that "standard pot-still whisky" shall contain at least 45 grams of esters, 3.5 of furfural, and 180 of higher alcohols per 100 litres of absolute alcohol … For Irish whisky no furfural standard is proposed at present, but the proportion of esters is required to be not less than 35 grams, and of higher alcohols 200 grams, per 100 litres of absolute alcohol.
From *Nature* 6 May 1915