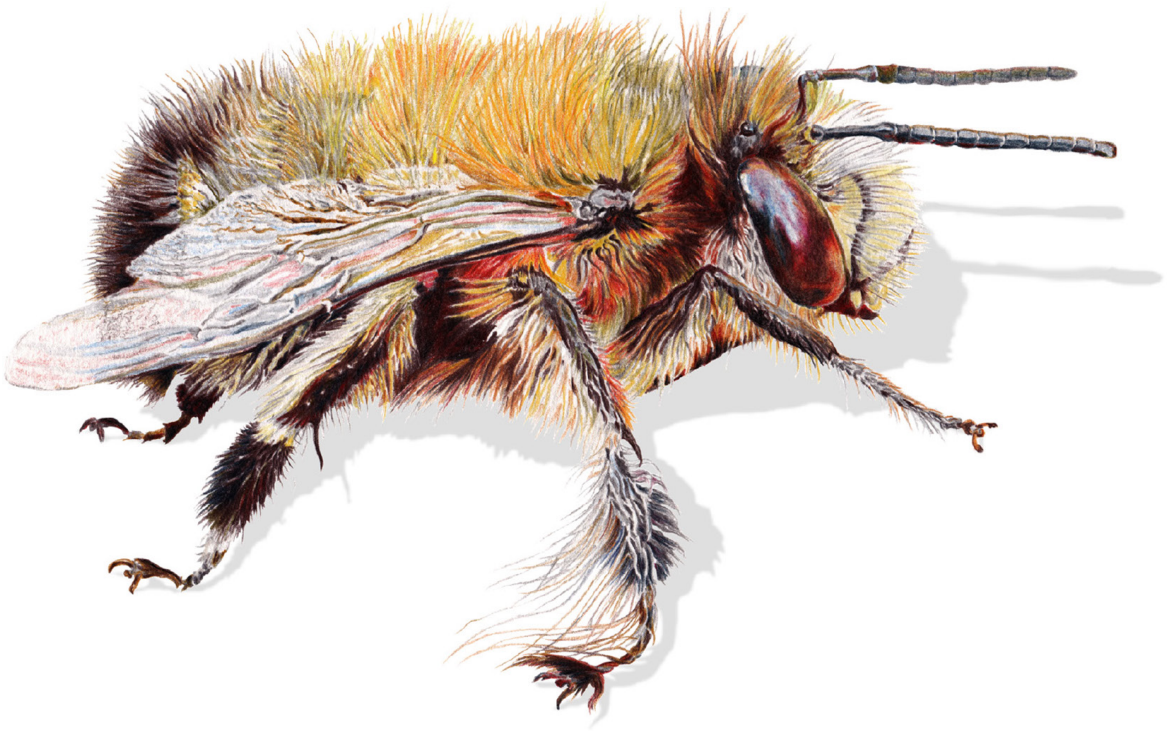


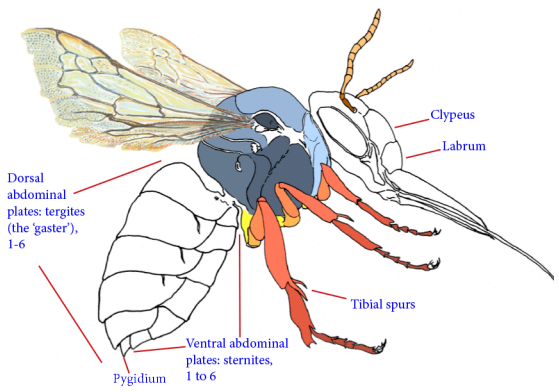
Hairy-foot long-tongue

Solitary bees, biodiversity & evolution in your backyard

David J Perkins

Two sample double spreads at reduced size:

BEE ANATOMY: external - internal



anti-clockwise around the thorax

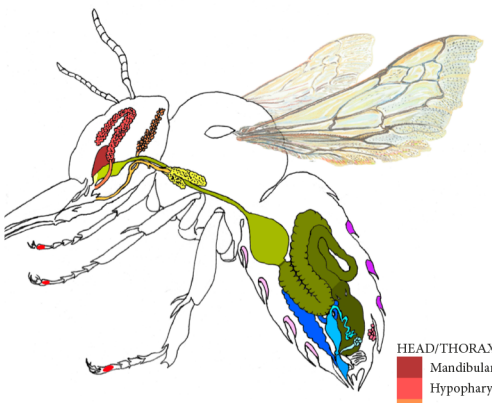
THORAX
Pronotum
Mesoscutum
Mesoscutellum
Metanotum
Propodeum
Episternum/ Mesepisternum
Tegula

ANTENNAE
Scape
Pedicel
Flagellum

LEGS
Coxa
Trochanter
Femur
Tibia
Basitarsus
Tarsus

Beneath the hairs of *Anthophora* is an **exoskeleton** that comprises a cuticle (composed of chitin) that is segmented and jointed. Chitin can be hardened to form the protective plates of the exoskeleton (tergites, sternites and other plates of the thorax) or the very tough mandibles, or it can be flexible and membranous to form links between plates. Hardened chitin is waterproof and often waxy on the outside, preventing loss of body fluids in dry conditions. The complexity of the exoskeleton is simplified above and is based upon *Anthophora*. The features shown are useful when thinking about the evolution and behaviour of bees. The thorax, for example, which is separated from the abdomen by the petiole, contains a segment – the **propodeum** – that in the ancestral insect was the first segment of the abdomen. The thoracic and abdominal plates are penetrated by openings – **spiracles** – that allow air to enter the respiratory system (p.15). In female *Anthophora* and other mining bees the sixth abdominal tergite is the **pygidium** (see p.46), which is used in nest-making to compact soil and spread waterproofing secretions.

'Fluffy - but tough'



Glandular secretions are crucial to bees. The generalised diagram above shows the glands and digestive system of bees. The development and function of the many glands in a bee's body vary across species according to their adaptations. In mining bees such as *Anthophora*, the Dufour's gland is large and its secretions are used to line underground nest cells, waterproofing the cell and discouraging bacterial and fungal growth. It is also nutrition for the larvae, which consume the lining (see p.53). In other species, Dufour's gland secretions are used for nest-site recognition. In social bees such as bumblebees or *Lasioglossum* species it is also used for nest-mate recognition and fertility signalling. In the highly social honeybee, the Dufour's gland is smaller and its secretion is one part of the queen's complex pheromone signal to the thousands of workers in the hive. Other glands such as the salivary and hypopharyngeal glands also have a range of functions across different species. Wax glands are only present in highly social honeybees, bumblebees and tropical stingless bees.

HEAD/THORAX GLANDS
Mandibular
Hypopharyngeal
Head salivary
Thoracic salivary
ABDOMINAL GLANDS
Koshevnikov
Venom gland
Venom sac
Sting bulb
Dufour's gland
Nasonov gland
Tergal glands
Sternal (wax) glands
TARSAL GLANDS
DIGESTIVE SYSTEM
Cibarium
Pharynx
Oesophagus/crop
Midgut
Intestine
Rectum

This introductory book explains bee biology and diversity complemented with beautiful drawings and photographs. It forms an essential companion to a field guide, an accessible and affordable alternative to a technical handbook.

The text is presented as themed double-page spreads covering all the major topics such as diversity, taxonomy, anatomy, behaviour, pollination, evolution and adaptation and the responses of bees to climate change. Bees that you may find in your garden, allotment or park are highlighted and the book is complemented with notes, references and reading recommendations if required. Hairy-foot, long-tongue has been designed to provide up-to-date research on the bees that are not honey- or bumble-, but represent the largest part of our bee fauna, in a beautifully illustrated, easily digested form that is a pleasure to look through as well as being informative.

One of our favourite solitary bees is the Hairy-footed flower bee *Anthophora plumipes*. One may ask "Why is the foot hairy?" and "Why is the tongue long?" This book answers these questions and many others and explores the complexities of solitary bee lives and their evolution. The book has over 250 photographs and over 150 drawings (in colour and pencil): the majority of the photographs, and all of the drawings, are by the author.

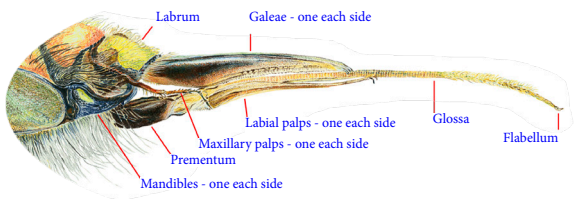
WHITTLES PUBLISHING

Print edition: £18.99;
978-184995-564-5; 240 x 170mm;
c. 200 pages; full of illustrations including over 250 photographs and scores of beautiful drawings, all in full colour. April 2024.
Softback.

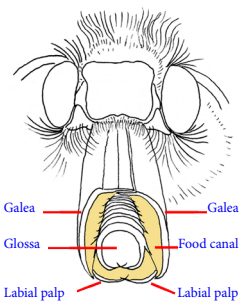
NECTAR AS FOOD

Nectar is a fluid produced by plants to lure flying pollinating insects. It is rich in a range of sugars, primarily sucrose though in some plants there will be glucose and fructose. Sugar concentration is generally 35–45% (but ranges from 7–70%). Nectar also contains small but important quantities of minerals, vitamins, organic acids and aromatic compounds. Some plants use caffeine in nectar to stimulate pollinators' memories, ensuring their return. Nectar is exuded from the nectaries, which are usually at the base of a flower so that the insect is drawn down past the pollen-bearing anthers.

The mouthparts of bees



The galeae and labial palps protect the bee's glossa and create an effective tube around it for collecting nectar. Nectar sticks to the hairs on the glossa and the spoon-like tip of the **flabellum**. Its many hairs enable capillary action to draw nectar between them and they expand the size of the glossa by up to 50%. They are also chemoreceptive hairs for detecting the nature of the nectar. The relative movements of the various mouthparts – the prementum, galeae, palps and glossa – bring the nectar up into the head in a cycle of loading, retraction and unloading. The part of the glossa projecting beyond the galeae is flexible and mobile. Watch *Anthophora* approaching a flower to feed and you will see the glossa exploring and preparing to enter and travel deep into the flower.

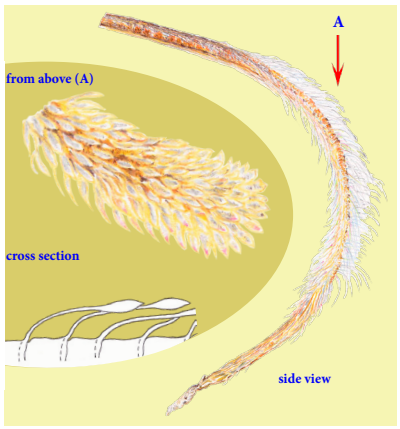


Solitary bees can refine nectar by 'blowing bubbles' to evaporate water.

Bumblebees make honey in small pots.

Sophisticated honeybees make loads of long-lasting anti-bacterial honey which is stored in their honeycomb.

Nectar is used directly as a source of energy (carbohydrate). Solitary bees mix it with pollen to make a rich 'cake' in the nest chamber for the growing larvae. Bumble and honeybees also feed it to larvae, but both store it separately from pollen in honey pots or honeycomb. However, nectar would easily grow bacteria and mould if the bee tried to store it straight from the flower, but if the mother bee can reduce the water content and raise the proportion of sugars, the nectar can be stored more safely for the young. If she also adds enzymes from her hypopharyngeal glands, sucrose in the nectar will be converted into fructose and glucose. These sugars are more soluble than sucrose and can increase the sugar concentration to over 80%. This refining of the nectar along with water evaporation makes the nectar a more valuable food that is resistant to bacteria and mould.



Left: close-up of the tip of *Anthophora's* glossa and flabellum showing the many tiny hairs that help to draw up nectar by flexing and filling with the sticky fluid.
Inset: hairs widen at their tips into a spatula form, improving nectar uptake.
Lower inset: diagrammatic cross-section showing rings of cuticle that make up the glossa, with strengthened rims from which the hairs arise. Between these the cuticle is membranous for flexibility and expansion.