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Biodiversity Record: Identity of a historical stingless bee nest entrance tube collected by H. N. Ridley from Pulau Ubin

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Subject: Nest entrance tube from a hive of the notch-toothed stingless bee, *Heterotrigona itama* (Insecta: Hymenoptera: Apidae)

Subject identified by: Zestin W.W. Soh, John S. Ascher, Chui Shao Xiong and John X. Q. Lee.

Location and date: Pulau Ubin, July 1898.

Habitat: Not recorded, but presumed to be coastal forest.

Observers: Specimen collected in 1898 by Henry Nicholas Ridley and deposited in the entomological collections of the Natural History Museum, London (United Kingdom). It was examined in 2016 by Zestin W. W. Soh.

Observation: The dried and preserved nest entrance tube of a stingless bee hive (Fig. 1) catalogued as BMNH(E) 650879, was examined. According to the specimen labels, the specimen is attributed to *Trigona collina*, formed of resin, and was found extending from a tree trunk within which the nest was built (Figs. 1A & B). The tube has a length of about 25 cm, and given its size, was likely to have been built over several years on a mature hive.

Remarks: Henry Nicholas Ridley was the first director of the Singapore Botanic Gardens, and is renowned as a prolific botanist (Holttum, 1957; Salisbury, 1957). In addition to his immense work on plants, Ridley took a keen interest in animal-plant relationships and contributed to the study of bee pollinators in Singapore (Salisbury, 1957; Soh, 2019). He collected specimens of various bees in the late 19th century, including a species that was later named after him, *Ceratina ridleyi* Cockerell (Cockerell, 1910; Soh & Ascher, 2020; Ascher et al. 2022). Ridley also collected the nests of stingless bees (tribe Meliponini) and carpenter bees (genus *Xylocopa*) in Singapore. With the rapid changes in the country's ecosystems over the last century (Corlett, 1992; Yee et al., 2011), the historical bee records by Ridley and other early collectors provide crucial insights for assessing the status of Singapore's native bee fauna (see Ascher et al, 2022).

The featured specimen was reported to have been constructed by the stingless bee *Trigona collina* Smith (1857) [presently *Tetragonula* (*Tetragonilla*) *collina* (see Engel et al., 2017)]. However, this species, known from Cambodia, China (Yunnan), Thailand, Laos, Vietnam, Peninsular Malaysia, Myanmar, Sumatra, and Borneo (Sakagami, 1975; Schwarz, 1939; Lee et al. 2016; Ascher and Pickering 2020; Li et al. 2021), has never been reported from Singapore. Did Ridley record an example of a stingless bee overlooked by other stingless bee specialists working in the region?

The architecture of nest entrance tubes constructed by stingless bees are diverse, and can be distinctive to the level of species and useful for identification (Roubik, 2006; Couvillon et al, 2008; Lima et al., 2013; Ndungu et al. 2019). Based on the tube's structure, colour and surface texture, we determine Ridley's specimen to have been built by the species *Heterotrigona* (*Heterotrigona*) *itama* (Cockerell, 1918), the only member of this subgenus known from Singapore. A similar and probably undescribed species with darker wings and more extensive hairs on the scutum occurs in Johor in southern Peninsular Malaysia and in the Riau Islands of Indonesia (unpublished data; see discussion of "variability in the obscuration of the wing" by Schwarz, 1939 and additional discussion by Sakagami, 1975). *Heterotrigona itama* generally construct a relatively large, smooth, amber yellow tube that often flares irregularly at its tip (Fig. 2A). It occurs in mature

forest sites across Singapore, including Pulau Ubin, where it has recently been recorded during the Comprehensive Ubin Biodiversity Survey organised by the National Parks Board (Fig. 2B, Soh & Ascher, 2020; Ascher et al. 2022). In contrast, *Tetragonula collina* generally builds a brown, thin cylinder with a more textured surface and no flaring at the tip (Roubik, 2006; Jongjitvimol & Wattanachaiyingcharoen, 2007; Lee et al. 2016; Fig. 3A & B). The location that Ridley found the tube, a tree trunk, is also suggestive of *Heterotrigona itama* as this species invariably constructs nests in tree cavities, whereas *Tetragonula collina* predominantly builds subterranean nests with entrance tubes often protruding from the base of trees rather than from the tree trunk (Eltz, 2003; Jongjitvimol & Wattanachaiyingcharoen, 2007; Kelly et al. 2014).

The featured specimen is notable as one of few historical records available for any bee species on Pulau Ubin (Ascher et al., unpublished data), and is also the earliest of the few historical records of *Heterotrigona itama* from Singapore. The type specimen of this species was collected by C. F. Baker in "Singapore", likely during 1917-1918 (see Ascher et al., 2019; 2022), and Schwarz (1939) noted records only for Bukit Timah on 11 July 1911, and Mandai on 29 December 1922.

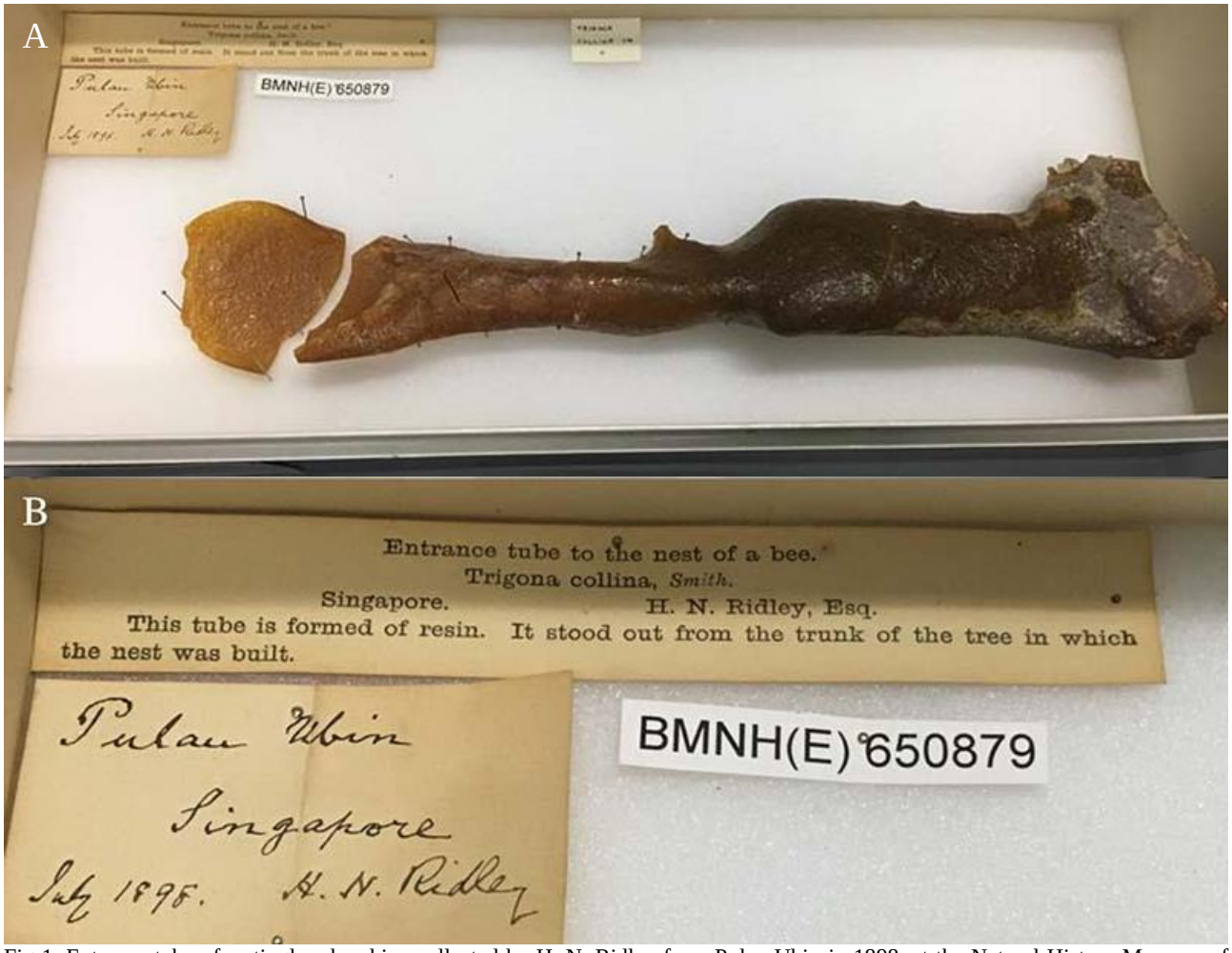

Fig 1. Entrance tube of a stingless bee hive collected by H. N. Ridley from Pulau Ubin in 1898, at the Natural History Museum of London. A) Lateral view of the tube with labels; B) close-up view of the labels and catalogue number. (Photographs by: Zestin W. W. Soh)

Finally, we comment on the taxonomy of *Trigona fuscibasis* Cockerell (1920), which has variously been treated as a variety of *Trigona collina* (Schwarz, 1939; Sakagami, 1975), or at least tentatively as a distinct species (Sakagami et al., 1990; Rasmussen et al., 2008; Engel et al., 2017). The leftmost individual on the nest entrance tube in Fig. 3A shows the red tegulae characteristic of *Trigona fuscibasis*, but – as noted by Schwarz (1939), and as can be seen from this photo (the lower individual from the same nest has darker tegulae) – Sundaic populations of *Trigona collina* sensu lato 'incline to testaceous in varying degree' and this colour difference, detectable even within nestmates, does not appear to be a reliable diagnostic character. Schwarz stated that, 'it is probable that *fuscibasis* instead of being a variety of *collina* is merely the callow stage of that insect' but our observations of variation in tegular colour among workers at the nest entrance and foraging on flowers suggests that the variation is not determined by the age of the bees. We tentatively consider *Trigona fuscibasis* to be a junior synonym of *Trigona collina*, but further studies involving molecular diagnostics are needed to resolve the status for this and various other Southeast Asian stingless bee taxa.

Fig. 2. Nest and worker of *Heterotrigona itama*. A: entrance tube from a nest in Negeri Sembilan, Malaysia; B: worker foraging from a flower of *Mimusops elengi* (Sapotaceae) on Pulau Ubin, Singapore.
(Photographs by: Zestin W. W. Soh)

Fig. 3. Nest of *Tetragonula* (*Tetragonilla*) *collina* sensu lato from Ulu Temburong National Park, Brunei. A: close up of the nest entrance tube with worker bees; B: entire nest entrance tube.
(Photographs by: Zestin W. W. Soh)

Note: The authors are grateful to Dr David Notton for kindly facilitating the first author's visits to the Natural History Museum, London (United Kingdom) in 2016, and allowing examination and photography of the featured specimen.

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