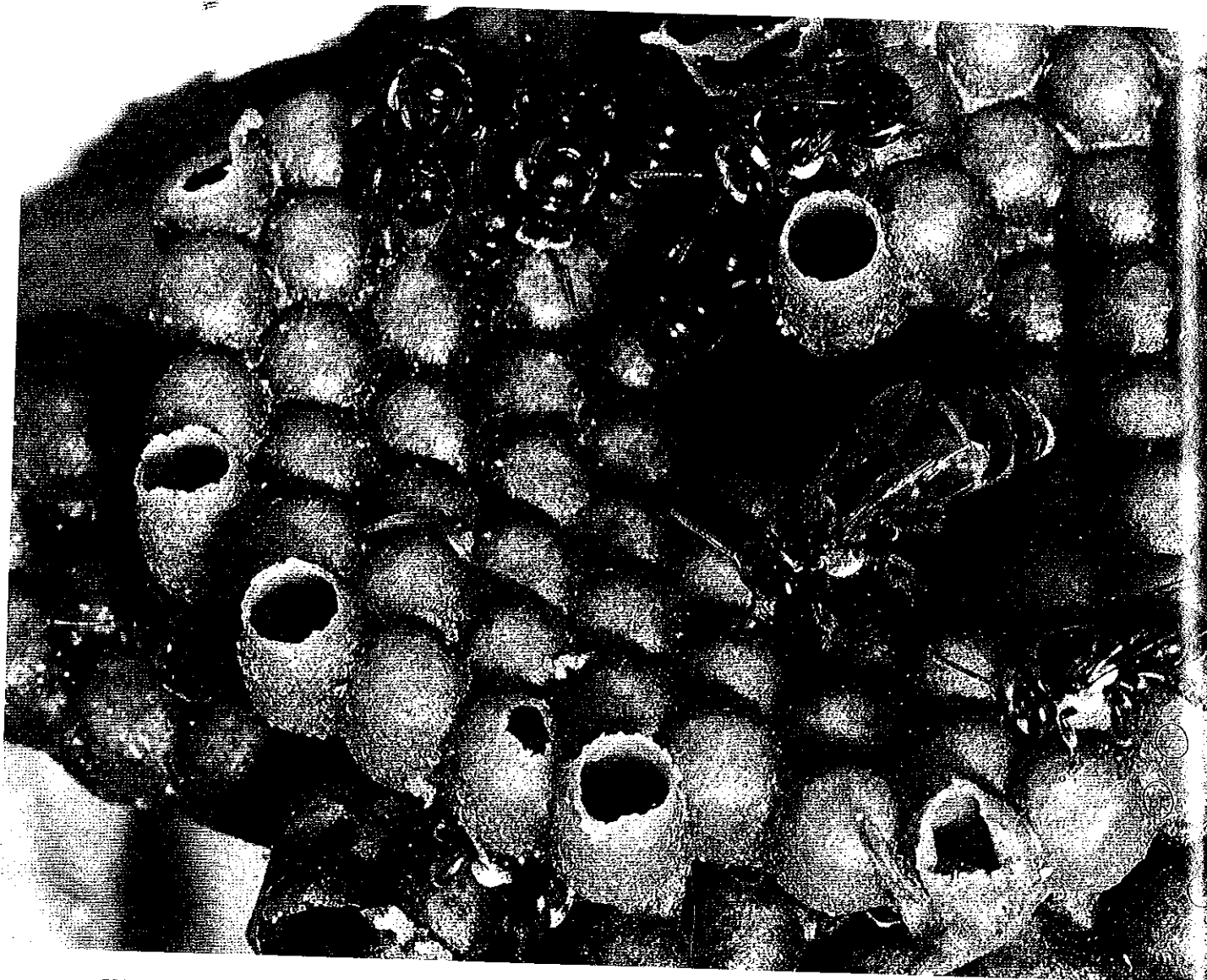


Stingless bees are also sometimes called sweat bees in the north because of their peculiar habit of collecting human sweat.

STINGLESS BEES

BY TIM HEARD

Austroplebeia australis honey pots contain white patches, which are all bubbles in the sealed pots. All bubbles in the honey pots of *Trigona carbonaria* are not visible because of their much thicker walls.



RIOR TO THE ARRIVAL OF European Honey Bees (*Apis mellifera*), the lives of Australian Aborigines were sweetened with honey extracted from nests of stingless bees (*Trigona* and *Austroplebeia* species).

Although often simply called 'native bees' (and 'sugarbag' by Aborigines), the common name of 'stingless bees' is preferred because it distinguishes them from the 1,600 other species of bees native to Australia. As the name suggests, their stings are vestigial and useless in defence. Stingless bees are also sometimes called sweat bees in the north because of their peculiar habit of collecting human sweat, which is presumably used as a source of minerals.

Unlike most of the world's 20,000 species of bees, stingless bees represent a peak of insect social organisation, rivalled only by ants, termites, some wasps and Honey Bees. Like these they exhibit cooperative brood care and have different castes—queens, workers (infertile females) and drones (males). Stingless bees are the only bee species native to Australia that are social and store pollen and honey (basically dehy-

drated nectar). The other species are solitary and use what nectar they collect immediately for food for themselves or for preparing provisions for a brood cell. In their search for nectar and pollen, stingless bees are important pollinators for many species of flowering plants. In this way they share the same ecological role as Honey Bees.

Stingless bees may be encountered in all tropical and subtropical parts of the world except isolated islands. Australia has about 14 species, although a taxonomic revision in progress may alter this figure. The poor state of our understanding is partly due to the similar appearance of most species, which are small (about four millimetres long) and black. Like Honey Bees they have enlarged areas on their back legs for carrying pollen back to the nest. These are known as corbiculae or pollen baskets. Their hind legs therefore appear wide and hang low when in flight.

Most Australian species are found in the tropical north, although two species, *T. carbonaria* and *A. australis*, are common in subtropical eastern Australia and have been observed as far south as Bega in southern New South Wales.

DESPITE THE SIMILARITIES IN SOCIAL behaviour between stingless bees and Honey Bees, there are major differences that have led biologists to believe that their societies evolved separately. Each may have evolved from a common ancestor like bumblebees, which represent an intermediate stage of social evolution.

The major differences between stingless bees and Honey Bees relate to their nest architecture and propagation, and the way they communicate food sources to fellow workers.

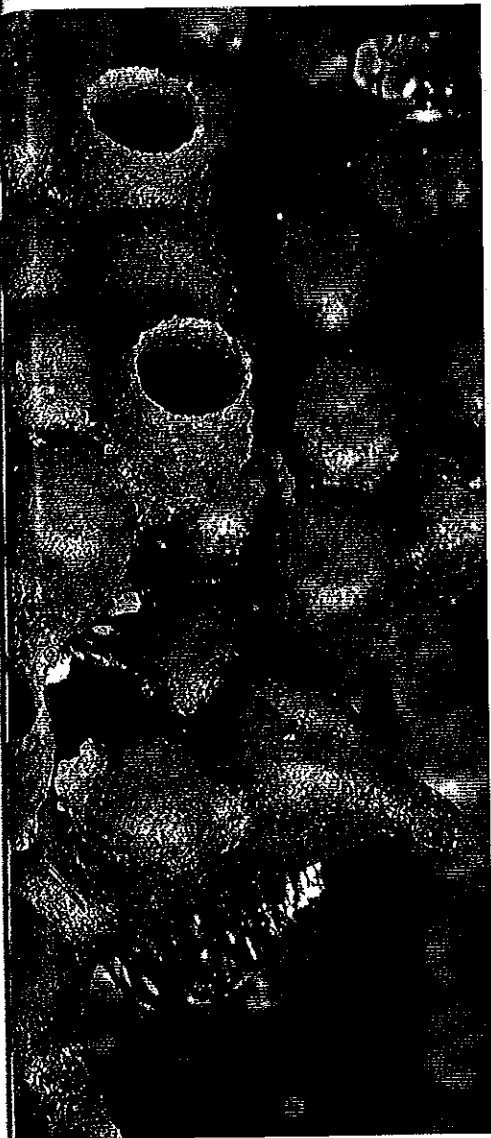
The structure of the nest of stingless bees is complex and unique. The inner sanctum of the nest consists of a brood chamber, a grouping of cells containing the immature bees, surrounded by an insulating waxen envelope. Unlike Honey Bees, which continually feed their larvae, larvae of stingless bees are mass provisioned. Each brood cell is stocked almost to the brim with honey, pollen and glandular secretions, an egg is laid in the cell by the queen and then the cell is closed. Complete larval and pupal development occurs in the closed cell. When the adult bee emerges from the cell, the cell is destroyed. It is thus used only once, unlike Honey Bee cells

A Trigona carbonaria queen patrols the comb.

The queens of highly social bees cannot live alone and new colonies are established by swarming. In Honey Bees the break is abrupt; a dense swarm of worker bees (known as a reproductive swarm) simply leaves the parent nest with the old queen, settles temporarily and starts looking for a new site. Immature queens are meanwhile developing in the parent nest and one of these will take over as the new queen. Stingless bee queens, on the other hand, are not transferred until the new nest has been fully prepared by workers. The reproductive swarms of stingless bees are therefore not as obvious as those of Honey Bees, and there is a lot of toing-and-froing between the old and new nests until the latter is ready. Furthermore, it is the new queen that makes the flight, with the old queen remaining in the parent nest.

Drones also swarm while waiting for the opportunity to mate with a new queen. These mating swarms occur around the old and new nests at the time the new queen makes her move. Mating usually takes place soon after the young queen has arrived at the new nest when she goes on a mating (nuptial) flight. Mating swarms also occur at established nests probably when the old queen has died and is being replaced by a young unmated one.

Another type of swarming occurs at *T. carbonaria* colonies, in which worker bees collide, grip onto each other, fall to the ground and fight to the death. This behaviour probably represents fighting between colonies. One such battle resulted in the death of 7,000 warriors, which I found in a tangled mass beneath the entrance to one of my hives. Although damaging to the populations of workers, the colonies nearly always recover from these scraps.



which are used many times. Surrounding the brood chamber are large egg-shaped pots of honey and pollen. This is in striking contrast to Honey Bee nests, with their vertical combs of regular hexagonal cells where brood, honey and pollen are all housed.

The nests of stingless bees may be useful in distinguishing species. For example, the presence of a projecting tube at the nest entrance of *A. australis* distinguishes it from *T. carbonaria* nests. The structure of the brood chamber of these two species also differs. The brood comb of *T. carbonaria* has a spiral arrangement, while that of *A. australis* forms a less organised cluster.

Stingless bee nests are made of cerumen, a material formed by mixing beeswax (a glandular secretion of worker bees) with propolis (resins of plant origin). Stingless bee workers may often be seen entering their nests carrying beads of clear resin in their pollen baskets. One northern Queensland species, *T. hockingsi*, has gained notoriety as a collector of wet paint, which it uses as a substitute for resin in nest construction. Honey Bees by contrast use pure wax for comb construction; they only rarely use resins.



A colony of *Trigona carbonaria* established in an artificial wooden hive. The two halves of the box have been separated for display. The brood comb is centrally placed in a spiral arrangement surrounded by a multi-layered waxen sheath. Surrounding this are the pots of honey and pollen.

JEFFREY WILLMER

At the entrance to the nests of *Austroplebeia australis* is a projecting tube. Two foragers laden with pollen are approaching the nest from the upper right, while two others have already made their landing. In contrast, the entrance of *Trigona carbonaria* does not have a tube but is flush with the surface of the tree.

ALL AUSTRALIAN SPECIES NEST IN hollow trunks and branches of trees or in rock crevices. They may also be encountered in wall cavities and sometimes more unusual situations, such as old garbage bins. Where the cavity they are occupying is too large, they isolate their nest with a thick layer of resin and wax.

With care, colonies of stingless bees may be relocated from natural sites into wooden hives, a good idea when the natural nest site is in danger from land clearing. On the Gold Coast of Queensland, Peter Davenport saves many colonies this way and has them available for sale. He also markets his honey and earns a premium price for this rare product.

If the hive is constructed with the correct design, the colony, once established, can be split to form two hives. As

STINGLESS BEES

Classification

Family Apidae (bees), subfamily Meliponinae (stingless bees), 21 genera worldwide, 2 genera and about 14 spp. (5 *Trigona*, 9 *Austroplebeia*) in Australia.

Identification

About 4 mm long, black body, covered in microscopic hairs, enlarged areas on hind legs for carrying pollen and resin. Fewer veins on the wings than most other bees.

Distribution and Habitat

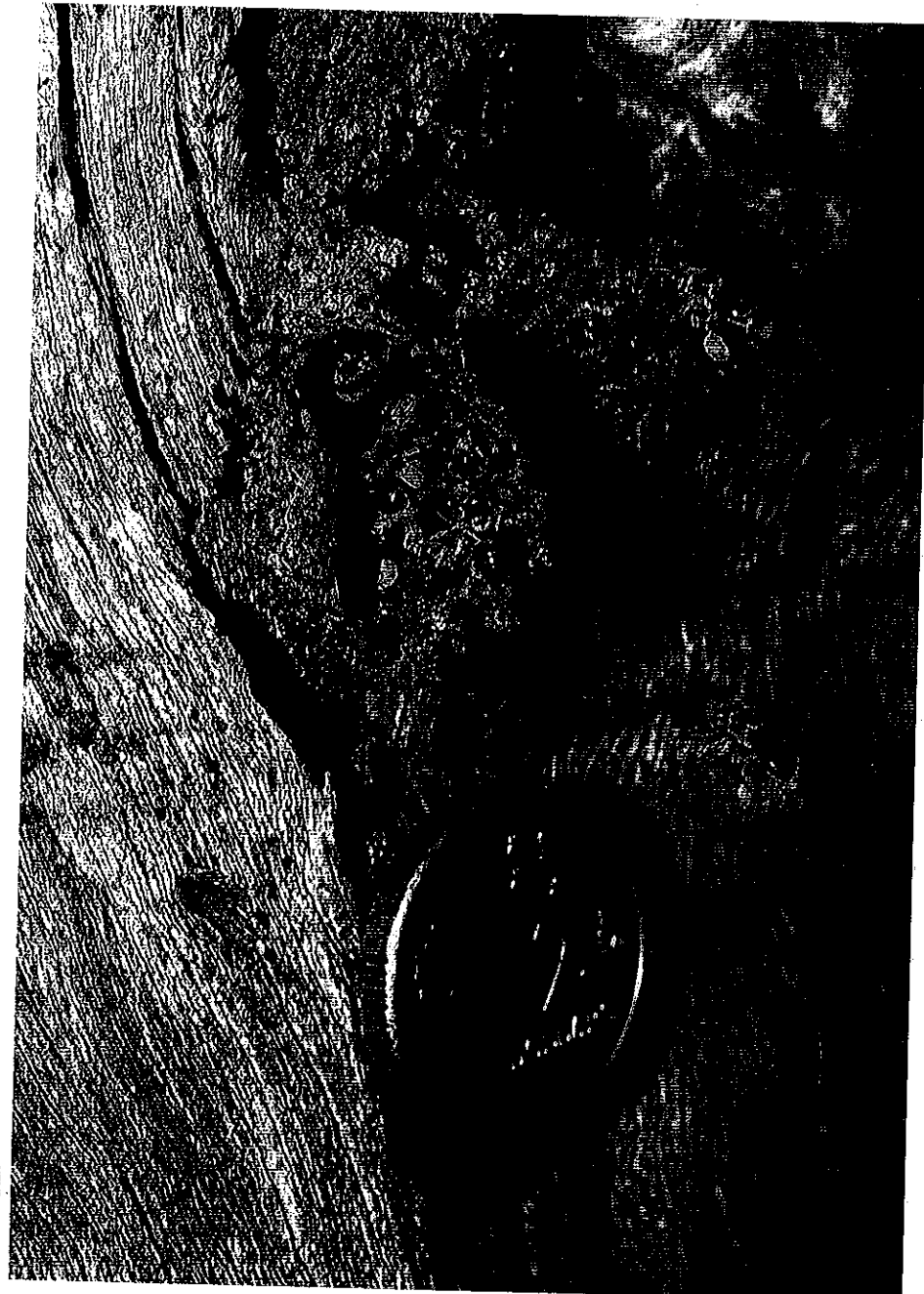
All tropical and subtropical parts of the world, except isolated islands. In Australia, they occur in the northern half, down the east coast to Bega and west coast to about the Hammersley Ranges. Most forest areas, including rainforest, eucalypt forest, mangroves, are suitable.

Biology

Highly social insects that live in large perennial colonies, nesting usually in tree cavities opening to the exterior through a small hole. Their social behaviour resembles Honey Bees in some respects, but is strikingly different in others.

Diet

Adults and young eat pollen and nectar, which they collect from flowers of both native and introduced species.



JEFFREY WILLMER

The dances of the Honey Bees, in which scout bees convey information regarding the direction and distance of flowers to hive mates, are well known. Stingless bees also direct nest mates to flowers, but by different means. Workers of some species merely jostle

they make zigzag runs and characteristic sounds that alert other bees to leave the nest and follow the trails. The method of recruitment is unknown for most Australian stingless bees, but for *T. carbonaria* it appears to involve the use of oral secretions.

The honey varies in quality depending on the species and the plants from which the nectar was collected.

other hive bees to alert them to the presence of a rich food source but do not convey information as to distance and direction. Workers of other species lay scent trails (pheromones) on the ground or vegetation between the food source and the nest. Upon return to the nest

Stingless bees are strong fliers. Although they are not able to reach the enormous ranges of Honey Bees, they can fly up to one kilometre. They will not fly any farther than they have to though; close resources are used in preference to ones farther away.

only one queen is present, the half that is queenless must make a new one. This is not usually a problem as a healthy hive continually produces new queens as witnessed by the presence of larger queen cells around the edge of the brood comb. The splitting process can be continued and eventually a large number of hives may be propagated from the original. The spiral brood architecture makes nest splitting straightforward for *T. carbonaria*, however no-one to my knowledge has successfully split hives of *A. australis*. Fortunately, nests of this latter species have been propagated by capturing reproductive swarms. In one case a swarm entered a nearby empty box and established itself there. In another case an empty box was positioned close by and the bees readily accepted it. Swarm capturing has never been performed for *T. carbonaria*.

The honey varies in quality depending on the species and the plants from which the nectar was collected. In general it is more liquid and more acidic than that of Honey Bees. Many people prefer the thicker, sweeter honey of *A. australis* to that of *T. carbonaria*. For both species it is aromatic from the plant resins used to build the pots in which the honey is stored. Usually less than 1.5 kilograms (one litre) of honey is produced by a hive in a year (compared to about 50 kilograms, or 75 litres, for a strong hive of Honey Bees). The structure of the nest also makes this honey difficult to extract. I prefer not to rob my hives of honey as the disruption to the nests slows down rates of colony growth. For me the value of these hives is more for conservation and pollination than honey production.

In summer, masses of small Cadagi (*Eucalyptus torrelliana*) seeds collect at the entrance of many *T. carbonaria* nests. Helen Wallace, while at the University of Queensland, discovered that the bees enter the gumnuts of this plant in search of resins. Seeds in the gumnut stick to the bees and are carried back to the nest, from which they are often discarded. Cadagi seedlings are commonly found at the base of the hives. This plant appears to have become adapted for seed dispersal by stingless bees, the first example of seed dispersal by bees ever found. A down side of this behaviour is that the species is rapidly being dispersed outside of its native range of northern Queensland. This efficient seed dispersal enhances the weed potential of this plant.

Stingless bees are thought to be important pollinators of many Australian native plants and also many of the exciting new fruits, nuts, spices, vegetables and oil seeds gaining popularity in Australia. They are proven pollinators of macadamias, which benefit from cross-pollination. Huge numbers of worker bees, however, are needed to pollinate large orchards. This requires leaving

extensive areas of adjacent forest. In areas where this vegetation has been removed, the bees need to be introduced. Now that the techniques to manage populations of stingless bees are available, we may see them joining the European Honey Bee as pollinators of macadamias and other crop plants. ■

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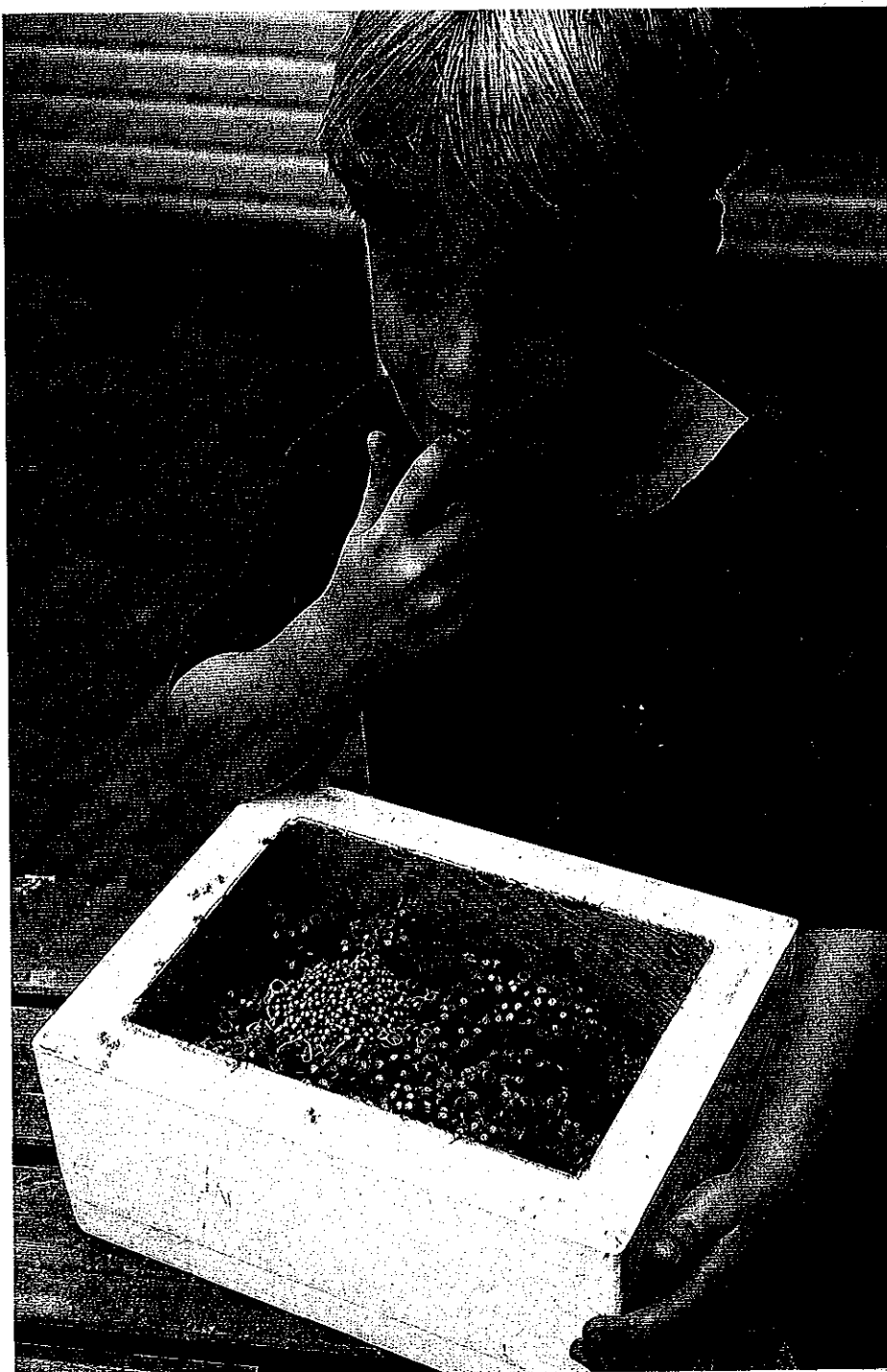
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Dr Tim Heard is an entomologist with CSIRO in Brisbane. His interest in stingless bees began in 1985 while researching insect pollination of nut crops. He continues to dabble with stingless bees in his spare time. A hive design, and the techniques for relocating and splitting stingless bee hives, may be obtained by writing to the author.

Stingless bee honey can be enjoyed without any fear of pain.



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