



Promiscuous queens produce studs, not duds

GENETICS

## Honeybee sex mystery solved at last

IN HONEYBEES, males don't have fathers, queens are promiscuous and bee breeders struggle to develop pure-bred animals – and now we finally understand why.

It was 1845 when a Polish parish priest named Johann Dzierzon discovered that male bees have no fathers. Unfertilised bee eggs, which we now know contain only one set of chromosomes (haploidy), develop into males. Fertilised eggs, with two sets of chromosomes (diploidy), become females. Ants and wasps have the same sex determination system, but how it works has been a mystery.

Occasionally, however, it goes wrong, and a fertilised egg develops into a diploid male, whose offspring are sterile. Now, thanks to 13 years of analysis of such animals, a team led by Robert Page of the University of California, Davis, has found the gene involved. Dubbed *complementary sex determiner (csd)*, the gene works in a completely different way to anything geneticists have discovered before, says Page.

There appear to be as many as 19 different variations of the gene. Although the precise mechanism is not yet understood, the team has

shown that as long as two different versions of *csd* are inherited, the proteins the two versions code for combine to switch on female development. An unfertilised egg, with just one copy of *csd*, becomes male (*Cell*, vol 114, p 419).

The system goes wrong when a fertilised egg inherits two copies of the same version of the gene, resulting in a diploid male. Such animals are usually destroyed by their brothers at the larval stage.

"This is a landmark event," says Gene Robinson, an entomologist at University of Illinois, Urbana-Champaign. "It opens the way to understanding honeybee biology at a much deeper level."

For instance, females probably mate with many males to ensure that they encounter partners with different *csd* genes and thus avoid producing useless diploid males. And attempts by bee-keepers to create pure-bred lines have probably failed because there is not enough *csd* diversity in the strains they create. In the future, it may be possible for breeders to screen stocks to ensure there is enough *csd* diversity to keep the bees fertile. Philip Cohen ●