AN INQUIRY INTO THE SYSTEMATICS OF THE TRIBUS *APIDINI* OR HONEYBEES (Hym.)

by

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"All the forms resemble,
Yet none is the same as another;
Thus the whole of the throng
Points at a deep hidden law."
J. W. GOETHE

Contents

I. INTRODUCTION

In spite of their comparatively small size, the honey- or hive-bees have aroused universal interest as far back as to prehistoric times. We find them figured on Egyptian monuments (3500 B.C.) and mentioned much more frequently than any other insects in the writings of numerous ancient poets, philosophers, etc. They form the subject of folklores of nearly every country and the center of innumerable myths and superstitions. In later centuries, their importance as honey- or wax-producers, plant-pollinators, etc. becomes more and more significant. As a combined result of the factors — familiarity and economics — the literature on these creatures is exceedingly scattered and voluminous. For instance, even 60 years ago, it was already known that not less than 2300 papers on the single species *Apis mellifera* had appeared (DE KELLER, 1881), and the bibliography of honeybees and bee-keeping, compiled years ago by the U.S. Bureau of Entomology, contained not far from 30.000 titles. One could, however,

hardly expect that we know everything there is to be known regarding honeybees. An enormous number of new treatises on them are being continuously streaming out, either in book-form or as longer or shorter articles in various technical or popular serials. There also exist about 300 distinct "bee journals" which have been active at one time or another (WILSON, 1927). Under such circumstances, an exhaustive critical survey of the literature will be scarcely attainable. In the present paper, no attempt is made to give a complete bibliography for each species and subspecies, not only to save time and space, but also because the probabilities of misidentifications and misconceptions by earlier authors render the published data of very doubtful value. The annotated bibliography of the tribus (Chapter XI) will only include the more important works relating to the systematics of the honeybee and will be arranged chronologically to enable us in tracing out the historical trends.

The major difficulties in re-classifying honeybees are the disappointing quality of the existing descriptions, the superabundant published "names" and the inaccessibility of type-specimens. The last are scattered over about 17 museums and several private collections. Many of them are no longer existing or traceable. Even when being located and definitely authenticated, they are usually unavailable to students and it is often impossible to dissect out certain structures and undertake critical re-examinations. Nevertheless, we must admit that the type is the last recourse to clarifying nomenclatural status. The only possible approach to an appropriate interpretation of previous descriptions is to utilize topotypical material for the preparation of more definite redescriptions so as to prevent further confusions. Such a procedure might run risk of misinterpretation only when the type-locality as given in the original description would be incorrect or too vague. In the present paper, all the known species will be reviewed in this way wherever adequate material is procurable.

But for a few exceptions and extensions, the terminology employed in the present paper will be adopted from MICHENER (1944). The venational notations (fig. 11) are according to the Tillyardian system (1926). As to the numbering of abdominal segments the usual practice will be followed, that is, the propodeum or the true first segment will be regarded as part of the thorax, the true second segment as segment I, and so on. The orientation of appendages will be in accordance with the practice followed by some dipterologists, i.e. the paired appendages are supposed to be fully stretched out horizontally, each being held in a position perpendicular to the hypothetical longitudinal axis of an insect so that the external feature

of an appendage can be divided — besides the basal and apical — into dorsal, ventral, anterior and posterior surfaces. The head will be considered to be of the prognathous type. The breadth of thorax will be measured so as to include both tegulae; the same of abdomen, for the maximum under natural condition, either at segment I or II; and the relative lengths and breadths, at the magnification of 26 x. Further explanations of the terminology employed will be given in Chapter IV (on diagnostic characters). The illustrations are camera lucida drawings from slides; those of the wings are traced out from a micro-projector.

The preparation of the present paper was started about fifteen years ago. Since that time, during intervals occupied by other duties, these insects have received a greater or less degree of attention by the writer. The manuscript once started has since been rewritten and extended several times. During the course of the study, the writer has received very kind and sympathetic assistance and encouragement unsparingly given by many colleagues. The one especially to be mentioned is Dr M. A. LIEFTINCK (Bogor, Java) for supplying invaluable material and information and for extending many other courtesies. The writer is also indebted to Prof. Dr A. S. SKORÍKOV (Leningrad) for the gift of some bibliographical rarities; Dr J. VAN DER VECHT (Bogor, Java), Dr E. S. ROSS (San Francisco, Calif.), Dr H. F. SCHWARZ (New York, N.Y.), Dr H. C. BLÖTE (Leiden), G. A. MAVROMOUSTAKIS (Limassol, Cyprus), Dr C. D. MICHENER (Lawrence, Kansas), Prof. W. E. HOFFMANN (formerly of Washington, D.C.), the Reverend Père A. DE COOMAN (Paris) and Dr DHIA D. AHMED (Baghdad) for some rare specimens; Prof. Dr O. SCHRÖDER (Kiel) and Dr S. L. TUXEN (Copenhagen) for informations about Fabrician types; Dr C. F. W. MUESEBECK and Mr K. V. KROMBEIN (both of Washington, D.C.) for information about POLLMANN's work; and Messrs S. C. CHIU and K. S. LIN for assistances in making microscopical preparations and drawings.

II. CASTE POLYMORPHISM

The distinction of the 3 castes (♂, ♀, ☿) of honeybees has long been well recognized, even by ancients. So many important additions to our knowledge of this phenomenon were contributed by numerous recent investigators that it seems sufficient to enumerate only the more important or interesting features, and those not mentioned in the forthcoming tribal and generic descriptions (Chapters V and VI).

Size. — Usually longest in ♀, most robust in ♂ and smallest in ☿.

Colour. — Usually palest in ♂, particularly wings, antennae and legs; darkest in ♀, particularly abdomen.

Pubescence. — Much thicker and longer in ♂, especially on face, thorax, coxae, trochanters and abdominal apex.

Head. — In "facial" aspect, if including labrum and mandibles, somewhat ovo-rhomboidal in ☿; slightly shorter and laterally more rounded in ♀; large and nearly circular in ♂. Face slightly longer than broad in ☿ (*ca.* 18 : 15, length measured from vertex to anterior clypeal margin), or ♀ (*ca.* 17 : 15), very markedly so in ♂ (*ca.* 18 : 11).

Eyes. — Each eye consists of 3000—4000 facets in ☿, 3000—5000 in ♀, and 7000—8000 in ♂.

Ocelli. — Largest and most prominent in ♂; ocello-antennal distance about 1.5 times as long as scape in ☿ or ♀, subequal in length to scape in ♂.

Antennae. — Thinner, longer and 12-segmented in ☿ or ♀; thicker, shorter and 13-segmented in ♂. Length of scape *vs* that of antenna *in toto* about 1 : 5 in ☿ or ♀, 1 : 3 in ♂. Sense plates (of *Apis mellifera*) numbering about 5000—6000 in ☿, 2000—3000 in ♀ and 30.000 in ♂ (*vide* VOGEL, 1923).

Labrum. — With simple hairs in ☿ or ♀, less strongly developed and with branched hairs in ♂.

Mandibles. — Largest in ♀, smallest in ♂; "ventral" surfaces strongly hollowed out and keeled in ☿, slightly so in ♀, not perceptibly so in ♂; rows of long, curled hairs along "ventral" keels present in ☿, rudimentary or entirely wanting in ♀ or ♂. Mandibular glands largest in ♀, smallest in ♂ (SNODGRASS, 1925).

"Tongue". — Longest in ☿, shortest in ♂.

Endoskeleton. — Internal median ridge of vertex wanting in ☿ or ♀, present in ♂.

Pharyngeal glands. — Well developed in ☿, rudimentary in ♀, entirely wanting in ♂.

Brain. — Smallest in ♀, slightly larger in ☿, much larger (especially optical lobes) in ♂ (JONESCU, 1909).

Wings. — Shortest in ♀ and longest in ♂; hind wings in ☿ or ♀ normal, in ♂ strongly amplified. Hamuli (of *A. mellifera*) 15 - 27 in ☿, 13 - 23 in ♀, and 13 - 29 in ♂ (BACHMETJEW, 1909).

Legs III. — Tibiae and basitarsi shortest and most strongly compressed in ☿, much longer in ♀ or ♂ and most weakly compressed in ♂.

Tarsal claws. — Smallest in ☿, largest in ♂; apical and subapical teeth broadest in ♀, well separated from each other in ☿ or ♀, and narrowest and scarcely separated in ♂; "dorsal" margins in profile in ☿ or ♀ very weakly angulated near the midpoint, in ♂ distinctly so, about at an angle of 100°.

Abdomen. — Longest in ♀, shortest in ♂; apex subconical in ☿ or ♀, subrotundate in ♂; with 6 externally visible segments (excluding pro-

podeum) in ☿ or ♀, 7 in ♂; tergum I longest in ♀ and shortest in ♂; sternal apodemes short in ☿ or ♀, very long in ♂; postglandular areas II - V relatively short and posteriorly rather deeply emarginated in ☿, longest and posteriorly scarcely emarginated or even slightly convexly curved in ♀, shortest and with 2 strongly produced postero-lateral lobes in ♂.

Sting. — Shorter in ☿. Both rami of valvulae and lancets straight in ☿, bent ventralwards beyond bulb in ♀; lancets each bearing about 10 barbs in ☿, 3 - 5 in ♀. Hemitergites VIII smaller and more loosely attached to valvular rami in ☿. Poison glands more fully developed and ducts shorter in ♀ than in ☿.

For the convenience of beginners, a key for the separation of the three castes is given below.

Key to the castes

1. Eyes meeting each other on vertex; antennae 13 segmented; abdomen externally 7 segmented, posteriorly subrotundate, terga II and V thickly covered with long, erect hairs, which are markedly longer than those on remaining terga; hind wings almost as broad as fore ones . . . . . **drone** or **male** (♂)
— Eyes widely separated from each other on vertex; antennae 12 segmented; abdomen externally 6 segmented, posteriorly subconical, bluntly pointed, terga II and V almost naked, at most with short, decumbent hairs which are practically of the same length as those on remaining terga; hind wings much narrower than fore ones . . 2
2. Mandibles simple; tibiae and basitarsi III very strongly compressed and dilated, corbiculae and scopae present, auricles well developed; head not or scarcely narrower than thorax . . . . . **worker** or **degenerated female** (☿)
— Mandibles bidentate; tibiae and basitarsi III scarcely compressed or dilated, corbiculae and scopae absent, auricles very poorly developed; head distinctly narrower than thorax . . . . . **queen** or "true" **female** (♀)

References on caste polymorphism cited:

BACHMETJEW, P. 1909. Zts. Wiss. Zool., Leipzig 94: 1-80.
JONESCU, C. N. 1909. Jenaische Zts. Naturw. 45: 111-180, pls. 10-14.
SNODGRASS, R. E. 1925. Anatomy and Physiology of the Honeybee. New York. 9 + 327 pp., 108 figs.
VOGEL, R. 1923. Zts. wiss. Zool., Leipzig 120: 281-324, 17 figs.
ZANDER, E. 1911. Der Bau der Biene (Handbuch der Bienenkunde, III). Stuttgart. 182 pp., 20 pls., 149 text-figs.

III. INTRASPECIFIC VARIATIONS

The variability of the various honeybee organs follows, to a more or less extent, their acclimatization and domestication and has attracted much attention of many investigators, most notably V. V. ALPATOV, A. S. MICHAILOV, E. F. PHILLIPS, A. S. SKORIKOV, etc. However, the material used in their intensive studies was practically confined to the common European species, *Apis mellifera mellifera*. Among the Oriental representatives, *A. cerana* has been investigated by TOKUTA (1924), KELLOGG (1923-36), and MAA *et al.* (1947). The following discussions on dimensional and venational variations will be devoted exclusively to the latter species, since it is too little known to Westerners.

(A) DIMENSIONAL VARIATION

The dimensional variations of *Apis cerana* may be summarized as in the following table (L. = Length; B. = Breadth). Besides this species, KELLOGG (1936) has investigated the tongue length of *A. mellifera mellifera* from Harbin, Manchuria; and MAA *et al.*, the dimensional variations of *Megapis dorsata* and *Micrapis florea*, both from India.

Table 1. Dimensional Variations of *Apis cerana* FABR.

	Material	Investigator	Range of Variation	Mean
L. Body[1]) (mm)	41 ♀	KELLOGG, 1936	10.5-13.0	12.010 ± 0.0834
Wing expanse (mm)	32 ♀	KELLOGG, 1929	20-22	20.800 ±
L. Mentum (mm)	206 ♀	KELLOGG, 1936	0.147-0.322	0.247 ±
L. Prementum (mm)	206 ♀	—	1.348-1.729	1.501 ±
L. Glossa (mm)	206 ♀	—	2.901-3.662	3.253 ±
Cubital Index	644 ♀	MAA *et al.*, 1947	0.200-0.600	0.353 ± 0.0642
„ „	1503 ♀		0.100-0.460	0.210 ± 0.0430
L. Cell *2m* (mm)	644 ♀		0.675-1.575	0.815 ± 0.0557
„	1504 ♀		0.563-0.855	0.696 ± 0.0403
L. Apical portion of cell *2m* (mm)	200 ♀	—	0.090-0.180	0.120 ± 0.0207
L. Tibia III (mm)	254 ♀	—	2.700-3.105	2.962 ± 0.0756
L. Basitarsus III (mm)	254 ♀	—	1.755-2.115	1.941 ± 0.0653
B. Basitarsus III (mm)	254 ♀	—	0.990-1.215	1.085 ± 0.0456

(B) VENATIONAL VARIATION

The following is quoted from the conclusion reached by MAA *et al.* (1947): "Of the 1,493 fore wings of *A. cerana* ♀♀ studied, 34% are asym-

[1]) Measured from freshly killed material.

metrical in venation. The cross-veins often tend to angulate near the distal end, therefrom each may produce into a short, poorly or well defined branch. Among the various veins and cells, the appendiculate cell (*ap*) ranks the 1st in liability to anomaly, whereas veins im_3 and im_2 rank the 2nd and 3rd, respectively. The venation of the ♂ appears to be less variable than that of the ☿."

(C) PIGMENTAL VARIATION

As is generally known, an adult ♀ honeybee may live four years, and a ☿, on the average, about six weeks. Thus, even during the life time of their adult stage, the integumental pigmentation may vary according to age, and is therefore never constant. On the other hand, the pigmentation of museum specimens changes in compliance with the nature of killing-agent and the condition of preservation (nature of preservative, temperature, light, etc.). A purely artificial pattern may result from postmortem decomposition and drying. MAA *et al.* (1947) have made a rather intensive survey in the colour variation of clypeus, malar areas, labrum, mandibles, scutellum and abdominal terga of *A. cerana*. In all the cases concerned, they found each might be arbitrarily subdivided into several transitions, none of which however could be considered as absolutely "predominant".

Albinism is also known in honeybees, more commonly in the ♂ caste. The heritable dominance and recessiveness of certain pigmental characters in these insects have been investigated by NEWELL (1915), MUNRO (1925), WATSON (1927), MICHAILOV (1930-31), NOLAN (1937) and others.

(D) GEOGRAPHICAL VARIATION

KELLOGG (1929) noted the "tongue" of *Apis cerana* from Foochow, South China (105 ☿) was longer than that from Soochow, East China (47 ☿), *viz.*, 4.78 mm ± 0.0116 *vs.* 4.70 mm ± 0.0256. MAA *et al.* (1947), on the other hand, found the cubital index of subalpine ♂ (541 ex.) of the same species to be higher than in those from neighbouring lowland (28 ex.), 0.373 *vs.* 0.350; but *vice versa* in ☿ caste, 0.200 *vs.* 0.212. The same index of ☿ from Darjeeling, East Himalayas (75 ex.) was found to be higher on the average than those from China proper (1503 ex.), 0.233 *vs.* 0.210.

Among the races of *A. mellifera mellifera* occurring in Russian steppe, the northerners have notably longer tongues than southerners. MICHAILOV (1926) is credited with bringing out a very interesting phenomenon of the linear correlation of tongue length and geographical latitude. The gradations of tongue lengths were found to be in close parallel with the latitudes. For instance, at Leningrad, it is 5.73 mm; Moscow, 6.12; mouth

of the Volga River, 6.50, and so on. This linear correlation, however, appears to be only true for races existing in great plains, such as the vast Yellow River basin or Siberian steppe, but not so for those in topographically complicated regions.

(E) MATERNAL VARIATION

The ovaries of worker honeybees are ordinarily rudimentary, but under certain circumstances they do produce mature eggs, which usually turn out to be parthenogenetic males [1]). To the writer's knowledge, the structural and dimensional differences of the males produced by queens and by workers have been little noticed by earlier authors. In the bee-collection of the Taiwan Agricultural Research Institute, there is a series of ♂ *Apis mellifera mellifera* which were labelled, most probably by M. INAMURA, as having been born by workers instead of queens. They differ from "normal" males in certain respects: Size much smaller, for instance, length of fore wing only 10—11 mm, in normal ♂, 11.5—12.5 mm; breadth of head (x 26) 106 mm *vs.* 120 mm; minimum breadth of abdominal sternum II (x 26) 90—95 mm *vs.* 103—107 mm; baso-"dorsal" corners of basitarsi III more weakly curved; antecosta of abdominal sternum II scarcely thicker than that of any of the following sterna; and so on.

References on intraspecific variations (excluding those on monstrosity) cited:

KELLOGG, C. R. 1929. Lingnan Sci. J., Canton 7: 613-623, 6 tables.
KELLOGG, C. R. 1936. Arch. Bienenk., Berlin 17 (1): 36-38.
MAA, T. & G. C. SHAO. 1947. Taiwan Agric. Res. Inst., Taipeh, Bull. 6: 23-49, 7 pls.
MICHAILOV, A. S. 1926. Arch. Bienenk., Berlin 7 (1): 28-33.
MICHAILOV, A. S. 1930. Opit. Paseka, Tula 1930: 215-228, figs.
MICHAILOV, A. S. 1931. Zts. indukt. Abstamm. & Vererbungslehre, Leipzig 59: 190-202.
MUNRO, J. A. 1925. Amer. Bee J., Hamilton, III. 65: 337-338.
NEWELL, W. 1915. Science, Cambridge, Mass. (n. s.) 41: 218-219.
NOLAN, W. J. 1937. U. S. Dept. Agric., Washington, D.C. YB. Agric. 1937: 1396-1418, 9 figs.
TOKUTA, Y. 1924. Tr. Sapporo N. Hist. Soc. 9: 1-27, 2 pls.
WATSON, L. R. 1927. Iowa State Apiarist Rept., Ames 1927: 36-41.

(F) MONSTROSITY

Gynandromorphic honeybees were first noted by LAUBENDER (1881), but the most important and interesting paper on this subject, so far appeared, is the one by ENGELHARDT (1913). The latter author not only exemplified

[1]) For the parthenogenesis of ♀ honeybees, reference may be made to a very interesting paper by R. W. JACK (1916. Tr. ent. Soc. London 1916: 396-403, pls. 105-106.

a number of sagittal, transversal, frontal and mosaic gynandromorphs, but also worked out their abnormal internal reproductive organs. On the other hand, MORGAN (1905-09) and ROSCH (1928) attempted to interpret their origin, and ENDERLEIN [1]) compiled a bibliography including 15 titles. A supplement to this bibliography follows:

1913. ENGELHARDT. Russ. pcelovod. list, Moscow 28: 125-129, 161-164, 199-203, 241-245, 272-277.
1913. ENGELHARDT. Zts. wiss. Ins-Biol., Berlin 10: 161-167, 215-222, 9 figs.
1914. KOJEWNIKOW. Congr. intern. Zool., Monaco 9: 743.
1915. MEHLING. Verh. phys. med. Ges. Würzburg, N. F. 43: 172-176.
1915. BOVERI. Arch. Entwickl. mech. Organ., Leipzig 41: 264-311, pls. 7-8.
1916. MORGAN. Amer. Naturalist, Boston 50: 39-45.
1921. BETTS. Bee World, Boston 2: 156.
1921. ZANDER. Handb. Bienenkunde (2nd Edit.) 2: 46.
1923. KOSCHEVNIKOV. Biol. Mitt. Timiriazeff, Moscow 1923 (1): 1-7.
1924. STÖCKHERT. Arch. Natg., Berlin A 90 (2): 109-151.
1926. ROSCH. SB. Ges. Morph. Physiol., Munich 37:
1928. ROSCH. Verh. deuts. zool. Ges., Leipzig 32: 219-226, 2 tables.
1934. ECKERT. J. econ. Ent., Geneva, N. Y. 27: 1079-1082, 2 figs.
1934. ANKEL. Natur u. Volk, Senckenberg 64: 61-72, 108-117, 7 figs.
1937. ECKERT. Ann. ent. Soc. Amer., Columbus, Ohio 39: 64-66.

It appears that gynandromorphic honeybees are not so rare as generally conceived. They are easily overlooked due to the following facts: (a) these structurally or functionally abnormal individuals are probably driven out of the hive immediately on disclosure by their sisters; (b) frontal or mosaic gynandromorphs are by no means as conspicuous as sagittal or transversal ones; and (c) sex-distribution in mesoderm may differ from that in ectoderm, accordingly, external examination does not necessarily clearly indicate internal gynandromorphism. The commonest feature of honeybee monstrosities, other than gynandromorphism, is the so-called "cyclopic" bee, which possesses but a single compound eye occupying the vertex of head. Further teratological examples have also been recorded, *viz,* absence of one or both antennae or mandibles, absence of ocelli, malformation of certain flagellar or tarsal segments, etc. Anomalies caused by parasitism are unknown in honeybees. The more important references on honeybee teratology are given below:

1865. LUCAS. Bull. Séances Soc. ent. France 1865: 99. (Young ♀ with eyes completely coalescent).
1886. CHESHIRE. Beekeeping, Scient. & Pract. 1: 117. (♂ without eyes and ocelli).
1912. NELSON. Proc. Acad. nat. Sci. Philadelphia 64: 3-5. (Abnormal ♀).

[1]) ENDERLEIN, G. 1913: Ein hervorragender Zwitter von *Xylocopa mendozana* aus Argentina, mit einem Verzeichnis aller beobachteten gynandromorphen Hymenopteren. Stett. Ent. Ztg., 74: 124-170, 1 pl.

1918. NELSON. Proc. ent. Soc. Washington 20: 105-107, pl. 8. (♂ without eyes).
1926. COCKAYNE. Tr. ent. Soc. London 1925: 401. (♂ with malformed tarsi).
1927. CAPPE DE BAILLON. Encyc. ent., Paris A 8: 1-291, 9 pls., 85 text-figs. (Monograph of insect teratology).
1931. ALFONSUS. Ann. ent. Soc. Amer., Columbus, Ohio 24: 405-406, 1 pl. (♀ without ocelli, but 1 eye).
1936. LOTMAR. Rev. Suisse Zool., Geneva 43: 51-72, 32 figs. (Anatomy of "cyclopic" bees).
1937. RICHARDS *et al.* J. N. York ent. Soc. 45: 1-60, 149-210. (Review of literature on insect teratology).
1937. ECKERT. Ann. ent. Soc. Amer., Columbus, Ohio 30: 66-68, pl. 1. (Missing antennae or mandibles in 10% of ☿ born by a ♀ after exposure to cold temperature).
1941. SCHWAN. Vaetskyddsnotiser Stockholm 1941 (6): 94-96. (Abnormal spermatheca in ♀).
1950. RAYMENT. Victoria Nat., Melbourne 66: 233, figs. 9-17. (Males with 6 ocelli but lacking eyes, with stalked ocellus, with stalked scape or with plumose eye-hairs; worker with abnormally small eyes).

IV. DIAGNOSTIC CHARACTERS

An attempt has been made to ascertain the diagnostic value of characters used by earlier authors for classifying honeybees and their allies, and to search for new, constant and distinctive ones. In the following account, they will be dealt with in order, beginning with general features, and then head, wings, etc., along with some explanations of the terminology employed. Characters new to honeybee diagnoses as herein introduced will be each marked with an asterisk (*).

(1) Dimensions. — The body length and wing expanse are long known characters. The former is of little value, since the abdomen is easily to be telescoped or compressed and this leads to difficulties in making out accurate measurements; whereas the latter is not at all practicable, as the wings of museum specimens are usually not well expanded. The relative lengths of head, thorax and abdomen were first utilized by GERSTÄCKER (1862), but their importance has been overlooked by subsequent workers. The relative breadths of these 3 parts*, breadth of abdominal sternum II* and length of fore wing (excluding tegula)* are rather constant in most cases. The symbol L/B will stand for the ratio of length to breadth; the term "median length" is to be measured along a hypothetical median longitudinal line; and the "posterior breadth" of an abdominal tergum or sternum is the maximum breadth of the posterior area. ARMBRUSTER (1938) used the length of "Cubitalbasis" or the total length of the 3 cubital cells along cubital vein for the separation of his species of *Hauffapis*.

(2) Body Weight. — KUMAROV and ALPATOV (1934) showed that the body weight of queens might serve for racial recognition of honeybees.

The true value of this quantitative character is quite problematical. In the case of *Apis cerana,* KELLOGG (1929) gave 0.0520 to 0.0816 gm as the range of the body weight of 203 freshly killed workers. And in another occasion (1936), the same range of a different lot of 42 workers proved to amount from 0.0638 to 0.0942 gm. Thus the range of variation was so broad that we can scarcely rely on it.

(3) Integumental Pigment. — This is another long known character for honeybees. The colour-pattern of clypeus, labrum, scape, scutellum and abdominal terga is rather indicative for certain species. As mentioned elsewhere in the paper, it is by no means constant mostly because of post-mortem decomposition. Unfortunately, a few species and varieties, such as *A. testacea* BINGH. and *A. mellifera* var. *nigrita* LUCAS, were erected upon discoloured specimens. In the present paper, the colour of a species will be described only from average specimens, and we should not lay too much stress upon this point. The colour of fore wings seems to be more reliable than that of the trunk, but the interspecific difference is very slight. The "varieties" of VON BUTTEL-REEPEN (1906) and many others were built upon the pattern of abdominal terga. Usually the anterior portion of a tergum is paler than the posterior. But in dried, contracted specimens, these pale bands are in most cases concealed and the terga appear to be entirely black or sooty brown.

(4) Pubescence. — The colour, length, thickness, erectness and nature of branchlets of pubescence are varying according to their location and also to species or group of species. Since most parts of the body of a honeybee are thickly pubescent and the body proper is thus not readily observable, earlier authors have extensively used the colour of pubescence as a "key character" even for species. A few varieties were founded upon the presence or absence of a narrow anterior band of thick, short, whitish, decumbent hairs on each of abdominal terga III-V. As a matter of fact, these bands do exist in all honeybees (♀) and, to a less extent, also on terga II and VI, although they are very rarely visible in contracted specimens.

(5) Punctation*. — The density, coarseness and deepness of punctures on clypeus, labrum and abdominal tergum II are rather distinctive for genus, and sometimes also for species.

(6) Eyes. — The size, shape and relative convergence of eyes are of little generic or specific importance, as an accurate measurement or appropriate description is scarcely possible because of their strong convexity. The difference of the minimum interspace of both posterior ocelli (= POL or post-ocellar line) and of that from either posterior ocellus to its nearest

orbit (= OOL or oculo-ocellar line) was first called to attention by GERSTÄCKER (1862), and later by SMITH (1865) for the grouping of species. In the present paper, this ratio will be used only for individual species.

(7) Ocelli. — Besides oculo-ocellar ratio, the ocelli provide some further generic or specific characters, *viz*, the relative size, ratio of lateral ocellar line (= LOL to POL, both first noticed by SMITH, 1865), relative prominence and location of ocellar triangle*, and shape of anterior ocellus* (♂).

(8) Frontal Line*. — This is the line extending from anterior ocellus to supraclypeal region. In the ♂ of the primitive genera, it is not entirely foveated but with the anterior two-thirds ridged.

(9) Antennae*. — The total length of antennae, relative lengths and thickness of certain segments will be described and illustrated (figs. 1 - 10) for genera and subgenera. The inter-antennal distance or minimum interspace of antennal sockets (♀) also varies with genera.

(10) Malar Areas*. — The KRÜGER index or B/L of this area multiplied by 100 and measured at articulation with mandible has been extensively used in the classification of Bombini or bumblebees and here proves to be also useful for Apidini.

(11) Mandibles* (fig. 48). — The shape of mandibles has been employed in classifying Bombini and Meliponini and can be utilized for separating genera, subgenera and sometimes even species of Apidini. "Ventrally", each ☿ mandible bears 3 oblique keels, *viz*, main, apical and "posterior". They are less strongly developed in ♀ and ♂ castes.

(12) Proboscis. — The proboscis or maxillo-labial complex is composed of submentum, mentum, prementum [1]), maxillae, glossa, paraglossae and maxillary and labial palpi. Because of its supposed economic importance, the "tongue" length has been extensively surveyed by many apiarists and the nationes recognized by SKORIKOV (1929a) for *Apis remipes transcaucasica* are exclusively built upon this quantitative character. The tongue is usually measured from the basal extremity of prementum to the apical extremity of mentum instead of prementum. The interspecific difference of apical segments of labial palpi was first noticed by ENDERLEIN (1906), but it seems that the importance of this character has been over-emphasized. The segment II of a palpus is sometimes with a false, subapical annulet*. For practical purposes, the shape* of prementum and relative lengths* of prementum, glossa and palpal segments are rather

1) The submentum, mentum and prementum as understood by MICHENER (1944) and adopted in the present paper were termed, respectively, by SNODGRASS (1925) and others as "lorum", "submentum" and "mentum".

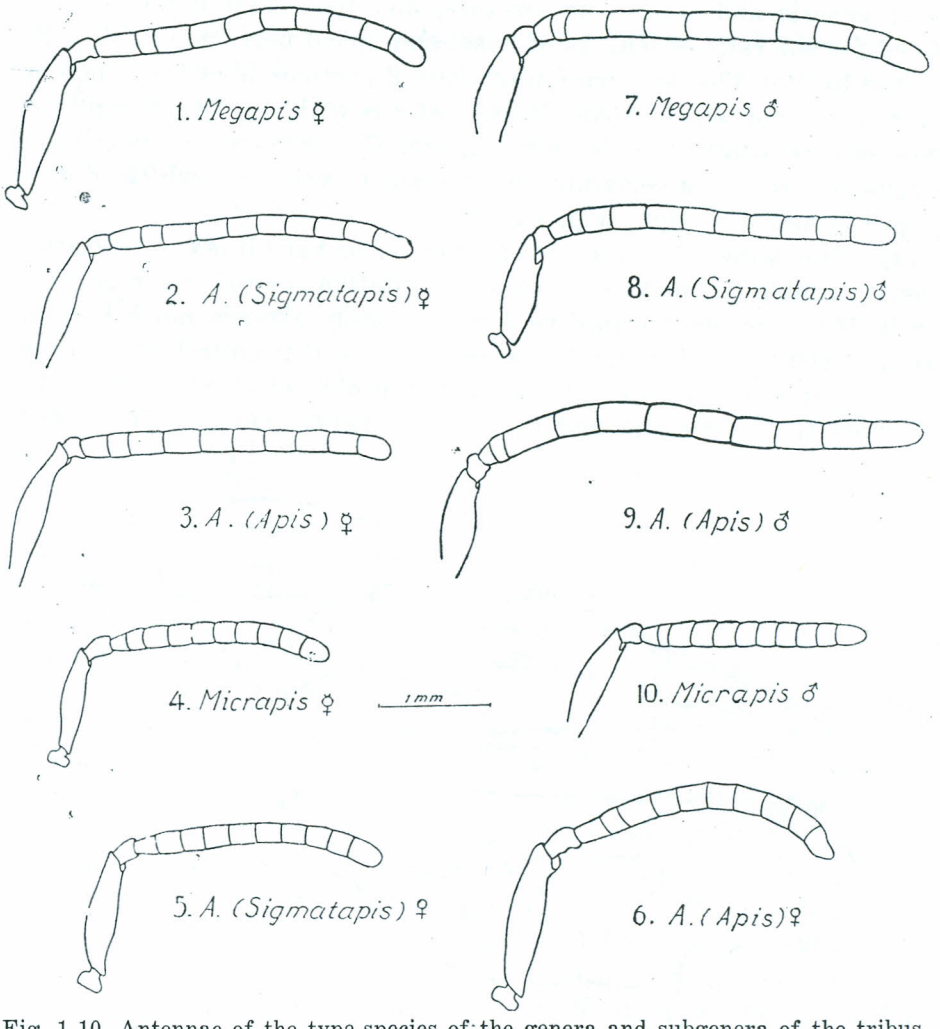


Fig. 1-10. Antennae of the type-species of the genera and subgenera of the tribus Apidini (fig. 4 and 10 slightly more highly magnified than the others).

useful. The prementó-palpal index is here proposed for the ratio of lengths of prementum and labial palpus including palpiger, multiplied by 100. The maxillary palpi do not provide any generic or specific character.

(13) Fore Wings (fig. 11). — The distinctiveness of the appendiculate cell (*ap*) is very variable, but ENDERLEIN (1906) took advantage of it in distinguishing *Micrapis florea* from *M. andreniformis*. The so-called cubital index or the ratio of lengths of 2nd and 1st abscissae of vein M_{3+4} in cell *2m*, seems also rather variable, notwithstanding it has been extensively used by American workers for racial differentiation. The shape* of cell

3r is of generic and specific importance, and the radial index is here proposed for the ratio of lengths of basal and apical portions of this cell, multiplied by 100. The demarcation of these 2 portions is at the junction of veins M_{1+2} and im_2. In *Megapis*, the cell *r* is with a faint, incomplete, transverse vein* originating from the stigma. This is more fully developed in ♂ caste and is almost certainly the remnant of vein rm_1, which is well developed in primitive Hymenoptera.

(14) Hind wings (fig. 11). — The number of hamuli is intraspecifically very variable but may serve as a quantitative character for genera. The vein M_{3+4}, in more primitive forms, apically extends much beyond the apex of cell *bm*, and in highly specialized ones, it is entirely coalescent with M_{1+2} and the two unitedly form the prolongation of *M*-stem. In other words, the cell *bm* may be apically truncated or sharply pointed; cell

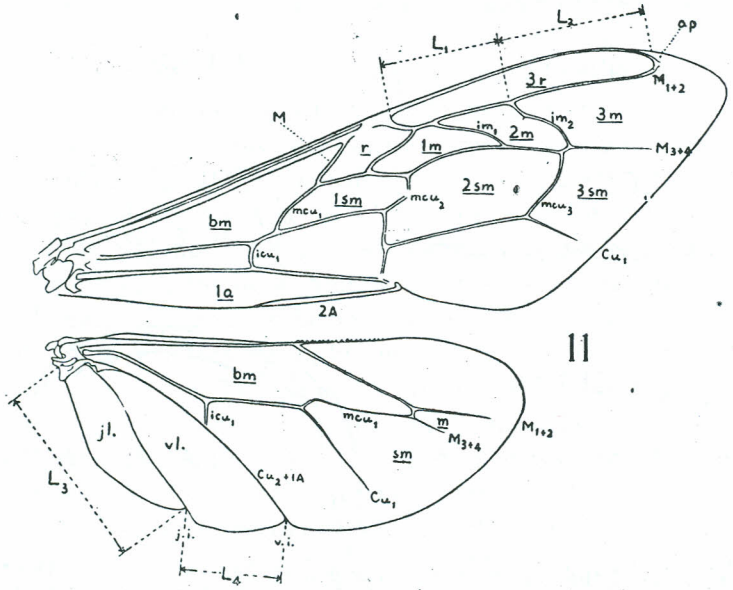


Fig. 11. Wings of *Megapis dorsata* (FABR.) ♂, showing terminology used in the present paper. Notations of cells underlined. L_1 = length of basal portion of cell *3r*, L_2 = length of apical portion of same, L_3 = length of jugal lobe, L_4 = length of vannal lobe.

m, well separated from or entirely combined with *sm;* and vein mcu_1, joining *M*-stem directly or through M_{3+4}. The interior angle formed by junction of veins icu_1 and $Cu_2 + 1A$ is much more acute in *Megapis* or *Apis* than in *Micrapis*. This was first noted by COCKERELL (1907). The jugal lobes (♀) are usually longer than the vannal, but in highly specialized forms, they are shorter than the latter. The jugo-vannal index* is to

stand for ratio of lengths of jugal and vannal lobes, multiplied by 100. The length of jugal lobe, for convenience and accuracy, will be measured from basal extremity of vein Cu_1 to jugal incision, more or less along jugal fold. This is only because its free margin, particularly in ♂, is strongly curved and the basal area is often folded and not clearly separable from basal sclerites of the wing. The vannal lobe will be measured from jugal to vannal incision.

(15) Legs III (fig. 110). — SMITH (1865) illustrated ☿ and ♂ tibiae and basitarsi of a number of species. In ♂ caste, the shape and carination* of these 2 segments are very distinctive for genera and subgenera, but scarcely so in ☿ or ♂. The number of rows of scopal bristles (☿) was first unearthed by GERSTÄCKER (1862) as a "group" character and later on employed by SMITH (1865), for species. These bristle-rows may be conveniently grouped into two series, pre- and post-auricular. The rows belonging to pre-auricular series lie basad to or on the level of basal auricular margin (at least the "ventral" half or halves being so) and are short, incomplete, rather irregularly or zigzaggedly arranged. An accurate counting of them is therefore very difficult. The post-auricular rows are long, complete, usually regularly arranged and always lie apicad to the level of basal auricular margin. The arrangement* of apical rows is rather distinctive and constant. In the following descriptions, the ultimate and penultimate rows will be termed, for convenience, as the 1st and 2nd respectively, and so on. In certain species, there is an extra, short row lying between the 1st and 2nd ones and near the "dorsal" margin of basitarsus. The latter will not be counted as a normal one. The basitarsus can be easily cleared of its scopal bristles by using a fine needle under a microscope after it has been sufficiently desiccated by dry clearing. It may be then treated with KOH to ensure transparency. In making out an accurate counting of the exact number of the bristle-row, the "posterior" surface should be put to face a slide, as the recurvature of auricle in "posterior" aspect may lead to a wrong — slanting instead of a proper — horizontal plane. The tibial spurs I* (♂) and medio- and distitarsi III* (♂) also exhibit some generic difference.

(16) Abdominal Terga. — The extent* of the tergum I in dorsal aspect is very useful to distinguish ♂ *Micrapis* from the two other genera. The relative posterior breadths* of terga I and II are, on the other hand, useful for grouping queens into genera. The breadth of the tergum III was used by some American workers as a quantitative racial character, and the relative flatness of terga *in toto*, by GERSTÄCKER (1862) and SMITH (1865) for "group" and species separation.

(17) Abdominal Sterna (fig. 12). — This exceedingly important character was first brought forward by SKORIKOV (1929*a*) who described and illustrated the sterna of queens of two species and workers of fourteen species and subspecies, five of them were recognized as new and were erected solely upon this character. It is, to a less extent, also specifically distinctive for the ♂ caste. Each sternum can be roughly divided into 3 major divisions: (a) antecosta, or the narrow, thickened, anterior margin; (b) apodemes, or the antero-lateral arms; and (c) membranous portion, which is very ample and is traversed by a strongly curved glandulus. The glandulus is attached internally to the intersegmentalia and may be divided arbitrarily into anteglandulus and lateroglanduli. The ante- and lateroglanduli, respectively, are transversal and longitudinal or nearly longitudinal; the former runs more or less parallel to the antecosta, and the latter, to the lateral sternal margins. Thus four subdivisions of the membranous portion may be recognized: preglandular, postglandular and lateral marginal areas. The preglandular areas III-VI in ☿ caste are almost entirely occupied each by a pair of wax-plates. The postglandular area is adorned with numerous fine, short hairs which are absent or practically absent elsewhere on the membranous portion of the sternum. SKORIKOV (*loc. cit.*) used the thickness at midpoint of antecosta II for the separation of his sectiones of the genus *Apis* sensu ASHMEAD, but this seems only serviceable for species. The general shape of sterna and of wax-plates and curvature of glanduli are markedly distinctive. In making a study of the sternal characters, the abdomen should first be softened by boiling in very weak KOH solution for a few minutes before the sterna are detached from the terga and separated from one another. The muscles and intersegmentalia of a detached sternum can be cleared off by using fine needles or scrapers, under a microscope. After that, it should be washed in clean water for several times, then stained with Congo red and mounted on a slide, preferably with glycerine jelly. Staining is essential for the specific study of *Apis* and *Micrapis*, otherwise wax-plates and glanduli are very poorly defined. Even after being stained, the glanduli in ♂ are very poorly defined.

(18) Sting. — The comparative morphology of the sting of certain species has been worked out by some Russian authors. The interspecific differences seem to be slight except for a few features of minor importance.

(19) Male Genitalia. — This organ has also been studied by Russian authors and, in fresh material, is of high specific importance. Its very weak sclerotization and complicated structure lead to utmost difficulties

in giving an adequate description or illustration from old, dried specimens and it is thus left out of consideration in the present paper.

On concluding the discussions on diagnostic characters, it must be strongly emphasized: (1) that the distinctive specific characters in honeybees are to be found only in the three castes of a species, taken as a whole, since the study of workers alone must result in the commission of errors (SMITH, 1855); and (2) that the males of honeybee species, in certain respects, are more sharply distinctive than are workers or queens. It is very unfortunate that most of the species are only known from workers, there being very few male specimens in the various collections.

V. TRIBAL COMPONENTS

The honeybees, as representing a distinct, supra-generic systematic unit, were first recognized by LEPELETIER (1836), and this was followed by many subsequent authors. In the present paper, they are understood to be the sole representatives of an independent tribus, which may be re-characterized as follows.

Tribus **Apidini** BÖRN., 1919.

= tribu *Apiarites* LEP., 1836 : 399 = subfamily *Apinae* ASHM. 1899 : 57.
= tribus *Apini* HANDL., 1925 : 823 = tribe *Apini* MICHEN., 1944 : 292.

Worker. — Eyes oblong, medium-sized, each broadest a little posteriorly to level of midpoints, densely covered with long, fine, erect hairs; mesal orbits subparallel, weakly concavely curved; anterior inter-orbital distance slightly longer than posterior. Clypeus convex, a little broader than long, broadest at level of mesial mandibular articulations; anterolateral corners slightly raised and scarcely deviated from the general curvature of anterior clypeal area, never distinctly protuberant; anterior margin very weakly, concavely curved. Epistomal suture posteriorly strongly arched. Labrum simple, about 2.5 or more times as broad as long, much narrower than clypeus; anterior emargination indistinct. Antennal sockets lying much anteriorly to level of orbital midpoints. Subantennal sutures posteriorly convergent and terminating near lateral margins of sockets. With its diameter as a measuring unit, the antennal socket is separated from its nearest anterior tentorial pit by about 1.5 diameter, from epistomal suture by $^1/_6$ diameter; inter-antennal distance 1.0 diameter, and subantennal suture much shorter than 1 diameter. Supraclypeal area wedge-shaped, raised. Ocelli arranged in a broad triangle and lying slightly anteriorly to posterior orbital line. Genal areas (= cheeks) about half as broad as eyes. Hypostoma and tentorium united only at posterior extremities. Malar areas ordinarily longer than broad. Antennae with segment I or scape about 5—6 times as long as thick; II or pedicel scarcely longer than thick; III about as

long as any one of the succeeding ones; IV, however, usually shorter than thick and always the shortest of all flagellar segments. Mandibles spoon-shaped, "dorsally" not sculptured; apical margins obliquely truncated, always without distinct dentation; "anterior" margins deeply incised; mesal basal articulations lying much posteriorly to level of anterior clypeal margin; lateral ones each at level of its nearest lateral orbit. Epipharynx triangular, about 2 times as broad as long. Stipites lacking subapical concavities on "posterior" margins; laciniae small, membranous, glabrous; galeae with prepalpal portions about half as long as stipites or one-fourth of postpalpal portions; maxillary palpi simple, subcylindrical. Submentum broadly V-shaped; mentum also V-shaped, but only about half as broad as submentum; prementum about 1.6—2 times as long as broad, lacking "ventro"-apical emarginations; glossa long, slender; flabellum flattened, circular, ventrally evenly pubescent; paraglossae moderately short, "dorso"-basally dilated mesad to embrace base of glossa; labial palpi 4-segmented, segment I flattened and longest and broadest of all, II also flattened, III clavate and basally articulated to apico-lateral corner of II, IV subcylindrical, thinnest of all and only a little longer than III. Thorax globular; scutellum swollen, overhanging notum III, which is vertical and very short; propodeum almost vertical; metasternum posteriorly with a median, wedge-shaped tooth. Wings hairy throughout, with small alar papillae. In the fore wings (fig. 11), stigmata small, narrow, lanceolate; cell *bm* costo-apically very acute; cell *3r* or marginal cell scarcely shorter than *bm*, apically rounded, slightly bent analwards and diverging from costal margin of the wing; *ap* or appendiculate cell usually wanting or ill defined; submarginal cells 3 in number (*r* or *1r* + *2r*, *1m* and *2m*); *r* nearly as long as *2m* along vein M_{3+4}; *1m* irregularly pentagonal, much longer than broad, and with its costal margin about one-eighth to one-fourth as long as the anal; vein rm_1 at most represented by a short, faint stub near stigma; rm_2 originating from midpoint of stigma; im_1 and im_2 subparallel; *M* stem more or less shorter than mcu_1; M_{1+2} strongly zigzagged; mcu_2 short, angulated near midpoint and originating from a point much basad to midpoint of cell *1m*; mcu_3 received in cell *2m* a little basad to or rarely at apex of the latter cell; icu_1 distinctly prefurcal; *2A* basally obsolete, apically thickened and a little shorter than half the cell *1a*; jugal lobes absent. Hind wings (fig. 11) much narrower and shorter than fore ones; vein Cu_1 with 2nd abscissa nearly as long as mcu_1; icu_1 apically slanting towards analo-apical corner of the wing; jugal lobes much narrower and usually longer than vannal ones; jugal incisions shallow. Tibiae III strongly bilaterally com-

pressed, markedly dilated towards apices, and lacking apical spurs; "anterior" surfaces each with a corbicula or glabrous, concave area (pollen-basket), marginally fringed with long, curled hairs; "posterior" surfaces each with a pecten or comb of short, very heavy bristles along apical margin. Basitarsi III very strongly compressed and dilated, fringed with very long, erect hairs, those on "dorsal" margins being finer but more than twice as long as on "ventral" ones; baso-"dorsal" corners each strongly produced and bent "anteriorly", forming the so-called "auricle"; "anterior" surfaces shining, thinly haired on discal and apical areas; "posterior" surfaces each with about 10—17 transverse rows of rather short, stiff, pollen-gathering bristles forming a scopa, strigilis or pollen-brush. Claws cleft; subapical teeth shorter than apical; arolia well developed. Abdomen with tergum I clearly visible in anterior and dorsal aspects; tergum VI simple, without pygidial process, nor pygidial plate; sterna III-VI each with a pair of wax-plates or "mirrors".

Queen. — Very similar to ♀ as described above. Inter-antennal distance more or less smaller than diameter of an antennal socket. Malar areas comparatively shorter. Antennae relatively thicker. Mandibles much broader, each with a sharply pointed apical and a broadly truncated subapical tooth; "antero"-basal corners strongly dilated. Labial palpi with segments II and III normally articulated. Tibiae III weakly compressed, comparatively less strongly dilated towards apices, without corbiculae; "anterior" surfaces weakly convex, densely covered with fine, setigerous punctures; marginal fringes and pectines weakly developed. Basitarsi III longer, less strongly compressed and dilated, fringes much shorter, those on "dorsal" margins being as long and fine as on "ventral"; auricles poorly developed; "anterior" surfaces mat, evenly covered with rather long, fine, dense hairs; "posterior" surfaces without scopae, but very thickly covered with rather soft, short hairs. Abdominal sterna without wax-plates.

Male. — Rather similar to ♀ as described above. Eyes very large and prominent, broadly kidney-shaped; mesal orbits strongly convergent and meeting each other on vertex. Labrum with a pair of weakly developed baso-submedian tubercles. Inter-antennal distance slightly smaller than diameter of an antennal socket. Ocelli lying much anteriorly to posterior orbital line. Genal areas poorly defined, invisible in lateral aspect. Malar areas much broader than long. Antennae with segment I about 4 times as long as broad; III more or less thicker than long, and as long as or slightly longer than IV; V and all succeeding ones subequal in length and thickness to one another. Mandibles narrow, subtriangular, bidentate;

"anterior" margins medially scarcely incised. Labial palpi with segments II and III normally articulated. Hind wings only slightly narrower than fore ones; jugal lobes scarcely narrower than vannal ones. Tibiae III strongly dilated towards apices, weakly compressed, without corbiculae, nor pectines; "anterior" surfaces weakly convex, very thinly covered with fine, short hairs. Basitarsi III thick, fringed with dense, short hairs; auricles and scopae wanting; "anterior" surfaces mat, practically hairless; "posterior" and ventral surfaces very thickly covered with rather short, stiff hairs. Abdominal tergum I at most only with antero-lateral corners visible in dorsal aspect; sterna without wax-plates.

Further morphological details of this tribus are available in the foregoing discussions (Chapter II) on caste polymorphism and in the works of ZANDER (1911), SNODGRASS (1925) and MICHENER (1944). For practical purposes, the tribus Apidini can be easily distinguished from all other bees by the following combination of characters: — Body never brilliant metallic blue or green. Fore wings with marginal or radial cell (*3r*) longest of all except for basal cell (*bm*); three submarginal or cubital cells, the 1st (*r*) about as long as 3rd (*2m*) but much shorter than 2nd (*1m*) which is irregularly pentagonal; 1st recurrent vein (mcu_2) originating basad to midpoint of 2nd submarginal cell (*1m*). Hind tibiae without apical spurs.

The generic names available for the tribus, as hereby delimited, are *Apis* LINN., *Apicula* RAF., *Apiarus* RAF., *Megapis* ASHM., *Micrapis* ASHM., *Synapis* CKLL. and *Hauffapis* ARMBR. The first one was originally established for the reception of all bees then known to its describer. All originally included species, except the genotype *A. mellifera,* are now referred to genera belonging to systematic units other than Apidini. *Apicula* and *Apiarus* are unnecessary emended forms of *Apis* and thus have no nomenclatural standings and have never been accepted by any subsequent author. ASHMEAD's genera were long neglected since their publication, and no species of honeybee have ever been originally described under either of them. The remaining two names have been erected only to include fossil forms. Accordingly, in enumerating the modern components of the tribus, we only have to deal with the names of species, subspecies, nationes, races, forms and varieties assigned to *Apis* at one time or another by their original denominators or subsequent authors and to see their true status. A rather painstaking search reveals that a total of not less than 600 such names has appeared, including some preoccupied, emended, pre-Linnean and manuscript ones and variants of spellings. As almost all of them can be traced out from DE DALLA

TORRE's (1896) catalogue and recent issues of the Zoological Record, and to save space, no complete list will be given here. The following is a cross-reference index of the names applicable to the tribus Apidini BÖRN., 1919 as here understood. It includes the names in their original combinations (of the known forms, the generic name in common — *Apis* — is here omitted), names of denominators, dates of publications, original references, type localities, immediate synonyms and homonyms (if any), and so on. The names which were overlooked by DE DALLA TORRE and the Zoological Record will be each prefixed by an asterisk (*). The original papers by GRASSI and KOSCHEVNIKOV are not available to the present writer and exact paginations of original references of their species, etc. cannot be given. The symbol "subsp." will be omitted, but "var." and other infra-specific catagories, retained; whereas combinations, other than the original ones, as well as misidentifications, excluded. The arrow-heads in parentheses indicate proper generic positions of known species belonging to genera other than *Apis*. The fossil genera and species will be enumerated elsewhere (Chapter X, Section C). The names here recognized as of "good" species are in the bold-face type.

absuana, see *remipes transcaucasica* natio *absuana*.

absuatna, see *mellifera remipes* natio *absuatna*.

acervorum, see *mellifera* natio *acervorum*.

**adamsoni*, MEUNIER, 1915. Zts. deuts. geol. Ges., Berlin 67: 210. (= err. pro *adansonii*).

adansoni, auctt. (= err. pro *adansonii*).

adansonii LATR., 1804*a*: 172. Senegal.

**aenigmatica* RAYM., 1935: 557. Australia. (nom. invalidum [intern. Code Zool. Nomencl., art. 27], because of neither part of the insect proper being described).

anatoliaca, see *mellifera anatoliaca*.

andreniformis F. SM., 1858: 49. Borneo (*Micrapis*).

armeniaca, see *remipes armeniaca*.

**australis* KIESENW., 1860: 317. A unnecessary nom. nov. for *A. ligustica* SPIN., 1806, which was supposed to be homonymous with *Bombus ligusticus* SPIN., 1805. Thus = *Apis mellifera mellifera* natio *ligustica*.

**banata*, SKOR., 1929*a*: 263. (= err. pro *banatica*).

banatica, see *mellifica* var. *banatica*.

bicolor KLG., 1807: 264, pl. 7, fig. 3. India. (nom. praeocc., nec FABRICIUS, 1781, nec SCHRANK, 1781, nec VILLERS, 1789) (= *Megapis dorsata*).

binghami, see *dorsata binghami.*

binghami sladeni CKLL., 1914: 13. Assam: Khasi Hills. (= *Megapis laboriosa*).

breviligula MAA, sp. nov. (*postea*) (*Megapis*). Luzon.

caffra LEP., 1836: 402. Kaffraria. (nom. praeocc., nec LINNÉ, 1767 (= *Apis adansonii*).

capensis ESCH., 1822: 97. Cape of Good Hope. (= *Apis adansonii*).

carnica, see *mellifica carnica.*

carniolica, see *mellifera* var. *carniolica.*

caucasica, see *mellifida caucasica.*

cecropia, see *mellifica* var. *cecropia.*

cerana FABR., 1793: 327. "China."

cerifera SCOP., 1770: 16. Europe. (= *Apis mellifera mellifera*).

cerifera (PALL. *in litt.*) GERST., 1862: 60. Russia. (nom. praeocc., nec SCOPOLI, 1770) (= *Apis mellifera mellifera*).

cypria, see *mellifica cypria.*

cypriaca, see *mellifera* var. *cypriaca.*

daurica FISCH.-WALD., 1843: 1. Russia. (= *Apis mellifera mellifera*).

**delesserti,* BUTT.-REEP., 1906: 168. (= err. pro *delessertii*).

delessertii GUÉR., 1844: 461. Pondichéry. (= *Apis indica*).

**domestica* RAY, 1710: 240. England. (nom. prae-Linn.) (= *Apis mellifera mellifera*).

dorsata FABR., 1793: 328. India. (*Megapis*).

dorsata binghami CKLL., 1906: 166. nom. nov. pro *Apis zonata* F. SM. (= *Megapis binghami*).

**eurasiatica* SKOR., 1929: 14. A unnecessary nom. nov. pro *Apis mellifera* var. *remipes* GERST.

fasciata LATR., 1804*a*: 171, pl. 13, fig. 9. Egypt. (nom. praeocc., nec LINNÉ, 1767, nec SCOPOLI, 1770) (= *Apis lamarckii*).

floralis, auctt. (= err. pro *florea*).

florea FABR., 1787: 305. "India." (*Micrapis*).

florea andreniformis var. *sumatrana* ENDERL., 1906: 339. Sumatra: Soekaranda. (= *Micrapis andreniformis*).

florea florea var. *fuscata* ENDERL., 1906: 338. India. (= *Micrapis florea*).

florea nasicana CKLL., 1911*a*: 241. Bombay: Nasik. (= *Micrapis florea*).

florea var. *rufiventris* (FRIESE *in litt.*) BUTT.-REEP., 1906: 170. Tonkin; Palawan. (nec *Apis rufiventris* SCHRANK, 1782). (= *Micrapis florea*). The specimen from Tonkin should be regarded as the holotype, the others as paratypes. FRIESE has never published any description of this variety, so that its authorship has to be

credited to VON BUTTEL-REEPEN. See also discussions under *M. florea* (Chapter VII).

friesei, see *mellifica unicolor* var. *friesei*.

**frisei*, see *mellifica unicolor* var. *frisei*.

fuscata, see *florea florea* var. *fuscata*.

**fuscata*, MEUNIER, 1915. Zts. deuts. geol. Ges., Berlin 67: 210. (= err. pro *fasciata*).

georgica, see *mellifera remipes* natio *georgica* and also *remipes transcaucasica* natio *georgica*.

germanica, see *mellifica germanica*.

**gregaria* GEOFF., 1762: 407. France. (= *Apis mellifera mellifera*).

gronovii GUILL., 1841: 323. Timor. (= *Apis peroni*).

**himalayana* MAA, 1944: 4. Darjeeling. (nom. nud.) (= *Megapis laboriosa*).

hymettea, see *mellifica hymettea*.

iberica, see *remipes transcaucasica* natio *iberica*.

indica FABR., 1798: 274. India.

indica var. *javana* ENDERL., 1906: 337. W. Java: Pengalengan. (= *Apis javana*).

indica philippina SKOR., 1929*a*: 252, 260, fig. 4 (1). "Philippine Is." (= *Apis philippina*).

**indica skorikovi* MAA, 1944: 4. Darjeeling. (nom. nud.) (= *Apis cerana*).

intermissa, see *mellifica unicolor* var. *intermissa*.

japonica, see *mellifica* var. *japonica*.

javana, see *indica* var. *javana*.

johni SKOR., 1929*a*: 251, 260, fig. 5. "Sumatra".

**kaffra*, JACK, 1916. Tr. ent. Soc. London 1916: 397 (= err. pro *caffra*).

koschevnikovi, see *mellifica indica* var. *koschevnikovi*.

laboriosa F. SM., 1871: 249, pl. 18, fig. 7. Yunnan. (*Megapis*).

lamarckii, see *mellifera lamarckii*.

lehzeni, see *mellifica mellifica* var. *lehzeni*.

lieftincki MAA, sp. nov. (*postea*). S. Sumatra: Mt Tanggamus.

**liguria*, F. SM., 1862. Proc. ent. Soc. London: 14. (= err. pro *ligustica*).

ligurica, TEGETMEIER, 1859. Proc. ent. Soc. London: 88 (= err. pro *ligustica*).

ligustica SPIN., 1806: 35, pl. 1, fig. 13. Italy: Liguria. (= *Apis mellifera mellifera* natio *ligustica*).

linda see *vechti linda*.

lobata F. SM., 1854: 416. India. (= *Micrapis florea*).

marginella, see *nigrocincta marginella*.

meda SKOR., 1929*a*: 253, 261, fig. 8. N. Iran: Lenkoran.

mellifera LINN., 1758: 576. Europe.

mellifera natio *acervorum* SKOR., 1929*a*: 253, 261. S. Russian steppe. (nec *Apis acervorum* LINN., 1758, nec CHRIST, 1791). A unnecessary nom. nov. pro *Apis mellifera mellifera* natio *tesquorum* SKOR., 1929. Both *acervorum* and *tesquorum* were intended for one and the same local "race" and were erected by the same author in the number and volume (but in 2 separate papers) of the same journal. The latter appeared on p. 29 of the first paper and thus should have priority over *acervorum*, which is, strictly speaking, already preoccupied in the genus *Apis*.

**mellifera anatoliaca* MAA, subsp. nov. (*postea*). "Turkey".

**mellifera* var. *carniolica* KOSCH., 1900: —. nom. emend. pro *Apis mellifica carnica*.

**mellifera* var. *cypriaca* KOSCH., 1900: —. nom. emend. pro *Apis mellifica cypria*.

mellifera lamarckii CKLL., 1906: 166. nom. nov. pro *Apis fasciata* LATR. (= *Apis lamarckii*).

**mellifera mellifera* natio *tesquorum* SKOR., 1929: 29. S. Russian steppe.

**mellifera remipes* natio *absuatna* (err. pro *absuana*) SKOR., 1929: 32. Georgia: Abchasia. (= *Apis remipes transcaucasica* natio *absuana*).

**mellifera remipes* natio *georgica* SKOR., 1929: 32. Georgia: Imeretia. (= *Apis remipes transcaucasica* natio *georgica*).

**mellifera remipes* natio *siganica* SKOR., 1929: 32. Georgia: Mingrelia. (= *Apis remipes transcaucasica* natio *siganica*).

mellifera taurica ALP., 1938: 480. 481. Crimea. (= *Apis mellifera mellifera* natio *taurica*).

mellifica LINN., 1761: 421. Sweden. (= *Apis mellifera mellifera*).

mellifica var. *banatica* GROZD., 1926: 57. N. Serbia. (= *Apis mellifera mellifera* natio *banatica*).

**mellifica carnica* POLLM., 1879: 45. Austria: Carniola. (= *Apis mellifera mellifera* natio *carnica*).

mellifica caucasica, see *mellifida caucasica*.

mellifica var. *cecropia* KIESENW., 1860: 315. Greece. (= *Apis mellifera mellifera* natio *cecropia*).

**mellifica cypria* POLLM., 1879: 52. Cyprus. (= *Apis mellifera cypria*).

**mellifica germanica* POLLM., 1879: 1. Germany. (= *Apis mellifera mellifera*).

**mellifica hymettea* POLLM., 1879: 50. Greece. A unnecessary nom. nov. pro *Apis mellifica* var. *cecropia* KIESENW.

mellifica indica var. *koschevnikovi* BUTT.-REEP., 1906: 192. Kamerun; N. Borneo. The specimen from Kamerun should be regarded as the holotype (the others as paratypes), thus = *Apis koschevnikovi.*

mellifica indica var. *picea* BUTT.-REEP., 1906: 193. N. Celebes: Tonkin. One of the specimens from N. Celebes should be regarded as the holotype, the others as paratypes, thus = *Apis nigrocincta nigrocincta.*

mellifica var. *japonica* RADOSZ., 1887: 436. Japan: Yokohama. (= *Apis cerana*).

mellifica mellifica var. *lehzeni* BUTT.-REEP., 1906: 184. W. Europe: Hannover, Holstein, Oldenburg, Holland. The specimen from Hannover should be regarded as the holotype, the others as paratypes. (= *Apis mellifera mellifera* natio *lehzeni*).

mellifica var. *nigrita* LUCAS, 1882: 62. France: Paris. (nec *Apis nigrita* FABRICIUS, 1775, nec CHRIST, 1791). (= *Apis mellifera mellifera*).

mellifica var. *remipes* (PALLAS *in litt.*) GERST., 1862: 61. Caucasus: probably Mozdok. (= *Apis remipes remipes*).

mellifica unicolor var. *friesei* BUTT.-REEP., 1906: 188. Togo: Bismarckburg. (= *Apis adansonii*).

mellifica unicolor var. *frisei,* ENDERL., 1906: 335. (= err. pro *friesei*).

mellifica unicolor var. *intermissa* BUTT.-REEP., 1906: 187. Algeria; Tanganyika; Kilimanjaro; Togo; Kamerun; N. Galla; N. Nyassa; Malta; Tunis. The specimen from Algeria should be regarded as the holotype, the others as paratypes. (= *Apis intermissa*).

mellifica unicolor var. *syriaca* BUTT.-REEP., 1906: 175. Syria. (= *Apis mellifera syriaca*).

**mellifida* (err. pro *mellifica*) *caucasica* POLLM., 1889: 90. Caucasus. (= *Apis remipes remipes*).

nasicana, see *florea nasicana.*

nigripennis LATR., 1804*a*: 170, pl. 13, figs. 7—8. Bengal. (= *Megapis dorsata*).

nigrita, see *mellifica* var. *nigrita.*

nigritarum LEP., 1836: 406. Congo. (= *Apis adansonii*).

nigrocincta F. SM., 1861: 93. SW. Celebes: Makassar.

nigrocincta marginella MAA, subsp. nov. (*postea*). C. Celebes: Todjambu.

nursei, CKLL., 1911: 319. nom. nov. pro *Apis testacea* BINGH. (= *Micrapis florea*).

peroni LATR., 1804*a:* 173, pl. 13, fig. 11. Timor.

peronii, auctt. (= err. pro *peroni*).

perrotteti, auctt. (= err. pro *perrottetii*).

perrottetii GUÉR., 1844: 461. Neelgerries. (= *Apis indica*).
philippina, see *indica philippina*.
picea, see *mellifica indica* var. *picea*.
remipes, see *mellifica* var. *remipes*.
remipes armeniaca SKOR., 1929*a*: 254, 262, figs. 13, 16. Armenia.
remipes transcaucasica SKOR., 1929*a*: 254, 262, figs. 10, 16. Trans-Caucasus: Georgia, Azerbaijan.
remipes transcaucasica natio *absuana* SKOR., 1929*a*: 254, 262, fig. 16. Georgia: Abchasia.
remipes transcaucasica natio *georgica* SKOR., 1929*a*: 254, 262, fig. 16. Georgia: Imeretia.
remipes transcaucasica natio *iberica* SKOR., 1929*a*: 254, 262, fig. 16. Azerbaijan.
remipes transcaucasica natio *siganica* SKOR., 1929*a*: 254, 262, fig. 16. Georgia: Mingrelia.
rufiventris, see *florea* var. *rufiventris*.
samarensis MAA, sp. nov. (*postea*). Samar.
scutellata LEP., 1836: 404. Kaffraria. (= *Apis adansonii*).
**semirufa* HOFFMG., 1818: 60. Java (= *Micrapis florea*, vide VON BÜTTEL-REEPEN, 1906).
siciliana GRASSI, 1880: —. Sicily. (= *Apis mellifera mellifera* natio *siciliana*).
siganica, see *mellifera remipes* natio *siganica* and *remipes transcaucasica* natio *siganica*.
sinensis F. SM., 1865: 380, pl. 19, fig. 4. China. (= *Apis cerana*).
siziliana, auctt. (= err. pro *siciliana*).
skorikovi, see *indica skorikovi*.
sladeni, see *binghami sladeni*.
socialis LATR., 1804: 390. India (= *Apis indica*).
sumatrana, see *florea andreniformis* var. *sumatrana*.
syriaca, see *mellifica unicolor* var. *syriaca*.
taurica, see *mellifera taurica*.
tesquorum, see *mellifera mellifera* natio *tesquorum*.
testacea F. SM., 1858: 49. Borneo. (= *Megapis dorsata*).
testacea BINGH., 1898: 129. India: Deesa. (nom. praeocc., nec F. SMITH, 1858). (= *Micrapis florea*).
transcaucasica, see *remipes transcaucasica*.
unicolor LATR., 1804*a*: 168, pl. 13, fig. 4. Madagascar.
vechti linda MAA, subsp. nov. (*postea*). N. Borneo.
vechti vechti MAA, sp. nov. (*postea*). E. Borneo.

zonata GUÉR., 1833: 504, pl. 4, fig. 6. Coromandel. (nom. praeocc., nec LINNÉ, 1758, nec GRAVENHORST, 1807). (= *Megapis dorsata*).

zonata F. SM., 1859: 8. Celebes. (nom. praeocc., nec LINNÉ, 1758, etc.). (= *Megapis binghami*).

VI. GENERIC SEGREGATION

LEPELETIER (1836), using the colour-pattern of the scutellum as a means of distinction, was the first systematist who attempted to divide his species of *Apis* into two artificial groups, but this arrangement was not approved by subsequent authors. The foundation of a natural classification of these insects was laid by GERSTÄCKER (1862), and this was followed by a series of modifications by SMITH, etc. (Table 2).

Table 2. Evolution of GERSTÄCKER's Classificatory System of the Tribus A p i d i n i.

GERSTÄCKER, 1862	g. *Apis*, gp. I (1)	g. *Apis*, gp. II (3)			
SMITH, 1865	„ „ (2)	„ „ (6)			
ASHMEAD, 1904	g. *Megapis* (2)	g. *Apis* (6)			g. *Micrapis* (1)
VON BUTTEL-REEPEN, 1906	"*A. dorsata*"	"*A. mellifica indica*"	"*A. mellifica unicolor*"	"*A. mellifica mellifica*"	"*A. florea*"
ENDERLEIN, 1906	„	"*A. indica*"	„ „	„ „	„
SKORIKOV, 1929 *a*	g. *Apis*, sg. *Megapis* (1)	g. *Apis*, sg. *Apis*, sc. I (4)	g. *Apis*, sg. *Apis*, sc. II (2)	g. *Apis*, sg. *Apis*, sc. III (6)	g. *Apis*, sg. *Micrapis* (1)
The present writer	g. *Megapis* (4)	g. *Apis*, sg. *Sigmatapis* (11)	g. *Apis*, sg. *Apis* (7)		g. *Micrapis* (2)

In the above table, the symbols g., gp., sc. and sg., respectively, are standing for genus, species-group, sectio and subgenus, and the Arabic numerals enclosed in parentheses, for the number of species recognized. As for the synoptic keys of the tribus, so far published, ASHMEAD's

serves only to the separation of the genera *Apis* and *Megapis* (☿); VON BUTTEL-REEPEN's goes as far as species, subspecies and varieties (☿♂); and ENDERLEIN's is a modification of the latter author's key which differentiates only the ☿ caste. GERSTÄCKER, SMITH and SKORIKOV did not formulate any keys.

Genus **Megapis** ASHM., 1904.

Worker. — Large-sized (fore wing 12.5—14.5 mm long). Hairs very long, dense and stiff. Head as broad as or slightly broader than thorax. Clypeus sparsely punctate. Antennal segments III and V each distinctly longer than thick, and subequal in length to each other; IV exceptionally short (fig. 1). Mandibles (figs. 45—48) with "posterior" keels as long as but much broader than main ones. Labial palpi with segment II much longer than III + IV and with a distinct, false, subapical annulet; IV scarcely curved and scarcely longer than III. Glossa narrow, with apical three-fourth densely pubescent and very strongly narrowed. Fore wings strongly infuscated; cell *ap* at most faintly indicated by a short, apical stub of vein M_{1+2}; *3r* normal, not noticeably narrowed apicad. Hind wings each with about 21—32 hamuli; cell *m* basally well separated from *sm;* 1st and 2nd abscissae of vein M_{3+4} always distinct; veins icu_1 and Cu_2 + *1A* forming an acute interior angle; jugal lobes longer than vannal lobes. Basitarsi III (figs. 78—81) long; post-auricular scopal bristles 12—13 rows. Abdominal sterna (figs. 12—14 & 16) very long; preglandular areas each with median length distinctly smaller than that of the corresponding postglandular area; glandulus II usually with anterolateral portions narrowly rounded, anteglanduli III-VI usually weakly retreated at middle; lateroglanduli III-IV weakly curved and posteriorly weakly divergent; wax-plates clearly defined under natural conditions, the VI much longer than broad, posteriorly very strongly produced; lateral marginal areas usually very narrow; sternum III with subapical area scarcely dilated.

Queen. — Unknown to the present writer. From a photograph by ROEPKE (1930), it is practically of the same size as ☿ [1]; the head is about two-thirds as broad as thorax; the abdomen weakly tapers off towards apex which does not exceed the level of wing apices in repose and the tergum I is as broad as II when measured along the posterior margins.

Male. — Almost as long as ☿, but a little stouter. Malar areas linear, very short. Mandibles (fig. 72) with apical teeth small, short, apically

[1] BINGHAM (1897) gave 18—21 mm for body-length of ♀ *M. dorsata* and 16—18 mm for ☿, thus the ♀ is a little larger than the ☿.

narrowly rounded; subapical teeth weakly, roundly curved; "posterior" margins almost straight. Frontal line with anterior two-thirds feebly ridged. Ocellar triangle very strongly raised; ocelli similar in size and shape to one another, but much larger and more prominent than those in ♀; POL about thrice as long as LOL. Antennae (fig. 7) comparatively long; flagellum about 3.5 times as long as scape; segment III shorter than thick and slightly longer than IV; V about 1.5 times as long as thick and much longer than III + IV; VI and following each distinctly longer than thick; hairs on scape shorter than thickness of scape. Hind wings with jugal lobes rather narrower and longer than vannal ones. Tibial spurs I with strigilar scrapers apically pointed. Basitarsi III (fig. 104) subequal in length to femora III, simple, distinctly tetragonal in cross-section, in other words, both "anterior" and "posterior" surfaces strongly carinated along median lines; mediotarsal segments of legs III each about twice as broad as long; distitarsi III similarly shaped as in I or II. Abdomen a little shorter than head and thorax together, slightly broader than head; tergum I, in dorsal aspect, with postero-lateral corners clearly exposed; sterna (fig. 15) very long, posteriorly weakly produced into 2 divergent lobes; antecostae very thin; apodemes moderately long; glanduli weakly curved.

Orthotype. — *Apis dorsata* FABR.

Habitat. — Oriental Region, extending eastwards as far as to Timor. 4 species.

Remarks. — The members of this genus fall into 2 natural groups, which may, if necessary, be considered subgenera. The one comprises *M. breviligula, M. binghami* and *M. dorsata,* the other includes only *M. laboriosa,* which occurs in subalpine regions far away from the distributional centre of honeybees and is clearly more highly specialized in structure than the 3 other species. The chief characters of these 2 groups are to be found in the synopsis of the species in Chapter VIII, section A, couplet 1.

Genus **Apis** LINN., 1758.

= *Apicula* RAFINESQUE, 1814. Principes fond. Somiologie: 27, 429 (nec 29) = *Apiarus* RAFINESQUE, 1815. Analyse nat.: 123. (nom. emend. pro *Apis*).

Worker. — Medium-sized (fore wing 7.00—10.00 mm long). Hairs moderately long, dense and stiff. Head a little narrower than thorax. Clypeus sparsely punctate. Antennal segment III (figs. 2—3) longer than thick, and distinctly shorter than V, but distinctly longer than IV. Mandibles

(figs. 49—64, 139—140) with "posterior" keels much longer and broader than main ones. Labial palpi with segment II much longer than III + IV, lacking a false, subapical annulet; IV weakly curved, distinctly longer than III. Glossa broad, with apical three-fourth densely pubescent and rather strongly narrowed. Fore wings weakly infuscated; cell *ap* at most faintly indicated; *3r* normal, evenly broad. Hind wings each with about 13—24 hamuli; cell *m* basally well distinguishable from or entirely combined with *sm;* 1st abscissa of vein M_{3+4} always distinct, 2nd abscissa often wanting or very short; icu_1 and $Cu_2 + 1A$ forming an acute interior angle; jugal lobes longer than vannal ones. Basitarsi III (figs. 82—97, 146—147) moderately long; post-auricular scopal bristles 8—9 rows. Abdominal sterna (figs. 17—22, 25—26, 29—30, 33—36, 39—40, 133, 136) very short; preglandular areas III-V each usually longer than the corresponding postglandular areas; glandulus II with antero-lateral portions narrowly or broadly rounded; anteglanduli III-VI more or less curved cephalad at middle; lateroglanduli III-IV usually weakly curved inwards and posteriorly weakly divergent to each other; wax-plates poorly defined under natural conditions, the VI as long as broad or slightly broader than long, posteriorly scarcely produced; lateral marginal areas rather narrow; sternum III with subapical area more or less distinctly dilated, never contracted.

Queen. — About 1.5 times as long as ♀. Head about five-sixth as broad as thorax. Mandibles (figs. 67—70, 141—142) basally strongly dilated; apical teeth projecting much beyond level of apical margins of subapical teeth. Antennae as in figs. 5—6. Inter-antennal distance slightly smaller than diameter of an antennal socket. Posterior ocelli with posterior margins lying just on posterior orbital line; POL subequal in length to OOL; oculo-occipital distance subequal to ocello-occipital distance. Hind wings with jugal lobes markedly longer than vannal lobes. Abdomen weakly tapering off towards apex which extends beyond level of wing apices in repose; tergum I as broad as II when measured along posterior margins; sterna (figs. 23, 27, 31, 37, 134, 137) moderately long, the II-V each distinctly broader than long.

Male. — Distinctly longer and more robust than ♀. Malar areas comparatively long. Mandibles (figs. 73—76, 143—145) with "posterior" margins almost straight or distinctly inwardly curved; apical teeth short but rather broad, apically more or less pointed; subapical teeth obliquely truncated at apices. Frontal line with anterior two-thirds distinctly carinated, posterior third sulcated. Ocellar triangle weakly raised; ocelli only slightly larger than those of ♀; anterior ocellus transverse, but not

larger than posterior ones which are roundish; POL about 2.5 times as long as LOL. Antennae (figs. 8—9) comparatively long; flagellum about 3—4 times as long as scape; segment III more or less shorter than thick and as long as or longer than IV; V-XIII each distinctly longer than thick; hairs on scape numerous and longer than thickness of scape. Hind wings with jugal lobes a little narrower but much longer than vannal lobes. Tibial spurs I with strigilar scrapers apically pointed. Basitarsi III (figs. 105—108, 150—152) subequal in length to femora III, simple, and in cross-section, distinctly trigonal, that is, only "posterior" surfaces strongly carinated along median lines; mediotarsal segments of legs III each about twice as broad as long; distitarsi III similarly shaped as in I or II. Abdomen almost as long as head and thorax together, distinctly broader than head; tergum I, in dorsal aspect, with postero-lateral corners clearly exposed; sterna III-V (figs. 24, 28, 32, 38, 132, 135, 138) short, posteriorly strongly produced into two divergent lobes; antecostae very thin; apodemes very long; glanduli rather strongly curved.

Logotype. — *Apis mellifera* LINN. (designated by LATREILLE, 1810).

Habitat. — Malagasian, Ethiopian, Palaearctic and Oriental Regions, chiefly Oriental. This is the largest and the most widely distributed of the 3 modern genera of honeybees and embodies about 17 species.

Remarks. — The word *Apis* in Latin is feminine in gender, means a bee and is probably first put in use by M. T. CICERO and P. VERGILIUS MARO. It appears to be originally derived from Greek *empis* (genit. *empidos*), feminine, a gnat or a mosquito, but not from Greek *Apis* (genit. *Apidos*), masculine, a king of Argos, or, the Peloponnese. Thus strictly speaking, the stem of the generic name *Apis* is *Apid-*, not *Ap-*, and the tribal and other names derived therefrom should be *Apidini*, not *Apini*, and so on.

The members of the genus were recognized by VON BUTTEL-REEPEN (1906) as a single composite species, *A. mellifica*, which was divided by him into 3 "subspecies", *indica*, *unicolor* and *mellifica*, by the length and breadth of body, length of fore wings, extent of vein M_{3+4} (hind wing) and geographical distribution. The "subspecies" *indica* corresponds with subgenus *Sigmatapis* as herein described; subsp. *unicolor* covers all of the forms in Africa and Syria-Palestine; subsp. *mellifica*, those found in Europe, Asia Minor, Transcaucasus and N. Persia. All these were each again subdivided into several "varieties" by colour-pattern and body size or by biological data. SKORIKOV (1929*a*), on the other hand, segregated them into 3 sectiones by the extent of vein M_{3+4} (hind wing), length of preglandular area II, thickness of antecosta II, size and shape of lateral

marginal areas II, size and shape of wax-plates and POL: OOL ratio of ♀ and by the density of pubescence on cheeks of ♂. The Sectio I embodied all of the Oriental species; II, Ethiopian; and III, Palaearctic. The "subspecies" *unicolor* and *mellifica* of VON BUTTEL-REEPEN and the Sectiones I and II of SKORIKOV appear to be only slightly different from each other; they are, accordingly, combined together in the present paper to form a single subgeneric unit.

The 18 species of this genus are so closely allied and superficially alike to one another that a detailed description for each of them would be only monotonous and superfluous. Only *A.* (*Sigmatapis*) *cerana* and *A.* (*A.*) *mellifera*, representatives of the two subgenera, will be treated in such a way for all of the three castes. The colour-pattern of the known species belonging to subgenus *Apis*, s. str. will not be given in the descriptions.

Subgenus **Sigmatapis** [1]) nov.

= *Apis (Apis)* sectio I, SKOR., 1929*a*.

Characters as given in the generic and subgeneric key (*vide infra*).

Orthotype. — *Apis cerana* FABR.

Habitat. — Oriental and Palaearctic (Manchurian Subregion) Regions. About 10 or more species.

Remarks. — Of this subgenus, SKORIKOV (1929*a*) recognized only 4 species and 1 subspecies, *A. johni*, *A. cerana*, *A. indica indica*, *A. indica philippina* and *A. japonica*. He added, however, "Um jedoch auf diesem Wege die in der Natur geltenden Verhältnisse zu erkennen, werden auch andere Forscher daran arbeiten müssen, die ein reicheres Material für dieses Thema, *besonders aus SO-Asien und Malesien besitzen*." In the following account, 11 species in all are recognized as distinct: SKORIKOV's *philippina* is raised to species rank, *japonica* suppressed as a synonym of *cerana*, and his *indica indica* split into 8 species by the revival of *A. peroni*, *A. nigrocincta*, *A. javana* and *A. koschevnikovi* as well as descriptions of *lieftincki*, *vechti* (including *linda*, subsp. nov.) and *samarensis*, spp. nov. Since the Oriental Region is the distribution centre of honeybees and many isolated islands within its limits are still *terra incognita*, a number of novelties certainly remain to be discovered and described. Some local races of the three widely distributed species, *javana*, *indica* and *cerana*, should perhaps be necessarily recognized as distinct subspecies or nationes. *A. nigrocincta* is here divided into two subspecies,

[1]) *σιγμα* (genit. *σιγμαγος*), S-shaped, in allusion to the shape of tibiae III (♂).

including *marginella,* subsp. nov. *A. peroni* and *A. koschevnikovi* are unknown to the writer and their true status is very doubtful.

The members of this subgenus may be allocated to two species-groups by the relative length of POL, arrangement of scopal bristle-rows, relative size of postglandular areas II and VI, relative breadth of lateral marginal areas and relative curvature of lateroglanduli II and of antecosta VI. The first group is represented by *johni, lieftincki* and *vechti,* and the second by *samarensis, indica, philippina,* and *cerana;* whereas *nigrocincta* and *javana* form the intermediate links of these two groups.

Subgenus **Apis** LINN., s. str.

= *Apis (Apis)* sectiones II et III, SKOR., 1929*a*.

Characters as given in the generic and subgeneric key (*vide infra*).

Habitat. — Malagasian, Ethiopian and Palaearctic Regions. About 7 or less species.

Remarks. — Of this subgenus, as here understood, SKORIKOV (1929*a*) enumerated in his text only 5 species, *unicolor, adansoni, meda, mellifera* and *remipes*. The first 2 were placed under his sectio II, the remaining 3 under sectio III. In his map of distribution (pl. 1), 3 additional species were indicated, *cypria, syriaca* and "Egyptian Bee"; the last 2 seem to be unknown to him. And, following his discussions on the systematic position of *A. meda,* mention was also made to Cyprian, Syrian and Anatolian bees, although he failed to give any descriptions. In the present paper, *A. mellifera lamarckii* and *A. mellifera unicolor* var. *intermissa* are raised to the rank of species, and *A. mellifera* is provisionally divided into 4 subspecies, *cypria, syriaca, anatoliaca* (subsp. nov.) and *mellifera,* s. str. Under *A. mellifera mellifera* and *A. remipes transcaucasica,* a number of nationes are also listed.

Genus **Micrapis** ASHM., 1904.

Worker. — Small-sized (fore-wing 6.5—7.0 mm long). Hairs comparatively short, sparse and fine. Head a little broader than thorax. Clypeus densely punctate. Antennal segments III and V each almost as long as thick, and subequal in length to each other (fig. 4). Mandibles (fig. 66) with "posterior" keels as long and as broad as main ones. Labial palpi with segment II subequal in length to III + IV, without a false subapical annulet; IV rather strongly curved, very markedly longer than III. Glossa broad, only apical third very weakly narrowed and with some short pubescence. Fore wings at most weakly infuscated; cell *ap* frequently

clearly defined; *3r* noticeably narrowed apicad. Hind wings each with about 9—15 hamuli; cell *m* basally inseparable from *sm;* vein M_{3+4} entirely coalescent with M_{1+2}; icu_1 apically almost perpendicular to $Cu_2 + 1A$, not so markedly slanting as in *Megapis* or *Apis;* jugal lobes shorter than vannal lobes. Basitarsi III (figs. 98—99) very short; postauricular scopal bristles 8—9 rows. Abdominal sterna (figs. 41—42) moderately long; preglandular areas III-V each slightly longer than the corresponding postglandular area; glandulus II with antero-lateral portions very narrowly rounded; anteglanduli III-V slightly curved cephalad at middle; lateroglanduli III-IV very strongly curved and posteriorly very strongly divergent; wax-plates very poorly defined under natural conditions, the VI exceptionally short (*ca.* 2 × 3), posteriorly not produced at all; lateral marginal areas exceedingly broad; sternum III with subapical area slightly contracted.

Queen. — About twice as long as ☿. Head about two-thirds as broad as thorax. Mandibles (fig. 71) basally moderately dilated; apical teeth not projecting beyond level of apical margins of subapical teeth. Inter-antennal distance about one-third as great as diameter of an antennal socket. Posterior ocelli lying much anteriorly to posterior orbital line; POL twice as long as OOL; oculo-occipital distance distinctly smaller than ocello-occipital distance. Hind wings with jugal lobes slightly longer than vannal lobes. Abdomen strongly tapering off towards apex, which extends beyond level of wing apices in repose; tergum I distinctly broader than II when measured along posterior margins; sterna (fig. 43) very long, for instance V slightly longer than broad.

Male. — Distinctly longer and more robust than ☿. Malar areas comparatively long. Mandibles (fig. 77) with "posterior" margins strongly curved; apical teeth long and pointed; subapical teeth roundly curved. Frontal line, as a whole, distinctly sulcated. Ocellar triangle weakly raised; anterior ocellus transversely elliptical and much larger than posterior ones, which are longer than broad; POL about 3.5 times as long as LOL. Antennae (fig. 10) short, thick; flagellum about 2 times as long as scape; segment III almost as long as thick and distinctly longer than IV; V slightly shorter than thick and slightly shorter than III + IV; VI-XII each more or less shorter than thick; hairs on scape very scanty and much shorter than thickness of scape. Hind wings with jugal lobes scarcely narrower but distinctly longer than vannal lobes. Tibial spurs I with strigilar scrapers apically broadly rounded. Basitarsi III (fig. 109) much shorter than femora III, strongly longitudinally carinated along median lines of "posterior" surfaces and each with a long, ventral lobe

originating near the base; mediotarsal segments of legs III each about 3 times as broad as long; distitarsi III dissimilarly shaped as I or II, only very slightly attenuated towards the base. Abdomen almost half as long as head and thorax together, and a little narrower than head; tergum I, in dorsal aspect, entirely overlapped by II; sterna III-V (fig. 44) moderately long, posteriorly slightly contracted; antecostae exceedingly thick; apodemes moderately long; glanduli weakly curved.

Orthotype. — *Apis florea* FABR.

Habitat. — Oriental Region. 2 species.

The foregoing descriptions of ♀ and ♂ of the genera *Megapis* and *Micrapis* are based upon their type-species. A key to the genera and subgenera, excluding extinct ones, of the tribus follows.

1. Worker: Clypeus densely punctate; antennae (fig. 4) with segments VI-XI each almost as long as thick; mandibles (figs. 65—66) with "posterior" keels as broad as main ones; labial palpi with segment II subequal in length to III and IV together; glossa only with apical 3rd very weakly narrowed and thinly covered with short hairs; fore wings with basal half of cell *3r* noticeably broader than apical half; hind wings with jugal lobes shorter than vannal ones; abdominal sterna (figs. 41—42) with lateroglanduli exceedingly strongly curved, lateral marginal areas very broad, and wax-plates VI only about two-thirds as long as broad. — Queen: Posterior ocelli lying much anteriorly to posterior orbital line; POL about twice as long as OOL; abdominal tergum I distinctly broader than II when measured along posterior margins, sternum V (fig. 43) slightly longer than broad. — Male: Frontal line entirely sulcated; anterior ocellus much larger than posterior ones; antennae (fig. 10) with scape about one-half as long as flagellum, segments V-XII each more or less shorter than thick; mandibles (fig. 77) with apical teeth projecting much beyond level of subapical teeth which are apically always roundly curved; basitarsi III (fig. 109) each with a long, ventral lobe near the base; abdominal tergum I entirely overlapped by II in dorsal aspect, sternal antecostae (fig. 44) exceptionally strongly thickened . . . . . gen. **Micrapis** ASHM.

— Worker: Clypeus sparsely punctate; antennae (figs. 1—3) with segments V-XII each more or less distinctly longer than thick; mandibles (figs. 45—64, 139—140) with "posterior" keels much broader than main ones; labial palpi with segment II much longer than III and IV together; glossa with apical three-fourths suddenly

narrowed and thickly covered with long hairs; fore wings with basal half of cell *3r* not broader than apical half; hind wings with jugal lobes longer than vannal ones; abdominal sterna (figs. 12 *et seq.*) with lateroglanduli almost straight, at most moderately strongly curved, lateral marginal areas moderately broad, and wax-plates VI longer than broad, at most very slightly shorter than broad. — Queen: Posterior ocelli with posterior margins lying just on posterior orbital line; POL not more than 1.5 times as long as OOL; abdominal tergum I as broad as II when measured along posterior margins, sternum V (figs. 23, 27, 31, 37, 134, 137) distinctly shorter than broad. — Male: Frontal line with anterior two-thirds carinated, posterior 3rd sulcated; anterior ocellus not noticeably larger than posterior ones; antennae (figs. 7—9) with scape not more than one-third as long as flagellum, segments V-XIII each distinctly longer than thick; mandibles (figs. 72—76, 143—145) with apical teeth not projecting beyond level of subapical teeth which are roundly curved or obliquely truncated; basitarsi III (figs. 104—108, 150—152) simple, without ventral lobes; abdominal tergum I, in dorsal aspect, with posterolateral corners exposed, sternal antecostae (figs. 15, 24, 28, 32, 38, 132, 135, 138) normal, never exceptionally strongly thickened . . . 2

2. Worker: Fore wings strongly infuscated; antennae (fig. 1) with segment III very slightly longer than V; labial palpi with segment IV robust and scarcely longer than III; post-auricular scopal bristles 12—13 rows; abdomen with glandulus II angulated or narrowly rounded at midpoint, preglandular area II almost always longest at middle; wax-plates clearly defined under natural conditions, the III almost always much shorter than postglandular area III.— Queen: Body as long as or slightly longer than ☿; head about two-thirds as broad as thorax; abdominal apex not exceeding level of wing apices in repose. — Male: Ocellar triangle very strongly raised, ocelli much larger and more prominent than those of ☿; mandibles (fig. 72) with subapical teeth apically roundly curved, "posterior" margins always nearly straight; basitarsi III (fig. 104) tetragonal in cross-section; abdominal sternum II (fig. 15) about two-thirds as long as broad, V posteriorly slightly contracted, never dilated. . . . . gen. **Megapis** ASHM.

— Worker: Fore wings (except in *Apis* (*Sigmatapis*) *johni*) at most weakly infuscated; antennae (figs. 2—3) with segment III distinctly shorter than V; labial palpi with segment IV slender and distinctly longer than III; post-auricular scopal bristles 8—9 rows; abdomen

with glandulus II very weakly arcuate at middle, preglandular area II never longest at middle; wax-plates poorly defined under natural conditions, the III usually as long as or slightly longer than postglandular area III. — Queen: Body about 1.5 times as long as ☿; head about five-sixths as broad as thorax; abdominal apex extending beyond level of wing apices in repose. — Male: Ocellar triangle weakly raised, ocelli as large and as prominent as those of ☿; mandibles (figs. 73—76, 143—145) with subapical teeth apically obliquely truncated, never roundly curved, "posterior" margins either nearly straight or S-shapedly curved; basitarsi III (figs. 105—108, 150—152) trigonal in cross-section; abdominal sternum II (figs. 24, 28, 32, 38, 132, 135, 138) about half as long as broad, V posteriorly strongly dilated, never contracted 3

3. Worker: Hind wings always with a well developed 2nd abscissa of vein M_{3+4}, which is at least 2.5 times as long as 1st abscissa, cell *sm* basally sharply separated from *m;* scopae almost always lacking an extra, short bristle-row intermediately to 1st and 2nd rows, the midpoints of the latter 2 rows being separated from each other by a distance at most 1.3 times as great as that for 2nd and 3rd rows; glandulus II (figs. 17 *et seq.*) antero-laterally narrowly rounded. — Queen: Mandibles (figs. 67—69) not obliquely keeled, subapical teeth apically emarginated, not truncated; antennal segment IV (fig. 5) slightly longer than III or V; basitarsi III (figs. 100—102) with rather prominent auricles; postglandular area VI subtriangular, posteriorly rounded, entire, never bilobed. — Male: Antennal segment III (fig. 8) distinctly longer than IV, V slightly longer than thick and about as long as III and IV together; mandibles (figs. 73—75) with "posterior" margins almost straight; tibiae III (figs. 105—107) in profile strongly S-shapedly curved along "dorsal" margins; preglandular areas III-V (figs. 24, 28, 32) at most half as long as the corresponding postglandular areas . . . . . gen. **Apis** LINN. (subgen. **Sigmatapis** nov.)

— Worker: Hind wings never with a well developed 2nd abscissa of M_{3+4}, which, when present, is at most half as long as 1st abscissa, cell *sm* often entirely merged into *m;* scopae almost always with an extra, short bristle-row lying intermediately to 1st and 2nd rows, the midpoints of the latter 2 rows being separated from each other by a distance about 1.5—2.0 times as great as that for 2nd and 3rd rows; glandulus II (figs. 33 *et seq.*) antero-laterally broadly rounded. — Queen: Mandibles (figs. 70, 141—142) distinctly obliquely keeled,

subapical teeth apically truncated, not emarginated; antennal segment IV (fig. 6) distinctly shorter than III or V; basitarsi III (figs. 103, 148—149) with scarcely recognizable auricles; postglandular area VI (fig. 37, 134, 137) subquadrangular, posteriorly clearly bilobed. — Male: Antennal segments III and IV (fig. 9) subequal in length, V about twice as long as thick and distinctly longer than III and IV together; mandibles (figs. 76, 143—145) with "posterior" margins distinctly undulated; tibiae III (figs. 108, 150—152) in profile very weakly curved along "dorsal" margins; preglandular areas III-V (figs. 38, 132, 135, 138) as long as, or even slightly longer than the corresponding postglandular areas . . gen. **Apis** LINN. (subgen. **Apis** s. str.)

VII. REVIEW OF THE SPECIES

As mentioned in previous chapters, the reclassification of honeybees of the World is confronted by many difficulties, because: (a) the literature on this group of insects is exceedingly scattered and voluminous; (b) their caste polymorphism and intraspecific variability are very strong; (c) the most distinctive characters for a honeybee species or subspecies are only to be found on the entirety of its three castes, but what has been known or described nearly always belonged to the ☿ caste, the ♀ and ♂ being usually rarities in collections; (d) the published specific and infra-specific names of honeybees are quite numerous, for the about 24 known species and subspecies, something like 80 "names" having been proposed even when the emended and variant forms are excluded; (e) the type specimens of the "old" honeybee species, contrary to others, are virtually useless for any critical re-examination; and (f) with very few exceptions, the existing descriptions are terribly disappointing. In the following lines, an attempt is undertaken to re-arrange and re-define all known species and subspecies as far as adequate material is available. No comments, however, are made to the infrasubspecific categories. The listing of the nationes of *Apis* (*Apis*) *mellifera mellifera* and *A.* (*A.*) *remipes transcaucasica* as well as varieties of *Megapis dorsata* and *Micrapis florea* does not mean that the systematic (not nomenclatural) status of such "names" is definitely recognized or established in the present paper, nor does the writer think it advisable to accept them as distinct. The mandibles, tibiae III, basitarsi III, scopal bristle-rows (☿) and abdominal sterna for each species or subspecies and for its three castes are presented in the form of figures, since verbal descriptions of these structures would be less comprehensive but more difficult. Further supply of material may serve to increase our knowledge of certain details at present not worked out.

Megapis breviligula, sp. nov.

= *Apis dorsata* var. *zonata* (partim), auctt. = *A. binghami* (partim), auctt.

Worker. — Colour-pattern similar to that of *M. binghami;* wings a little paler, also with bronzy iridescence; mesopleura with comparatively smaller patches of sooty brown hairs. Ocelli as in *M. dorsata;* POL: OOL: IOL about 13 : 9 : 7. Mandibles (fig. 45) with apical portions scarcely broader than basal. Relative lengths of segments I, II and III + IV of labial palpi about 38 : 18 : 8. Tibiae and basitarsi III as in fig. 78; pre-auricular scopal bristles with about 2 regularly arranged rows; post-auricular bristles (fig. 110) 13 rows, the 2nd irregularly arranged and a little more distant from 1st rather than from 3rd. Wax-plates (fig. 12) comparatively larger than those of *M. binghami,* III posteriorly not widely separated; lateral marginal areas V much shorter than in *M. binghami;* sternum V with median length/posterior breadth about 0.69. Length of body about 16—18 mm, fore wing 13—14 mm, tongue 4.65 mm; relative breadths of head, thorax and abdomen about 117 : 110 : 136.

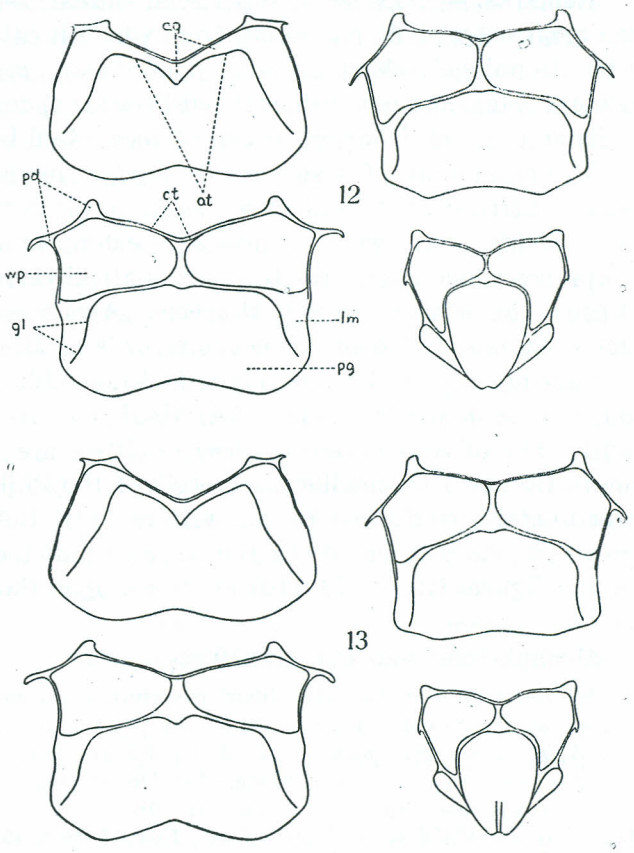


Fig. 12. *Megapis breviligula,* sp. nov. ♀, abdominal sterna II, III, V and VI. *ag,* preglandular area; *at,* anteglandulus; *ct,* antecosta; *gl,* lateroglandulus; *lm,* lateral marginal area; *pd,* apodeme; *pg,* postglandular area; *wp,* wax-plate. Fig. 13. *Megapis binghami* (CKLL.) ♀, abdominal sterna II, III, V and VI.

Queen & Male.— Both unknown.

Specimens examined. — Luzon: Los Baños, 11.iv.1928 (S. TAKANO), 1 ♀ (Holotype).

Mindoro: San José, 13.iii.1945 (ROSS & SKINNER), 2 ♀. "Philippine", 1 ♀ (det. T. SHIRAKI as *Apis dorsata binghami*). Holotype partly mounted on slides, in the Taiwan Agric. Res. Inst.; 1 paratype in California Acad. Sci., 2 further paratypes in the author's collection.

Distribution. — Philippine Is. (Luzon, Mindoro).

Remarks. — Because of superficial similarities, this species has often been confused with *M. binghami*, from which it can be readily distinguished by its uniquely short glossa, longer malar areas, less strongly raised ocellar triangle and much shorter but broader abdominal sternum V. From *M. dorsata* and *M. laboriosa* it can be recognized by much darker pattern.

The occurrence of a species of *Megapis* in the Philippines was first noted by SMITH (1865) in his discussions on the synonymy of "*Apis*" *nigripennis* and "*A.*" *dorsata:* "I have seen examples of a black bee from the Philippines which may prove to be a climatical variety of *A. dorsata:* it has not the ocelli so large as the next species (*Apis zonata* F. SM.)". This statement subsequently led to erroneous records of *M. dorsata* or *M. binghami* as occurring on these islands. Thus, ASHMEAD (1904) recorded "*M. zonata*" from Bacoor, and COCKERELL[1]) "*A. binghami*" from Mount Banahao and Manila. The above-mentioned three localities are all in Luzon I. SMITH's remark (*loc. cit.*) on smaller-sized ocelli of the Philippine "black bee" was unfortunately overlooked by all writers until ROEPKE (1930) raised the question whether it was really the same as that from Celebes. The accompanying figures (12, 45, 78, 110) are based upon the holotype (No. Ap-012).

Megapis binghami (CKLL.), 1906.

= *Apis zonata* F. SM., 1859 (nom. praeocc.) = *A. dorsata binghami* CKLL., 1906 (nom. nov. pro *A. zonata* F. SM.).

1896. *Apis dorsata* var. *zonata*, D.T.: 590 (bibliography).
1897. *Apis dorsata* var. *zonata*, BINGH.: 558 (description).
1904. *Megapis zonata* (partim), ASHM.: 121 (list).
1906. *Apis dorsata* var. *zonata* (partim), BUTT.-REEP.: 167 (synonymy), 169 (key to varr. ♀), 195 (description; Celebes & "Java" records).
1906. *Apis dorsata* var. *zonata*, ENDERL.: 340 (Celebes record), 341 (key to varr. ♀).
1929. *Apis dorsata* form *binghami*, DOVER: 65 (key to "forms" ♀).
1930. *Apis zonata*, ROEPKE: 7—8 (Celebes record; synonymy).

Worker. — Integument almost uniformly pitchy black; labrum (anterior margin), mandibles (apices), antennae (excluding segments I-IV) and medio- and distitarsi I more or less tinted with reddish: proboscis reddish brown; wings a little darker than typical *M. dorsata*, with a little

[1]) COCKERELL, T. D. A. 1919. Philipp. J. Sci., Manila 14 : 80; *Ibid.* 1920. *op. cit.* 16 : 632.

bronzy iridescence. Pubescence dominantly black or sooty brown (pale hairs only found on face where they are very short, whitish, decumbent and concealed by long, black ones); yellowish brown to dirty brown on genal areas, occiput, scutum II (lateral and posterior margins), scutellum, thoracic pleura (with a large patch of brown hairs on each mesopleuron), thoracic sterna, propodeum, coxae, trochanters, femora, tibiae III ("anterior" surfaces) and abdominal tergum I (anterior and lateral margins) and sternum I; and golden red on labrum, mandibles and tarsi I-II (ventral surfaces) and III ("posterior" surfaces). Ocelli comparatively large, very prominent; ocellar triangle very strongly raised and thus posterior ocelli each placed on a plane of about 50° to main surface; POL: OOL: LOL about 11:8:7. Mandibles as in fig. 46. Relative lengths of segments I, II and III + IV of labial palpi about 39:17:8. Tibiae and basitarsi III as in fig. 79; pre-auricular scopal bristles with about 1 regularly arranged row; post-auricular bristles (fig. 111) 13 rows, the 2nd rather irregularly arranged and scarcely more distant from 1st than from 3rd. Wax-plates (fig. 13) being the smallest of the genus, the III posteriorly widely separated from each other; sternum V very long, median length/posterior breadth about 0.77, lateral marginal areas exceptionally long and posterior margin very weakly curved. Length of body about 15—17 mm, fore wings 14.0—14.5 mm, tongue 6.27 mm; relative breadths of head, thorax and abdomen about 121—122: 115—116: 129—138.

Queen & Male. — Both unknown.

Specimens examined. — S.W. Celebes: Neengo, Watampone, 500 m, 22.vi.1936 (L. J. TOXOPEUS), 1 ♀ W. Celebes: Palu, xii.1936, 1 ♀. C. Celebes: Palopo, 2 ♀; Palopo, Todjambu, 900—1000 m, vii.1936 (L. J. TOXOPEUS), 4 ♀; N. Celebes: Menado, 10.xi.1937 (J. S. PHILLIPS), 1 ♀; id., Tondano, 30.v.1940 (R. G. WIND), 3 ♀. W. Celebes: Bay of Mamudju, 4—5.viii.1929 (SNELLIUS Exped.), 3 ♀.

Sula Is., Lampao, Mangoli I., 5 m, ix.1939 (S. BLOEMBERGEN), 2 ♀; Taliabu I., 18.iii.1930 (SNELLIUS Exped.), 2 ♀.

Distribution. — Celebes; Sula Is. (new record); Buton (vide MÜLLER).[1])

Remarks. — The "key characters" of this species are the very short wax-plates and strongly raised ocellar triangle. SMITH (1865) distinguished it from *M. dorsata* by the following 6 points: (a) larger size, 9 *vs.* 7.5 lines; (b) abdomen very convex above; (c) abdominal terga II-V each with an anterior band of snow-white pubescent pile; (d) basitarsi III different in shape; (e) ocelli relatively larger; and (f) face not pubescent. As noted

[1]) MÜLLER, S. 1857. Reisen en Onderz. in den Ind. Arch. 2: 17.

elsewhere in the present paper, SMITH's points (a) and (b) are of very little, if any, diagnostic value, (c) is a common feature of almost all ☿ honeybees, (d) and (e) are good characters, whereas (f) is scarcely true at all, since the whitish pubescence on the face of this species in only slightly less extensive and black hairs thereon comparatively shorter than in *M. dorsata*. This species is not recognized by SKORIKOV (1929*a*). The record of its occurrence in Java by VON BUTTEL-REEPEN (1906) is doubtless an error. The accompanying figures (13, 46, 79, 111) are based upon specimens from Todjambu (Nos. Ap-013 & Ap-025).

Megapis dorsata (FABR.), 1793.

= *Apis dorsata* FABR., 1793 = *A. nigripennis* LATR., 1804 = *A. bicolor* KLG., 1807 (nom. praeocc.) = *A. zonata* GUÉR., 1833 (nom. praeocc.) = *A. testacea* F. SM., 1858.

1896. *Apis dorsata* + var. *bicolor* + var. *testacea* (excl. var. *zonata*), D.T.: 589 - 590 (bibliography).

1897. *Apis dorsata* + var. *bicolor* + var. *nigripennis* + var. *testacea* (*excl.* var. *zonata*), BINGH.: 557 (key to spp. ☿), 577 - 578 (descriptions; India, Burma, Tenasserim, Ceylon & China records), pl. 4, fig. 11 (☿).

1904. *Megapis dorsata* + var. *bicolor* + var. *testacea*, ASHM.: 121 (Strait Settlement record).

1906. *Apis dorsata* var. *dorsata* + var. *testacea* (excl. var. *zonata*), BUTT. - REEP.: 163 (evolution), 167 (synonymy), 168 (key to spp. ☿), 169 (key to varr. ☿), 169 - 170 (descriptions of ♀♂), 194 - 196 (descriptions of ☿ ♂; Java, Sumatra, Assam, Ceylon, Borneo, Palawan, Philippine Is. & Annam records), text-fig. 7 (photograph of ♂).

1906. *Apis dorsata* typ. + var. *testacea* (excl. var. *zonata*), ENDERL.: 340 (India & Sumatra records), 340 (key to spp. ☿), 341 - 342 (key to varr. ☿), text-fig. 4 (☿ labial palpus).

1929*a*. *Apis* (*Megapis*) *dorsata*, SKOR.: 250 & 259 (descriptions), pl. 2 (distribution), text-fig. 2 (☿ abd. sterna).

1929. *Apis dorsata* (typica, typical form) + form *testacea* (excl. forms *binghami* & *sladeni*), DOVER: 64 (Malay Penin., Borneo, India, Ceylon, Andamans, Sumatra & Cochin-China records), 65 (key to "forms" ☿), 68 (Malay Penin. & Peninsular Siam records).

1930. *Apis dorsata*, RÖEPKE: 8 - 23 (review of literature on geographical distribution & bionomics; biology in Java & Sumatra), pls. 2—4 & 6 (photographs of the comb), 5 (photograph of the 3 castes).

Worker. — Integument shining black; proboscis yellowish brown; labrum, mandibles (apices), tegulae, scutellum and legs more or less paler, usually chestnut brown; abdomen with terga I-II and sternum I honey-yellow, the following ones gradually turning to dirty black towards abdominal apex. Fore wings fusco-hyaline, with a little purplish iridescence, darkest in cells *bm* (apical margin), *r*, *3r* (particularly costal margin) and

2m (anal margin); palest at basal cells; apical margins slightly paler than submarginal areas; veins at costal areas blackish brown and those at anal areas reddish brown; stigmata also blackish brown. Hind wings paler, evenly and very slightly stained with brownish, basal areas almost clear hyaline; veins correspondingly paler. Pubescence on frons short, decumbent, very dense and whitish, intermixed with a few rather long, erect, black hairs; on clypeus short, fine, black; on vertex very long, stiff, black; on eyes short, fine, brown; on genal areas and occiput long, yellowish; on notum I and scutum II moderately long, black; on thoracic pleurae and sterna very long, dominantly sooty brown; on scutellum and propodeum long, yellowish; on legs brown, longest on coxae and trochanters and shortest but stiffest on venter of tibiae I-II and "posterior" surfaces of III; and on abdominal terga short, very dense, decumbent, yellowish brown, that on III and following usually gradually turning to black towards abdominal apex. Tibiae and tarsi III fringed with black hairs; tarsi I-II ventrally and III "posteriorly" thickly covered with golden red hairs; abdominal tergum I anteriorly and laterally (in dorsal aspect) fringed with a few long, yellowish hairs; sterna II-V each anteriorly with a transverse band of short, decumbent, whitish hairs (as in terga, usually concealed underneath their corresponding preceding sterna when contracted) and posteriorly fringed with long, brownish hairs.

Ocelli comparatively small, moderately prominent; interspace of posterior ocelli comparatively weakly raised; POL: OOL: LOL about 12: 13: 6. Antennae as in fig. 1. Mandibles as in fig. 47. Relative lengths of segments I, II and III + IV of labial palpi about 38: 16: 9. Tibiae and basitarsi III as in fig. 80; the former very short; pre-auricular scopal bristles with 3—4 regularly arranged rows; post-auricular bristles (fig. 112) only 12 rows, the 2nd regularly arranged and a little more distant from 1st than from 3rd. Wax-plates (fig. 112) still larger than those of the preceding species, the V laterally distinctly produced caudad; sternum V posteriorly rather deeply emarginated, median length/posterior breadth about 0.77. Length of body about 14.5—18.0 mm, fore wing 12.5—13.0 mm, tongue 5.96 mm; relative breadths of head, thorax and abdomen about 112—116: 102—110: 116—130.

Queen. — Unknown to the writer. From a photograph given by ROEPKE (1930), fore wings much darker than in ♀, abdominal terga uniformly black.

Male. — Head and thorax black; antennae yellowish brown with "posterior" surfaces a little darker; tegulae and legs I-II blackish brown

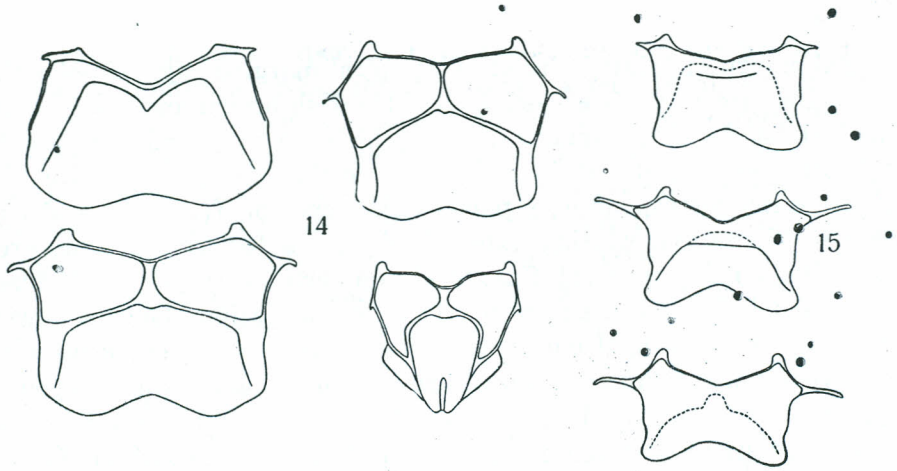


Fig. 14-15. *Megapis dorsata* (FABR.), abdominal sterna II, III, V and VI of ♀ (14) and II, III and V of ♂ (15).

(medio- and distitarsi paler); legs III almost uniformly reddish brown. Wings clear hyaline, cell *bm* costo-apically very weakly stained with brownish; veins yellowish brown, the costal ones and stigmata brown. Abdomen also reddish brown; terga V-VI dull brown, VII chestnut brown; 1st claspers of sternum VIII black; genital aperture chestnut brown. Pubescence short, dense, dirty brown; that on "postero"-dorsal margins of basitarsi III black; on abdominal tergum I long, yellowish; on posterior margins of II-IV short, sparse, bright brown; on V-VI very long, dense, dirty brown; on sterna long, yellowish; on surroundings of genital aperture short, stiff, decumbent, brownish black. POL : OOL about 7 : 1.5. Antennae as in fig. 7. KRÜGER's index 325. Mandibles as in fig. 72. Prementum with L/B = 3.10. Premento-palpal index 68.89; relative lengths of segments I, II aan III + IV of labial palpi about 30 : 9 : 6. Wings as in fig. 11; cell *3r* (fore wings) with L/B = 9.64, radial index 80.00; jugo-vannal index 146.55. Tibiae and basitarsi III as in fig. 104. Abdominal tergum II finely, densely punctate; sterna as in fig. 15. Length of body about 17 mm, fore wing 14 mm, tongue 3.15 mm; relative breadths of head, thorax and abdomen about 120 : 146 : 119.

Specimens examined. — India: Agra, 28.iii.1929 (G. LINSLEY), 8 ♀; Anaimalai Hills, 4—5000 ft, S. India, x.1946 (P. S. NATHAN), 1 ♀; Birbhum Distr., Bengal, x.1937 (T. MAA), 26 ♀; Calcutta, 1937—1938 (T. MAA), 6 ♀; Fetchpur Sikri, near Agra (T. D. A. COCKERELL), 1 ♀.

Ceylon: 5 ♀.

Siam: Doi Sutep, iv.1929 (Mrs MCKEAN), 1 ♀; Nam, 31.xii. (T. D. A. & Mrs COCKERELL), 1 ♀.

Tonkin: Hoa-Binh, vii.1940 (A. DE COOMAN), 1 ☿.

Hainan: "Hainan Exped.", ii-v.1934 (C. HO), 40 ☿; "Hainan", 4 ☿ (ex coll. T. SHIRAKI).

N. Sumatra: Medan, 3.ix.1937 (P. A. VAN DER LAAN), 1 ☿; same loc., 1929 (W. ROEPKE), 2 ♂; Pendeng, Atjeh, 400 m, ii-iii.1937 (A. HOOGERWERF), 10 ☿; Tinggi Radja, 18.vi.1939 (P. A. VAN DER LAAN), 1 ☿.

Nias: Gunung Sitoli, Nias, 1 ☿ (det. H. FRIESE).

Mentawei Is.: Siberut I., ix.1924 (C. BODEN KLOSS & N. S.), 2 ☿.

Riouw-Arch.: Durian I., vi.1923 (K. W. DAMMERMAN), 1 ☿, 2 ♂.

W. Java: Bolang near Bogor, 600 m, 11.v.1930 (M. A. LIEFTINCK), 1 ☿; Depok, 25.xi.1920, 1 ☿; Mt Pantjar, Bogor, 300 m, 27.ix.1936 (J. VAN DER VECHT), 2 ☿; same loc., i.1936 (F. DUPONT), 1 ☿; Palabuanratu, Tjisolok, xii.1935 (F. DUPONT), 3 ☿; same loc., 2.v.1932 (M. A. LIEFTINCK), 1 ☿; Priangan, Pameungpeuk, 400 m, 11.vii.1934 (M. A. LIEFTINCK), 1 ☿; Mt Salak, G. Bunder, 700 m, 6.vi.1931 (M. A. LIEFTINCK), 1 ☿; Sukanegara, 400—1000 m, ii.1940 (native coll.), 1 ☿; E. Java, Idjen Plateau, Blawan, xii.1935 (TOXOPEUS), 1 ☿; same loc., 14.xii.1939 (H. LUCHT), 1 ☿.

Borneo: Central E. Borneo, viii.-x.1925 (H. C. SIEBERS), 4 ☿; "Borneo", 2 ☿, 1 ♂ (ex coll. T. SHIRAKI); E. Borneo, Balikpapan, Mentawir R., 50 m, x. 1950 (A. M. R. WEGNER), many ☿.

Flores: Mbura, vi.1937 (J. K. DE JONG), 3 ☿.[1])

Wetar: Wetar, 1898 (C. & K. SCHÄDLER), 5 ☿.

Timor: Menas, 1200 m, Atapupu Forest, 5.vii.1949 (H. VOS), 1 ☿.

Distribution. — India; Ceylon; Indochina; China (Hainan Id.); Malay Penin.; Andaman Is.; Sumatra; Mentawei Is. (new record); Riouw Arch.; Java; Borneo; Palawan; Lombok; Flores; Wetar; Kisar; Roma; Timor; Kei Is.

Remarks. — The workers of this species are generally subdivided into 3 "varieties" according to the extent of pale pubescence on abdominal terga, namely: (a) var. *bicolor* (KLG.) (nom. praeocc.!), terga I-II honey-yellow, III-VI black, in strong contrast; (b) forma typica, I-II and most part of III honey yellow, IV-VI black or sooty brown; (c) var. *testacea* (F. SM.), I-V or I-VI entirely pale testaceous, VI sometimes blackish, integument (including wings) paler, undoubtedly being newly-emerged individuals.

[1]) The probable occurrence of *Megapis dorsata*, or a closely allied species or subspecies, on the island Alor (between Flores and Wetar), is hinted at by a unknown observer who published some observations on huge nests of true honeybees in tall trees of Canarium in a ravine on that island (Tijdschr. Kon. Ned. Aardrijksk. Gen. 37, 1920 : 787). On the other hand, there is definite proof that no species of honeybee has ever been observed on the island Sumba. Recent information obtained from the native population by members of the Swiss Sumba Expedition 1948, has confirmed earlier reports stating that honey, as a product of food, is unknown in the island. — M. A. LIEFTINCK (Ed.)

The scopal bristles of "*dorsata*" (= *dorsâta* + *binghami*, as redefined here) were described by VON BUTTEL - REEPEN (1906) as of 15 rows, of which 2—3 inconspicuous, by SMITH (1865), of 14 rows. The result of the present writer's observations is that: pre-auriculars 3—4 rows (if 4, then 1 of them is short or incomplete), post-auriculars 12 rows. This is the commonest and most widely distributed species of the genus. The accompanying figures (1, 7, 11, 14, 15, 47, 72, 80, 104, 112) are based upon a ♀ specimen from Hainan (No. Ap-030) and a ♂ from Borneo (No. Ap-018).

Megapis laboriosa (F. SM.), 1871.

= *Apis laboriosa* F. SM., 1871 = *A. binghami sladeni* CKLL., 1914 = *A. himalayana* MAA, 1944 (nom. nud.).

1896. *Apis laboriosa*, D. T.: 594 (bibliography).

1929. *Apis dorsata* form *sladeni*, DOVER: 65 (key to "forms" ♀).

Worker. — Colour-pattern similar to *M. binghami;* wings slightly paler, with a little purplish iridescence; pale hairs also found on ocellar triangle (more or less intermixed with black ones) and covering entire thorax (a little darker on disc of scutum II), abdominal tergum 1 as a whole and all sterna. Ocelli comparatively small, scarcely prominent; posterior ocelli with scarcely raised interspace, each being placed on a plane of only about 35° to main surface; POL: OOL: LOL about 10: 17: 7. Mandibles as in fig. 48. Relative lengths of segments I, II and III + IV of labial palpi about 43: 20: 9. Tibiae and basitarsi III as in fig. 81; basitarsi in profile conspicuously narrowed apicad; pre-auricular scopal bristles entirely irregularly arranged; post-auricular bristles (fig. 113) only 12 rows, the 2nd regularly arranged and about 1.5 times as distant from 1st as from 3rd. Wax-plates (fig. 16) being the largest of the genus; anteglandulus II medially arcuate, not angulated, III-V each medially produced cephalad, not weakly curved caudad; median length/posterior breadth of sternum V about

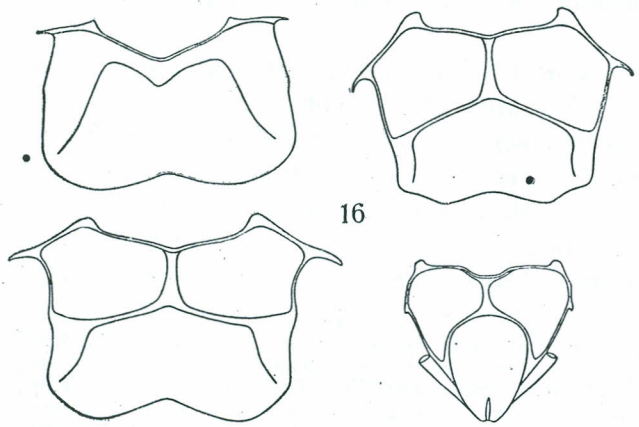


Fig. 16. *Megapis laboriosa* (F. SM.) ♀, abdominal sterna II, III, V and VI.

0.77. Length of body about 18—19 mm, fore wing 13.0—13.5 mm, tongue 6.08 mm; relative breadths of head, thorax and abdomen about 120—130: 121—130: 123—135.

Queen & Male. — Both unknown.

Specimens examined. — India: Tiger Hill, Darjeeling, 2450 m, 30.iv. 1938 (T. MAA), 2 ☿.

China: Tsé-kou, (R. OBERTHÜR ex MGR. SOULIÉ), 1 ☿; "China", 1 ☿ (ex coll. T. SHIRAKI).

(?) "Philippines", 1 ☿ (det. T. SHIRAKI as "*A. dorsata* var. *binghami*").

(?) "Tabu", 1 ☿ (record from the Amer. Mus. Nat. Hist.).

Distribution. — India (Sikkim; Assam); China (W. Yunnan). Probably also occurring in N. Burma.

Remarks. — In the original description, the abdomen of this species is said to be almost naked and without anterior bands of whitish pubescence on terga III-V. Both of these two points are not true for the specimens at hand, except perhaps for the one from Tsé-kou, of which the black, decumbent hairs have doubtless already been rubbed off.

This is the most highly specialized species of the genus, which can be very easily distinguished from all its congeners by the less prominent ocelli, longer malar areas, much paler thoracic pubescence, much broader lateral marginal areas II, much longer wax-plates and peculiar curvature of glanduli. In the structure of its abdominal sterna, it clearly exhibits some affinities which ally it to the next species, *Apis* (*Sigmatapis*) *johni*.

This species has long been neglected since the appearance of its original description, except by VON BUTTEL-REEPEN (1906), who treated it as a synonym of "*A. dorsata* var. *zonata* F. SM." and COCKERELL (1914) as a new subspecies (*sladeni*) of "*A. binghami*". The accompanying figures (16, 48, 81, 113) are based upon a specimen from Darjeeling (No. Ap-004).

Apis (Sigmatapis) johni SKOR., 1929.

Worker. — Unknown to the present writer.

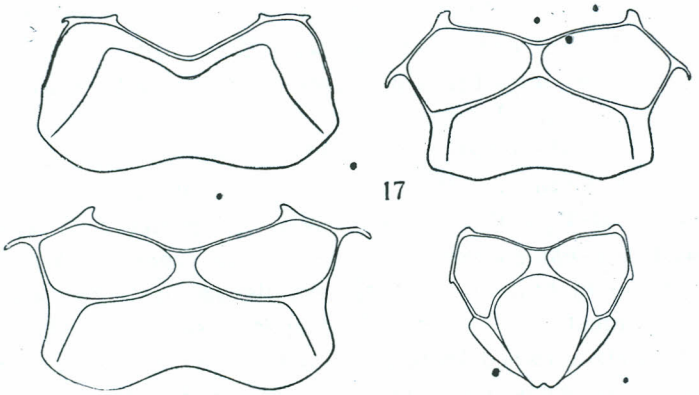
Queen & Male. — Undescribed.

Distribution. — "Sumatra".

Remarks. — From the original description, this remarkable species is the most primitive member of the genus and is unique for the subgenus in having (a) anteglandulus II medially strongly convergent to antecosta II which is medially thickened, (b) antecosta VI almost straight, (c) postglandular area VI exceptionally long, and (d) glanduli III-IV anterolaterally weakly angulated and slightly produced cephalad. The wings are said to be "einfach angeraucht".

Apis (Sigmatapis) lieftincki, sp. nov.

Worker. — Colour-pattern similar to *A. javana,* but abdominal terga with black bands more extensive. POL: OOL about 7 : 10. Mandibles (fig. 49) very broad, "anterior" margins shallowly incised. Tibiae and basitarsi III as in fig. 82; post-auricular scopal bristles (fig. 114) 9 rows, the 2nd scarcely divergent from 1st. Abdominal sterna (fig. 17) with very long postglandular areas; glanduli III-IV antero-laterally narrowly rounded. Length of body about 11—12 mm, fore wing 8.0—8.5 mm, tongue 4.31 mm.



17

Fig. 17. *Apis* (*Sigmatapis*) *lieftincki,* sp. nov. ☿, abdominal sterna II, III, V and VI.

Queen & Male. — Both unknown.

Specimens examined. — S. Sumatra: Mt. Tanggamus, 550 m, SW. Lampong Distr., xii.1939 (M. A. LIEFTINCK), 5 ☿. Holotype and 1 paratype in the Bogor Museum, 3 further paratypes in the author's collection.

Remarks. — The arrangement of apical scopal bristle-rows of this species is unique for the subgenus with the possible exception of *A. johni,* which is also described from Sumatra. At first sight, it was supposed to be a "major form" of the widely distributed *A. javana.* Since its abdominal sterna II-III are so markedly distinctive from those of either of them, it seems justified to consider this a distinct species. From *A. vechti,* which appears to be rather closely related, it can be distinguished by duller pattern, much shorter tongue, much narrower basitarsi III, and details of the sterna. The accompanying figures (17, 49, 82, 114) are based upon one of the paratypes (No. Ap-008).

Apis (Sigmatapis) vechti vechti, sp. nov.

Worker. — Almost uniformly reddish yellow, with frons, vertex, genal areas, occiput, notum II and thoracic pleura and sterna all black;

pedicels, flagella and tarsi II-III dull brown; wings weakly coppery iridescent, distinctly stained with brownish, dullest along costal margins, yellowish on basal areas; abdominal terga I-V usually posteriorly a little darkened. Pubescence uniformly reddish yellow, except for a few erect, brown hairs on clypeus, supraclypeal area and vertico-occipital margin. POL: OOL about 6.5 : 10. Mandibles as in fig. 50. Tibiae and basitarsi III as in fig. 83; post-auricular scopal bristles (fig. 115) 9 rows, the 2nd equidistant from 1st and 3rd. Abdominal sterna (fig. 18) with pregland-

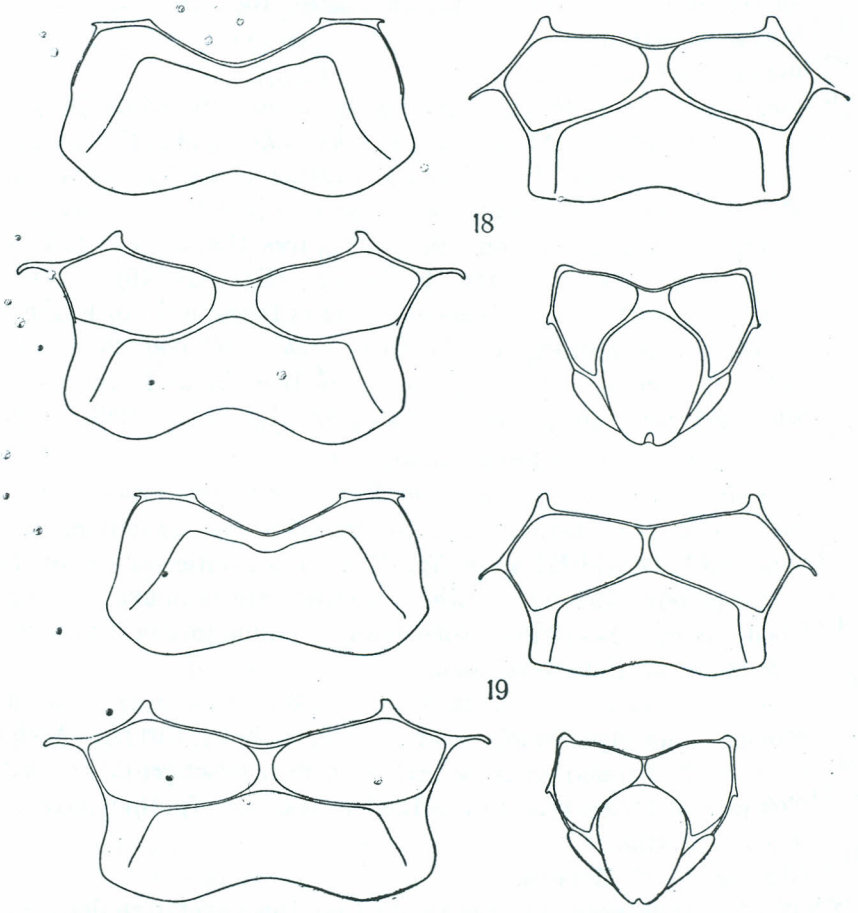


Fig. 18. *Apis* (*Sigmatapis*) *vechti vechti*, sp. nov. ♀, abdominal sterna II, III, V and VI. Fig. 19. *Apis* (*Sigmatapis*) *vechti linda*, subsp. nov. ♀, the same as in fig. 18.

ular area II short, lateral marginal areas II-III narrow and post-glandular areas very long. Length of body about 10—11 mm, fore wing 8.5—9.0 mm, tongue 6.15 mm.

Queen & Male. — Both unknown.

Specimens examined. — E. Borneo: Sangkulirang, Kariorang, 50 m, iv.1937 (Mrs M. E. WALSH), 1 ♀ (Holotype); same region, Maluwi, 0 m, and Pelawanbesar, 0 m, v.1937 (Mrs M. E. WALSH), 3 ♀; Central E. Borneo, 17—19.ix.1925 (H. C. SIEBERS), 2 ♀; "Borneo", 1 ♀ (det. T. SHIRAKI as *Apis mellifera* var. *koschevnikovi* BUTT. - REEP.!); E. Borneo, Balikpapan, 50 m, Mentawir R., 3—6.x.1950 (A.M.R. WEGNER), many ♀. Holotype and 2 paratypes deposited in the author's collection, further paratypes in the Bogor Museum, Taiwan Agric. Res. Inst. and Dr J. VAN DER VECHT's collection.

Distribution. — E. Borneo.

Remarks. — This species can very easily be distinguished from all other honeybees (except the African *A. koschevnikovi*), by the uniform rufous pattern. Structurally, it is chiefly characterized by short wax-plates, short POL and long postglandular areas and is rather closely allied to the preceding species. The accompanying figures (18, 50, 83, 115) are based upon a paratype from Central E. Borneo (No. Ap-046). As mentioned above (Chapter V), typical *koschevnikovi* is found only in Kamerun and beyond doubt has nothing to do with *vechti*. ENDERLEIN's (1906) notes on the occurrence of *koschevnikovi* in the Himalayas is evidently a *lapsus calami* for Borneo in quoting VON BUTTEL - REEPEN's (1906) paper.

Apis (Sigmatapis) vechti linda, subsp. nov.

= *Apis mellifica indica* var. *koschevnikovi* BUTT. - REEP., 1906 (partim).

Worker. — Colour-pattern similar to typical *vechti*. Mandibles as in fig. 51. Tibiae and basitarsi III as in fig. 84; scopal bristles as in fig. 116. Abdominal sterna (fig. 19) with rather narrow lateral marginal areas. Length of body about 11—13 mm, fore wing 8.5 mm, tongue 3.54 mm.

Queen & Male. — Both unknown.

Specimens examined. — "North Borneo", 3 ♀ (including Holotype) (det. by somebody as *Apis indica* var. *koschevnikowi* BUTT.). Without locality, 1 ♀ (det. T. SHIRAKI as *Apis mellifera* var. *koschevnikovi* BUTT. - REEP.) Holotype and 1 paratype in the Leiden Museum, further paratypes in the author's collection.

Distribution. — N. Borneo.

Remarks. — It is rather unfortunate that the exact type-locality of this new subspecies is unknown, except for the vague term "North Borneo". Its wings are a little paler and its tongue much shorter than in the typical subspecies, and further differentiating characters are to be found in the synoptic key (Chapter VIII, section B, couplet 4). The latter (19, 51, 84, 116) are based upon a paratype from N. Borneo (No. Ap-033).

Apis (Sigmatapis) nigrocincta nigrocincta F. SM., 1861.

= *Apis mellifica indica* var. *picea* BUTT.-REEP., 1906.

1896. *Apis indica* var. *nigrocincta*, D. T.: 593 (bibliography).
1897. *Apis indica* var. *nigrocincta*, BINGH.: 558 (description) (excl. Burma record).
1904. *Apis nigrocincta*, ASHM.: 121 (list).
1906. *Apis mellifica indica* var. *peroni* (partim), BUTT.-REEP.: 192 (S. & N. Celebes records).
1906. *Apis mellifica indica* var. *picea* BUTT.-REEP.: 193 (N. Celebes record) (excl. Tonkin record).
1906. *Apis indica* var. *picea*, ENDERL.: 343 (key to varr. ♀).

Worker. — Colour-pattern similar to *A. indica;* mandibles baso-"posteriorly" black; clypeus (rarely black on posterior margin), scape (rarely black on "posterior" surface) and femora II-III (and, rarely tibiae II-III also) brownish yellow; wings a little darker; abdominal terga I-V brownish yellow, II posteriorly narrowly and III-VI each broadly black-banded, sometimes entirely black. Black hairs on face more dominant than whitish ones; thoracic pubescence dirty yellow; scutum II with numerous and scutellum with a few black hairs. POL: OOL about 8.5 : 12.5. Mandibles as in fig. 52. Tibiae and basitarsi III as in fig. 85; post-auricular scopal bristles (fig. 117) 9 rows, arrangement of apical rows similar to that in *A. cerana.* Abdominal sterna (fig. 20) with preglandular area II rather short, lateral marginal areas II rather narrow, and postglandular area VI short. Length of body about 9.5—11.0 mm, fore wing 8.0—8.5 mm, tongue 3.50—3.92 mm.

Queen & Male. — Both unknown.

Specimens examined. — S. W. Celebes: Mt Lompobatang (Piek van Bonthain), 2000 m (BÜNNEMEYER), 3 ♀; G. Hsutalumpang(?), 2500 m, vii. 1936 (L. J. TOXOPEUS), 2 ♀. N. Celebes: Mapanget, Minahassa, 85 m, vi-vii.1941 (native coll.), 8 ♀; Tondano, 20.v.1940, 1 ♀.

Distribution. — Celebes.

Remarks. — *A. nigrocincta* has been suppressed as a synonym of *peroni* by VON BUTTEL-REEPEN (1906) and has been erroneously recorded from China, India and many other localities by numerous writers. It can be recognized by the following combination of characters: POL very short, post-auricular scopal bristles 9 rows, anteglandulus II running parallel to antecosta II, and postglandular areas III moderately long. The accompanying figures (20, 52, 85, 117) are based upon a specimen from Mt Lompobatang (No. Ap-007).

Apis (Sigmatapis) nigrocincta marginella, subsp. nov.

Worker. — Similar to the typical subspecies, mandibles as in fig. 53, tibiae III (fig. 86) a little shorter, basitarsi III (fig. 118) apically narrow-

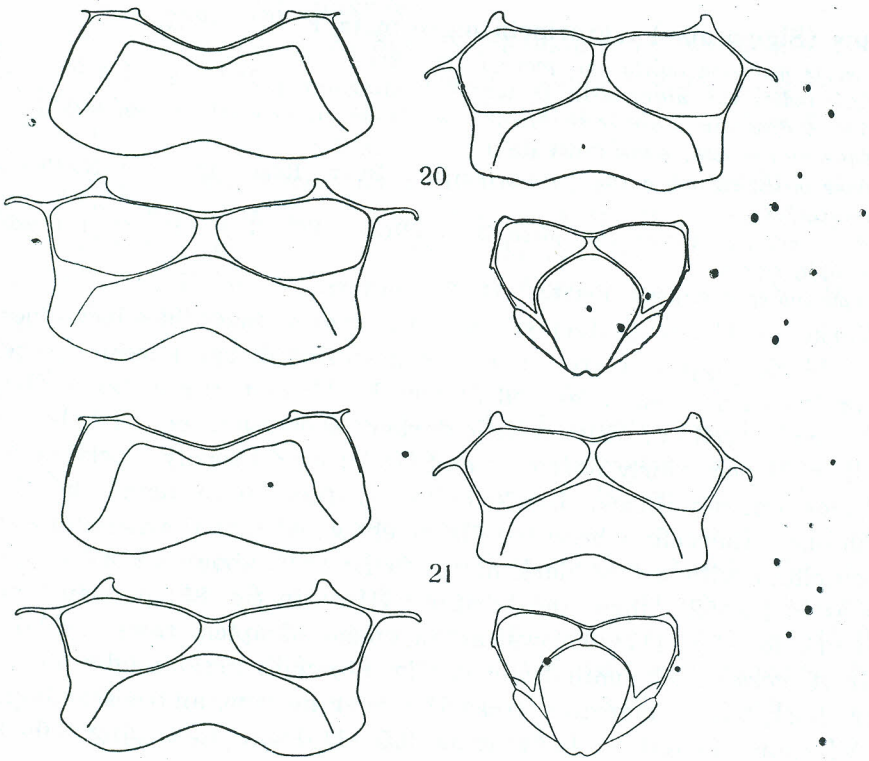


Fig. 20. *Apis* (*Sigmatapis*) *nigrocincta nigrocincta* F. SM. ♀, abdominal sterna II, III, V and VI. Fig. 21. *Apis* (*Sigmatapis*) *nigrocincta marginella*, subsp. nov. ♀, the same as in fig. 20.

er, and abdominal sterna (fig. 21) with lateral marginal areas II-III distinctly broader, sternum III posteriorly more strongly dilated laterad, latero-glanduli III posteriorly scarcely convergent to lateral sternal margins, and postglandular area VI much narrower.

Queen & Male. — Both unknown.

Specimens examined. — C. Celebes: Todjambu, 900 m, vii.1936 (L. J. TOXOPEUS), 2 ♀. Holotype in the Leiden Mus., paratype in the author's collection.

Distribution. — C. Celebes.

Remarks. — The status of this subspecies has puzzled the author for a long while. Repeated comparisons of the material at hand make it more convincing that the differences as given above are beyond the ordinary range of intraspecific variation. Thus, it is here recognized as a distinct subspecies. The accompanying figures (21, 53, 86, 118) are based upon the paratype (No. Ap-043).

Apis (Sigmatapis) javana (ENDERL.), 1906.

= *Apis indica* var. *javana* ENDERL., 1906.

1929a. *Apis* (*Apis*) *indica* (misidentification), SKOR.: 252, 260 (descriptions), text-fig. 4 (♀ abd. sterna).

1930. *Apis indica* (misidentification), ROEPKE: 4—7 (biology in Java), pl. 1 (reformed artificial hive), text-figs. 1 & 2 (natural enemies).

1932. *Apis indica* (misidentification), FRANSSEN, Natuurh. Maandbl. Maastricht 20: 44—48, 56—64, 71—74 (descriptions & biology of the castes).

Worker. — Colour-pattern similar to *A. indica;* mandibles usually baso-"posteriorly" black; scutellum rarely dull brown; wings a little darker; abdominal terga I-IV posteriorly black-banded; thoracic pubescence yellowish; long black hairs numerous on face, vertex, scutum II and scutellum. POL: OOL about 9:10.5. Mandibles as in fig. 54. Tibiae and basitarsi III as in fig. 87; postauricular scopal bristles (fig. 119) 8 rows, the apical ones similarly arranged as in *A. cerana,* but the 2nd not so strongly divergent from 1st. Abdominal sterna (fig. 22) with lateral marginal areas III posteriorly distinctly narrowed; wax-plates V short; postglandular area VI rather long. Length of body about 10.0—11.5 mm, fore wing 7.5—8.0 mm, tongue 3.42 mm.

Queen. — Integument black; clypeus (anterior margin), mouth-parts, malar areas, tegulae, legs and abdominal sterna (posterior margins) reddish brown; wings weakly but distinctly stained with brownish. Pubescence brownish, that on vertex and supra-antennal areas sooty brown; face anteriorly with a mixture of black and yellowish hairs. POL: OOL about 11:10. KRÜGER's index 82. Mandibles as in fig. 67. Prementum with L/B = 2.67. Premento-palpal index 77.78. Cell *3r* (fore wings) with L/B = 5.92, radial index 71.11; jugo-vannal index 162.86. Tibiae and basitarsi III as in fig. 100. Abdominal sterna as in fig. 23. Length of body about 13 mm, fore wing 9 mm, tongue 2.77 mm.

Male. — Colour-pattern similar to that of *A. cerana;* wings apically a little darker. POL: OOL about 7.5:1. KRÜGER's index 150. Mandibles as in fig. 73. Prementum with L/B = 2.40. Premento-palpal index 61.54. Cell *3r* (fore wings) with L/B = 7.71, radial index 76.18; jugo-vannal index 148.39. Tibiae and basitarsi III as in fig. 105. Abdominal sterna as in fig. 24. Length of body about 10 mm, fore wing 9.5 mm, tongue 2.46 mm.

Specimens examined. — Hainan: "Hainan Exped.", 13.viii.1934 (C. Ho), 1 ♀.

Siam: Doi Sutep, 1700 m, 14—16.iii.1928 (MCKEAN), 2 ♀; Nan, 3.i. (W. P. COCKERELL), 1 ♀ (all the above 3 ♀ det. T. D. A. COCKERELL as *Apis indica peroni* LATR.!); Bangkok, 12.x.1920, 1 ♀; Chiengmei 23.x.1920, 1 ♀.

Malay Penin.: Nam Heng, Johore (S. KIYOTAKE), 1 ♀.

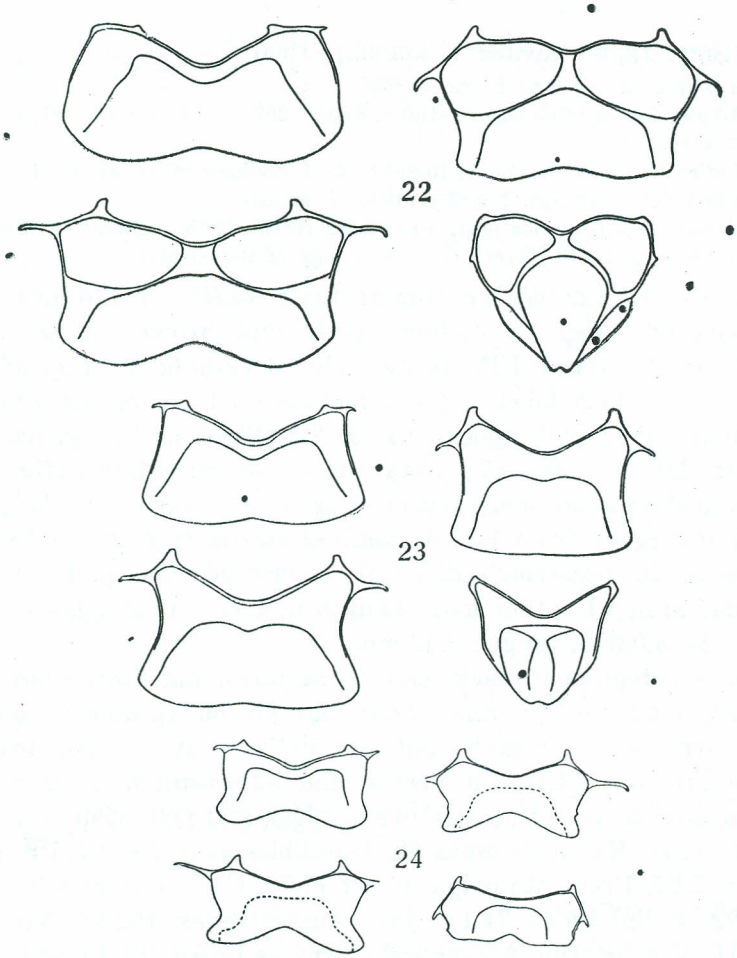


Fig. 22-24. *Apis* (*Sigmatapis*) *javana* (ENDERL.), abdominal sterna II, III, V and VI of ☿ (22), the same of ♀ (23), and the same of ♂ (24).

N. Sumatra: Atjeh, Mt Leuser, 3300—3500 m, E-Top, ii.1937, 1 ☿; id., Mt Ngo Lembuh, 2000 m, ii.1937, 2 ☿; id., Pendeng, 400 m, ii-iii.1937, 4 ☿; all A. HOOGERWERF. S. Sumatra: Lampong Distr., Kedaton & Wai Rilau, 150 m, 25—27. iii.1937 (J. & E. VAN DER VECHT), 2 ☿. "Sumatra", 1 ☿ (ex coll. H. Y. EDWARDS, Amer. Mus. Nat. Hist.).

Java: Antjol, near Djakarta, 25.i.1931 (M. A. LIEFTINCK), 2 ☿; Bandung, 700 m, 30.i.1940 (J. OLTHOF), 2 ☿; Bogor, 250 m, viii.1935 (C. J. H. FRANSSEN), 1 ☿; Res. Cheribon, Tjideres, 100 m, 29.i.1936 (F. C. DRESCHER), 1 ☿; Djeruklegi, South Banjumas, 10 m, vii.1935 (F. C. DRESCHER), 2 ☿; Djocja, xii.1935 (H. OVERBECK), 1 ♂; Idjen, Ongop-ongop, 1850 m, v.1924

(K. W. DAMMERMAN), 2 ☿; Mt Pangrango, Tjisarua Z., 1000 m, 9.xi.1941 (M. A. LIEFTINCK), 2 ☿; Pasar Ikan, Djakarta, 9.ii.1920 (A. SUNIER), 1 ☿; Rembang, Klino, Mt Pandan, 4.ii.1940 (M. E. WALSH), 2 ☿.

Karimondjawa Is.: 22—30.xi.1930 (M. A. LIEFTINCK), 7 ☿.

Lombok: Midan, i.1930 (T. AKASHI), 1 ☿.

Ambon: x.1949 (M. A. LIEFTINCK), 6 ☿; same loc., ix.1930 (T. M. TJOA), 1 ☿.

Flores: Ende, 19.ix., 1 ☿, probably collected by S. ISSIKI on his New Guinea expedition.

Distribution. — China (Hainan I.); Siam; Malay Penin.; Sumatra; Java; Karimondjawa; Lombok; Flores; Ambon (introduced). All except Java are new records.

Remarks. — The examples from Johore, Siam, Hainan, Lombok and Flores perhaps represent distinct subspecies or nationes. They differ from the typical form in the relative length of preglandular area II and, to a less extent, in the relative breadth of lateral marginal areas II. Pending more material, they are provisionally referred to *A. javana*.

This species has been confused with *A. indica* by many authors, including SKORIKOV (1929*c*). From the latter species (☿) it can be immediately separated by its larger size, much narrower lateral marginal areas II and less strongly curved latero-glanduli II. It may conveniently be considered an intermediate form of the *vechti* and *cerana* groups. The accompanying figures (22—24, 54, 67, 73, 87, 100, 105, 119) are based upon 1 ☿ from Bandung (No. Ap-041), 1 ♀ from Bogor (Ap-051) and 1 ♂ from Djocja (Ap-053).

According to Dr M. A. LIEFTINCK (*in litt.*), "The Ambon form is also common on the small island of Saparua, south of Ceram, and I believe that the species has been introduced in these islands long ago, perhaps more than a century." ROEPKE (1930: 4) found "*A. indica*" in Ambon abundantly flying about sugar- and syrup-supplies in the market, but he failed to discover any such bees in Buru, Sula, Obi or Batjan. And, to the knowledge of the present writer, no indigenous honeybees have ever been recorded from New Guinea. It thus appears rather safe to assume that the Papuan Subregion is not an original habitat of honeybees.

Apis (Sigmatapis) peroni LATR., 1804.

= *Apis gronovii* GUILL., 1841.

Worker. — "Noirâtre brun, avec un duvet gris jaunâtre, entremêlé de quelques poils noirâtres; un léger duvet cendré sur la tête; écusson roussâtre; abdomen presque glabre; les deux premiers anneaux, le bas du

troisième, leurs bords postérieurs exceptés, celui du second surtout, d'un roussâtre jaunâtre; dessous de l'abdomen d'un roux jaunâtre pâle, à l'exception de l'extrémité; ailes supérieures ayant une légère teinte brune et la côte noirâtre." — (LATREILLE, 1804).

Queen & Male. — Both undescribed.

Distribution. — "Timor".

Remarks. — "*A. mellifica indica* var. *peroni*", or "*A. indica* var. *peroni*" as recognized by VON BUTTEL - REEPEN (1906), ENDERLEIN (1906) and many other writers, has nothing to do with this species and is merely a heterogeneous assemblage of unrelated but superficially similar forms. Under such names, it has been recorded from India, Ceylon, Tonkin, China, Japan, Andamans, Nicobars, Sumatra, Java, Palawan, Luzon, Celebes, Lombok, Ambon, and even Mauritius, Senegal, and Cape Verde Is. If the type locality given in the original description is assumed to be correct, we can only accept *peroni* as a distinct species since Timor is so isolated from other parts of the Oriental Region that it is unlikely to be found elsewhere. Or — like the honeybee from Ambon — it might be identical with *A. javana* and was introduced into Timor from Malaysia centuries ago. Should the latter be the case, *peroni* has priority over *javana*.

Apis (Sigmatapis) samarensis, sp. nov.

Worker. — Colour-pattern similar to *A. philippina*. Clypeus brownish yellow. POL: OOL about 7 : 11. Mandibles as in fig. 55. Tibiae and basitarsi III as in fig. 88; post-auricular scopal bristles (fig. 120) 9 rows, the 1st to 4th subparallel to one another, 6th to 9th "dorsally" very strongly slanting. Abdominal sterna (fig. 25) very closely similar to those of *A. philippina*, but lateral marginal areas II-III narrower and postglandular

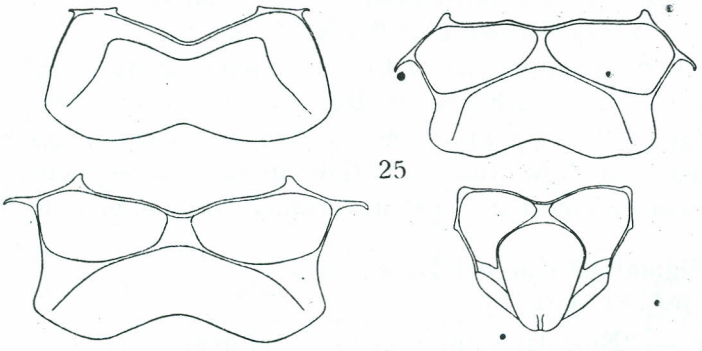


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Fig. 25. *Apis* (*Sigmatapis*) *samarensis*, sp. nov. ♀, abdominal sterna II, III, V and VI.

area VI longer. Length of body about 9.5—11 mm, fore wing 7.0—7.5 mm, tongue 3.50 mm.

Queen & Male. — Both unknown.

Specimens examined. — Samar: Naval Base, iv.1945 (G. E. BOHART), 4 ☿. Holotype and 1 paratype in the California Acad. Sci., 2 further paratypes in the author's collection.

Remarks. — This species appears to be most closely allied to *A. indica* and *A. philippina* and differs from the latter in the following points: post-auricular scopal bristles 9 instead of 8 rows, postglandular area VI much longer, lateral marginal areas II-III much narrower, glandulus II antero-laterally not angulated and wax-plates V larger. The accompanying figures (25, 55, 88, 120) are based upon a paratype (No. Ap-056).

Apis (Sigmatapis) indica FABR., 1798.

= *Apis socialis* LATR., 1804 = *A. delessertii* GUÉR., 1844 = *A. perrottetii* GUÉR., 1844.

1896. *Apis indica* + var. *perrottetii* (excl. varr. *nigrocincta* & *peronii*), D. T.: 593 (bibliography).

1897. *Apis indica* (excl. varr. *unicolor* & *nigrocincta*), BINGH.: 557 (key to spp. ☿), 558 (description), pl. 4, fig. 12 (☿, the magnification appears to be $^3/_2$ rather than $^1/_1$ as indicated in the explanation of the plate).

1904. *Apis indica*, ASHM.: 121 (list).

1906. *Apis mellifica indica* var. *indica* (excl. all other varr.), BUTT.-REEP.: 163 (evolution), 168 (synonymy), 169 (key to subspp. ♂), 170 (key to subspp. ☿), 171 (key to varr. ☿), 189—191 (description; synonymy).

1906. *Apis indica* typ. (excl. all other varr.) ENDERL.: 335 (India record), 341 (key to spp. ☿), 343 (key to varr. ☿).

1929*a*. *Apis* (*Apis*) *indica* (partim), SKOR.: pl. 1 (distribution), text-fig. 1 (☿ hind wing).

1929. *Apis mellifica indica* (typica) (excl. form *peroni*), DOVER: 65 (key to "forms" ☿).

Worker. — Integument black; mouthparts, scutellum (sometimes black), coxae II-III and trochanters II-III brownish yellow; clypeus (anterior margin), malar areas (lateral portions), scape (both extremities), tegulae and legs more or less tinted with reddish brown. Wings almost clear hyaline, very feebly stained with brownish, cell *3r* (fore wings) costally a little darker; veins brownish, the costal ones and stigmata duller. Abdominal terga I-IV a little darker; V-VI posteriorly broadly black-banded; sterna all brownish yellow, only with VI darker. Pubescence whitish, that on face more or less intermixed with a few black hairs; on supra-antennal areas postero-laterally dominantly sooty brown; on vertex dominantly black; on venter of tarsi I-II and on "posterior" surfaces of III golden red; on posterior abdominal terga sooty brown to black.

POL: OOL about 9 : 11. Mandibles as in fig. 56. Tibiae and basitarsi III as in fig. 89; post-auricular scopal bristles (fig. 121) 8 rows, the apical ones similarly arranged as in *A. cerana*. Abdominal sterna (fig. 26) with lateral marginal areas II broad, III posteriorly suddenly narrowed; wax-plates V very long. Length of body about 9—11 mm, fore wing 7.5—8.0 mm, tongue 4.46 mm.

Queen. — Colour-pattern similar to that of *A. javana*, but a little paler. POL: OOL about 11.5 : 10. KRÜGER's index 97. Mandibles as in fig. 68. Prementum with L/B = 2.04. Premento-palpal index 67.95; relative lengths of segments I-IV of labial palpi about 18 : 8 : 2.5 : 3.2. Cell *3r* (fore wings) with L/B = 6.25, radial index 71.43; jugo-vannal index 153.62.

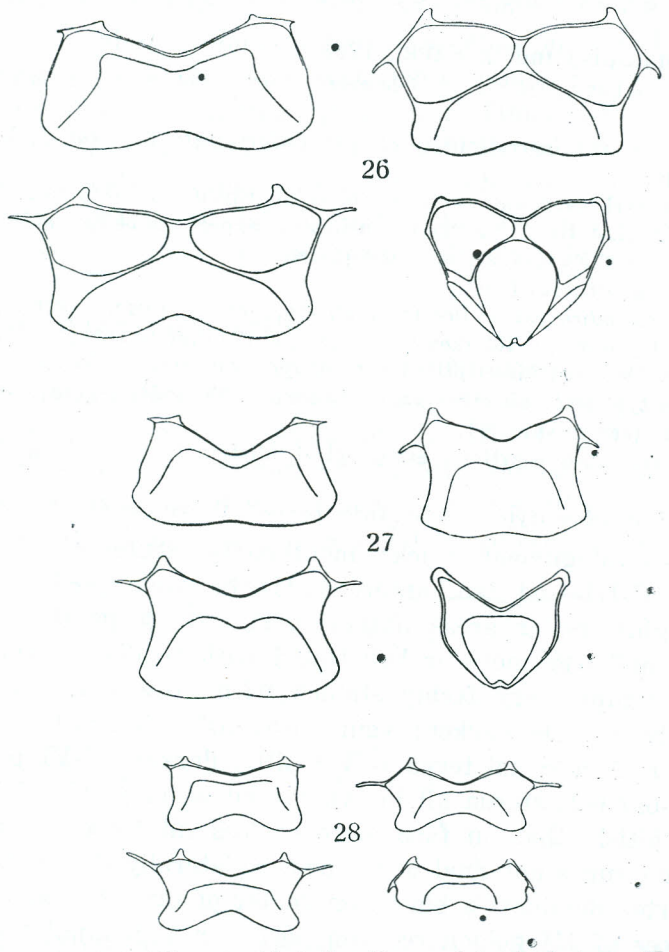


Fig. 26-28. *Apis* (*Sigmatapis*) *indica* FABR., abdominal sterna II, III, V and VI of ☿ (26), the same of ♀ (27), and the same of ♂ (28).

Tibiae and basitarsi III as in fig. 101. Abdominal sterna as in fig. 27. Length of body about 14 mm, fore wing 9 mm, tongue 3.0 mm.

Male. — Colour-pattern similar to that of *A. javana*. Posterior ocelli laterally practically contiguous to mesal orbits. KRÜGER's index 170. Mandibles as in fig. 74. Prementum with L/B = 1.74. Premento-palpal index 57.14; relative lengths of segments I-IV of labial palpi about 15: 7.5: 2.5: 3. Cell *3r* (fore wings) with L/B = 7.23, radial index 60.34; jugo-vannal index 180.55. Tibiae and basitarsi III as in fig. 106. Abdominal sterna as in fig. 28. Length of body about 11 mm, fore wing 9 mm, tongue 1.85 mm.

Specimens examined. — India: Anaimalai Hills, 4—5000 ft., S. India, 27. viii.1946 (P. S. NATHAN), 8 ☿; Botanical Garden, Calcutta, Bengal, x.1937 (T. MAA), 3 ☿; Kurum-Bagaram, Karikal, S. India, iii.1947 (P. S. NATHAN), 1 ♀, 2 ♂; Santiniketan, Birbhum Distr., Bengal, x.1937 (T. MAA), 4 ☿. "India", 1 ☿ (det. T. SHIRAKI as *Apis florea* FABR.!).

Ceylon: 5 ☿.

Distribution. — India; Ceylon.

Remarks. — The concept of this species as here accepted is founded only on tradition. The types (3 ☿) in the Copenhagen Museum are labelled "Ex Ind. or. et Cap. b. sp." and the type locality as indicated in the original description is "India orientali", which was understood to be applicable to any part of south-east Asia. Many Asiatic and African species and subspecies have been recognized and recorded in literature as varieties of *Apis indica*. The abdominal sternum II of this species (☿) is very similar to *A. samarensis*, but the V and VI are like those of *A. philippina*. These 3 species can be distinguished from other members of the subgenus by their strongly incurved lateroglanduli II. They are allied to *A. cerana* in having very broad sterna and are thus decidedly different from *A. javana*. The abdominal terga I-IV of all the Ceylonese specimens are posteriorly black-banded, and those from the Anaimalai Hills are uniformly black (probably due to postmortem discoloration). The accompanying figures (26, 27, 28, 56, 68, 74, 89, 101, 106, 121) are based upon a ☿ from Calcutta (No. Ap-023), a ♀ and a ♂ from Karikal (Ap-083 and Ap-084).

Apis (Sigmatapis) philippina (SKOR.), 1929.

= *Apis* (*Apis*) *indica philippina* SKOR., 1929.

Worker. — Colour-pattern similar to *A. indica:* clypeus almost entirely reddish brown; wings a little darker; abdominal terga I-IV posteriorly black-banded; scutum II and scutellum (anteriorly) with some long, brown hairs. POL: OOL about 6.5: 10. Mandibles as in fig. 57. Tibiae and

basitarsi III as in fig. 90; post-auricular scopal bristles (fig. 122) 8 rows, the 2nd very weakly divergent from 1st. Abdominal sterna (fig. 29) with lateral marginal areas II exceedingly broad, postglandular area VI short. Length of body about 9.5—11 mm, fore wing 7.0—7.5 mm, tongue 3.15 mm.

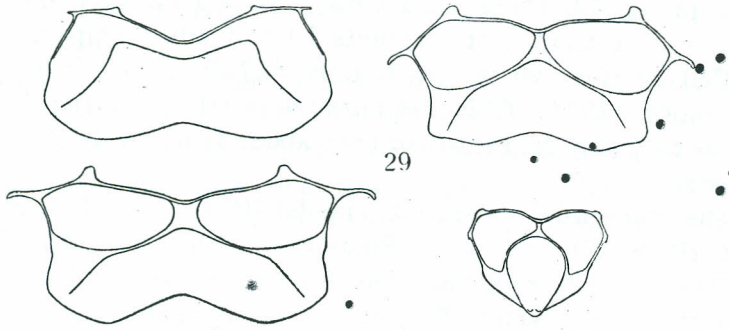


Fig. 29. *Apis* (*Sigmatapis*) *philippina* (SKOR.) ♀, abdominal sterna II, III, V and VI (magnification of sternum VI on slightly lower scale than that of the three others).

Queen & Male. — Both unknown.

Specimens examined. — Luzon: Bangui, xi.1923 (MCGREGOR), 2 ♀; Los Baños, 11.iv.1923 (S. TAKANO), 2 ♀; Manila, 23.vii.1919, 2 ♀; same loc., viii.1923 (MCGREGOR), 1 ♀. The 4 examples from Bangui and Manila have been determined by T. D. A. COCKERELL as *Apis indica nigrocincta* F. SM.

Distribution. — N. Luzon.

Remarks. — The "key character" of this species is in its lateral marginal areas II, which are exceptionally broad and are unique among the members of this genus. The accompanying figures (29, 57, 90, 122) are based upon specimens from Los Baños (Nos. Ap-047 and Ap-063).

Apis (Sigmatapis) cerana FABR., 1793.

= *Apis sinensis* F. SM., 1865 = *A. mellifica* var. *japonica* RADOSZ., 1887 = *A. indica skorikovi* MAA, 1944 (*nom. nud.*).

1896. *Apis mellifera* var. *cerana* + var. *japonica* + *A. sinensis*, D. T.: 608, 609 & 613 (bibliography).

1904. *Apis cerana*, ASHM.: 121 (China & Japan records).

1906. *Apis mellifica indica* var. *sinensis* + var. *japonica*, BUTT.-REEP.: 168 (list), 171 (key to varr. ♀), 183 & 194 (Yunnan & Japan records).

1906. *Apis indica* var. *sinensis* + var. *japonica*, ENDERL.: 343 (key to varr. ♀).

1929*a*. *Apis* (*Apis*) *cerana* + *A.* (*A.*) *japonica*, SKOR.: 251-252 & 260 (descriptions), text-figs. 14 (♀ abd. sternum VI) & 15 (♂ tibia & tarsus III).

Worker. — Colour-pattern similar to *A. indica;* clypeus anteriorly with a large, pale, triangular marking; abdominal terga brown, I-IV

posteriorly broadly black-banded; thoracic pubescence dirty yellow. Antennae as in fig. 2. POL: OOL about 8:10. Mandibles as in fig. 58. Relative lengths of segments I, II and III + IV of labial palpi about 31:13:9. Tibiae and basitarsi III as in fig. 91; pre-auricular scopal bristles with 2 or 3 irregularly arranged rows; post-auricular bristles (fig. 123) 8 rows, with 2nd, 3rd and 4th rows subparallel to and equidistant from one another and "dorsally" slanting basad and distinctly diverging from 1st. Abdominal sterna (fig. 30) with lateral marginal areas II-III very broad;

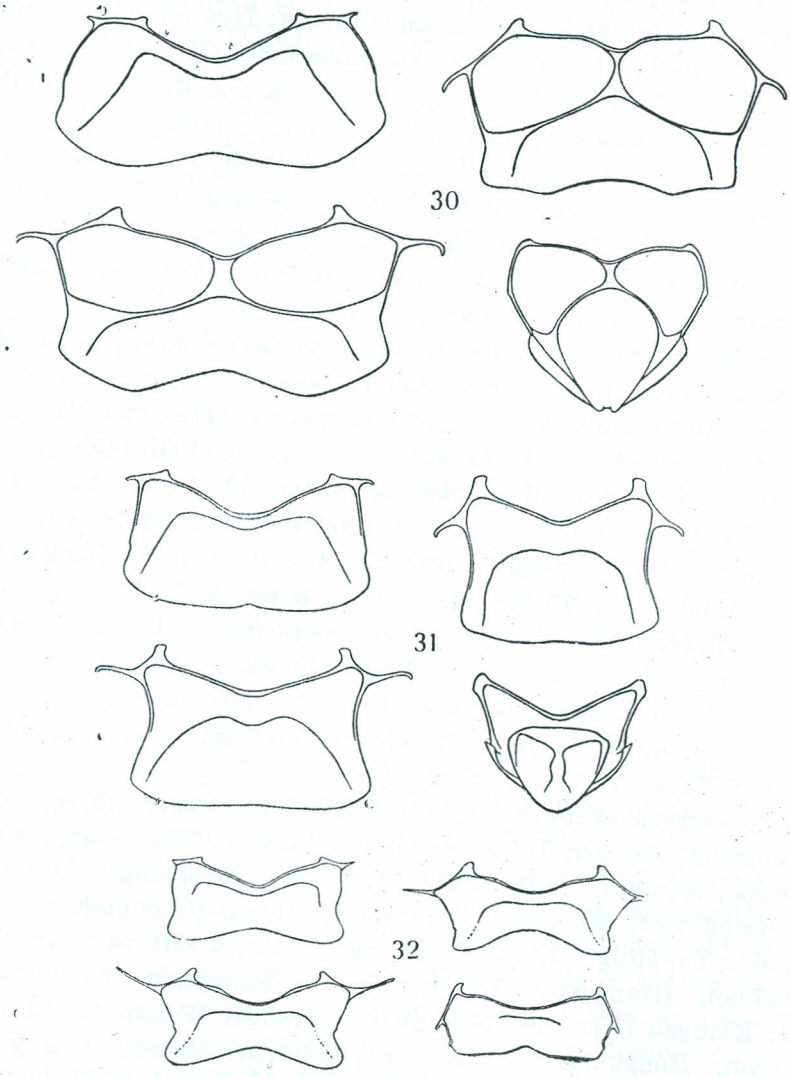


Fig. 30-32. *Apis* (*Sigmatapis*) *cerana* FABR., abdominal sterna II, III, V and VI of ☿ (30), the same of ♀ (31), and the same of ♂ (32).

lateroglanduli III subparallel to lateral sternal margins III; wax-plates III very broad, V very long. Length of body about 10—13 mm, fore wing 8.5—9.0 mm, tongue 4.92 mm; relative breadths of head, thorax and abdomen about 96 : 101 : 106.

Queen. — Integument black; clypeus (anterior margin), mouth-parts (mandibles apically black), scape, pedicel, tegulae, legs and abdominal sterna (posterior margins) brownish yellow; wings weakly but distinctly stained with brown; veins and stigmata dull brown. Pubescence dirty yellow, darkest on vertex and supra-antennal areas; face anteriorly with a mixture of black and yellowish hairs. Antennae as in fig. 5. POL: OOL about 12 : 13. KRÜGER's index 135. Mandibles as in fig. 69. Prementum with L/B = 2.90. Premento-palpal index 74.36; relative lengths of segments I, II and III + IV of labial palpi about 17 : 9 : 6.5. Cell *3r* (fore wings) with L/B = 7.58, radial index 75.00; jugo-vannal index 151.28. Tibiae and basitarsi III as in fig. 102. Abdominal sterna as in fig. 31. Length of body about 13—16 mm, fore wing 9.5—10.0 mm; relative breadths of head, thorax and abdomen about 95 : 116 : 125.

Male. — Integument black or brownish black; clypeus (partly or entirely), labrum, mandibles (apices) and proboscis yellow; wings clear hyaline, basally and costally very slightly darkened, veins and stigmata dull brown. Pubescence blackish. Antennae as in fig. 8. POL: OOL about 8 : 0.5. KRÜGER's index 207. Mandibles as in fig. 75. Prementum with L/B = 2.17. Premento-palpal index 63.42; relative lengths of segments I, II and III + IV of labial palpi about 17 : 9 : 8. Cell *3r* (fore wings) with L/B = 7.85, radial index 75.65; jugo-vannal index 173.33. Tibiae and basitarsi III as in fig. 107. Abdominal sterna as in fig. 32. Length of body about 11—13 mm, fore wing 10—12 mm, tongue 2.31 mm; relative breadths of head, thorax and abdomen about 112 : 140 : 129.

Specimens examined. — India: Darjeeling and environs, 2400—3000 m, iv-v.1938 (T. MAA), 75 ♀.

China: numerous examples from the provinces Shensi (Kingyang), Hopei (Chengting, Eastern Tomb, Peiping), Yunnan (Chengkiang, Kienshui, Kunming, Mengtsz, Tali), Kweichow (Hingi, Kweiyang), Szechwan (Chengtu, Kwanhsien, Mt. Omei, Wanhsien), Hunan (Chengteh, Chenki, Lihsien, Luki, Yuanling), Kiangsi (Kuling), Anhwei (Hwangshan, Wuyuan), Chekiang (Hangchow, Lishui, Ningpo, Sungyang, Tienmushan, Wenchow), Kiangsu (Nanking, Shanghai), Kwangsi (Wuchow), Kwangtung (Canton, Hongkong, Loufoushan), Fukien (Amoy, Changting, Chungan, Fuan, Haiteng, Kienow, Kienyang, Kwangtseh, Lungki, Luyuan,

Nanping, Putien, Shanghang, Shaowu, Sienyu, Tatien, Tehhwa, Yungan), Taiwan (Arisan, Daisuikutsu, Fujieda, Heito, Kagi, Kanko, Kanshirei, Koshun, Musha, Nichigetsutan, Raisha, Rakuraku, Rato, Rengachi, Rikiriki, Rokiri, Shinchiku, Taiheizan, Taihoku, Taito, Tompo, Toyohara, Urai).

Loochoo Is.: x-xi.1910 (J. C. THOMPSON), 3 ☿.

Japan: Hamansan (Chikuzen), Kyushu, 6.iv.1931 (HORI, FUJINO & CHO), 1 ☿; Ise, Honshu (J. YAMANOUCHI), 1 ☿, 1 ♂; Kobe, Honshu, 1 ☿; Yokohama, Honshu, 29.iii.1931 (L. GRESSITT), 1 ☿; Yoshihama, Sapporo, Yezo (T. SHIRAKI), 1 ☿.

Tsushima Is.: 15.xi.1910 (v. KÜHNE), 1 ☿.

Distribution. — India (Darjeeling); China (Shensi; Hopei; Yunnan; Kweichow; Szechwan; Hunan; Kiangsi; Anhwei; Kiangsu; Chekiang; Kwangsi; Kwangtung; Fukien; Taiwan); Loochoo Is.; Japan (Yezo; Honshu; Kyushu; Shikoku); Tsushima.

Remarks. — The concept of *A. cerana* as here accepted is also founded only on tradition. It was originally described from "China", but the types (2 ☿) left by FABRICIUS in the Copenhagen Museum bear no locality labels. Since published, the name has been neglected until ASHMEAD (1904) revived it as a distinct species and put *japonica* and *sinensis* under it as synonyms. GERSTÄCKER (1862) noticed its close similarity in size and pattern to *A. lamarckii*, and VON BUTTEL-REEPEN (1906) suppressed it as a synonym of *A. adansonii*.

SKORIKOV (1929*a*) failed to differentiate the ☿ of *A. cerana* from his "*A. indica*" which is doubtless a misidentification for *A. javana*. However, these two are distinguishable at a glance by their abdominal sterna II-III. The same author also maintained that the form found in Central Japan represents a distinct species, *A. japonica*, which he distinguished from *cerana* only by the shape of sternum VI. An extensive study of the rich material at hand reveals that the shape of this very sternum, at least in this species, exhibits very strong individual variation, and a comparison of the males from China and Japan fails to disclose any definite distinctive character but confirms ASHMEAD's conclusion. Besides China proper and Japan, SKORIKOV (*loc. cit.*) recorded *cerana* from S. Ussuria and SE. Manchuria also, but the present writer has not yet been able to see such material. The only ☿ at hand from Vladivostok is a true *A. mellifera*. The record of occurrence of "*A. indica*" in Formosa or Taiwan by this eminent entomologist is evidently wrong. The accompanying figures (2, 5, 8, 30, 31, 32, 58, 69, 75, 91, 102, 107, 123) are based upon specimens from Tienmushan (No. Ap-065, ☿) and Shaowu (Ap-015, ♀; Ap-017, ♂).

Apis (? Sigmatapis) koschevnikovi (BUTT. - REEP.), 1906.

= *Apis mellifica indica* var. *koschevnikovi* BUTT. - REEP., 1906.

1906. *Apis indica* var. *koschevnikovi*, ENDERL.: 335 (key to varr. ♀).

Worker. — Unknown to the present writer.

Queen & Male. — Undescribed.

Distribution. — Kamerun.

Remarks. — This species was founded on 8 ♀ from Kamerun (KARSTENSEN leg.) and 1 from N. Borneo (J. WATERSTRADT leg.) (both without further details). Kamerun is here accepted as the restricted type locality. As species of *Sigmatapis* have been repeatedly recorded from W. Africa by a number of writers, there is little probability that these specimens were mis-labelled. For zoogeographical reasons, true *koschevnikovi* is believed to be distinct from *A.* (*Sigmatapis*) *vechti*, although these 2 species have a very similar colour-pattern. The exact status of *koschevnikovi* must be left undecided until authentical material is available.

Apis (Apis) adansonii LATR., 1804.

= *Apis capensis* ESCH., 1822 = *A. caffra* LEP., 1836 (nom. praeocc. = *A. scutellata* LEP., 1836 = *A. nigritarum* LEP., 1836 = *A. mellifica unicolor* var. *friesei* BUTT. - REEP., 1906.

1896. *Apis capensis* + *A. mellifera* var. *adansonii* + var. *caffra* + var. *nigritarum* + *A. scutellata*, D. T.: 587, 608, 609 & 612 (bibliography).

1904. *Apis nigritarum*, ASHM.: 121 (list).

1906. *Apis mellifica unicolor* var. *adansoni*, + var. *friesei* BUTT. - REEP.: 168 (synonymy), 171 (key to varr. ♀), 186—187, 188—189 & 192—193 (descriptions; Senegal, Guinea, Gabon, Cape Prov., Delagoa Bay, Angola, Natal, Togo, Tanganyika, Mozambique, E. Usambara & Kamerun records).

1906. *Apis mellifica unicolor* var. *adansoni* + var. *friesei*, ENDERL.: 335 (E. Africa & Kamerun records), 342 (key to varr. ♀).

1929*a*. *Apis* (*Apis*) *adansoni*, SKOR.: 252 & 261 (descriptions), pl. 1 (distribution), text-fig. 7 (♀ abd. sterna).

Worker. — POL: OOL about 13.5 : 11. Mandibles as in fig. 59. Tibiae and basitarsi III as in fig. 92; apical basitarsal emargination in profile (fig. 124) almost lying on median line; post-auricular scopal bristles 8 rows, the 2nd, 3rd and 4th rows nearly straight, subparallel to and equidistant from one another and running perpendicular to "ventral" basitarsal margin. Abdominal sterna (fig. 33) with antecosta II almost evenly thick; median 3rd of preglandular area II evenly long; wax-plates III exceptionally short; lateral marginal areas III long; preglandular areas III-V short; antecosta VI medially weakly curved. Length of tongue about 4.08 mm.

Queen. — Unknown.

Male. — Mandibles as in fig. 143. Prementum with L/B = 2.33; premento-palpal index 61.8. Cell *3r* (fore wings) with L/B = 8.35; radial index 76.3; jugo-vannal index 190.9. Tibiae and basitarsi III (fig. 150) long and narrow; "ventral" basitarsal margins in profile very weakly curved. Abdominal sterna (fig. 132) with exceptionally thickened apodemes, sternum II relatively short. Length of fore wing about 12.2 mm, tongue 2.35 mm.

Specimens examined. — Liberia (Miss MALONEY), 1 ♀.

Uganda: Ganga, 4.iii.1909, 1 ♀.

Tanganyika, 27.xi.1925 (A. H. RITCHIE), 1 ♀.

Nyasaland: Zamba, v.1927 (C. SMEE), 1 ♀, 1 ♂.

S. Rhodesia: Matopo Hills, 17—30.iv.1932 (J. OGILVIE), 1 ♀; Salisbury, 21.i.1941, 1 ♀ (said to be from ♀ egg!).

Transvaal: Pretoria xii.1926, 2 ♀, 1 ♂.

Natal: Durban, 1 ♀; National Park, 3—15.iii.1932 (A. MACKIE), 1 ♀.

Cape Province: Calvinia, 11—16.xi.1931 (J. OGILVIE), 1 ♀; Ceres, 12—18.ii.1932 (J. OGILVIE), 1 ♀ (both det. T. D.A. COCKERELL).

"Africa", 4 ♀ (ex coll. T. SHIRAKI).

Distribution. — All over continental Africa, south to about 15° N. Lat.

Remarks. — As far as the structure of legs III and abdominal sterna in ♀ and ♂ castes is concerned, this species is most closely approached by *A.* (*A.*) *lamarckii*. The very short wax-plates III (♀), very weakly curved antecosta VI (♀) and very thick sternal apodemes (♂), however, are exceptional for the subgenus. In size and colour-pattern, *adansonii* is practically inseparable from *mellifera*. The accompanying figures (33, 59, 92, 124, 132, 143, 150) are based upon a ♀ from Ceres (No. Ap-055) and a ♂ from Pretoria (No. Ap-107).

Apis (Apis) unicolor LATR., 1804.

1896. *Apis mellifera* var. *unicolor*, D. T.: 610 (bibliography).
1897. *Apis indica* var. *unicolor*, BINGH.: 558 (description) (excl. Ceylon record).
1904. *Apis unicolor*, ASHM.: 122 (list).
1906. *Apis mellifica unicolor* var. *unicolor* (excl. all other varr.), BUTT.-REEP.: 171 (keys to subspp. & varr. ♀), 188 (description; Madagascar & Mauritius records).
1906. *Apis mellifica unicolor* var. *unicolor* (excl. all other varr.), ENDERL.: 334-335 (Madagascar records), 342 (keys to subspp. & varr. ♀).
1929*a*. *Apis* (*Apis*) *unicolor*, SKOR.: 253 & 261 (descriptions), pl. 1 (distribution), text-fig. 6 (♀ abd. sterna).

Worker. — POL: OOL about 12.5: 11.5. Mandibles as in fig. 60. Basitarsi III (fig. 93) in profile apically comparatively broad; postauricular scopal bristles (fig. 125) 8 rows, the 2nd, 3rd and 4th rows very

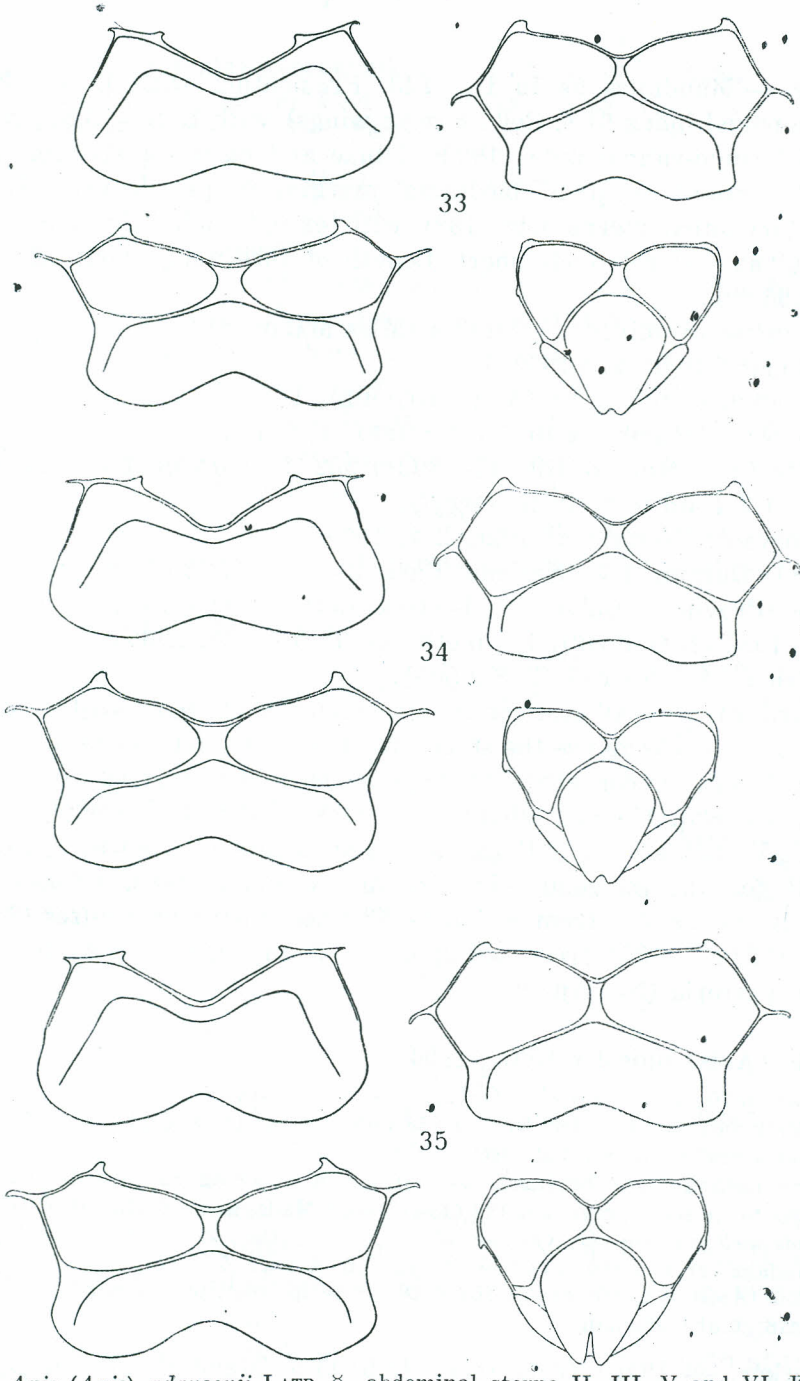


Fig. 33. *Apis* (*Apis*) *adansonii* LATR. ♀, abdominal sterna II, III, V and VI. Fig. 34. *Apis* (*Apis*) *unicolor* LATR. ♀, the same as in fig. 33. Fig. 35. *Apis* (*Apis*) *intermissa* (BUTT.-REEP.) ♀, the same as in fig. 33.

weakly undulated, subparallel to and almost equidistant from one another. Abdominal sterna (fig. 34) with preglandular area II exceptionally strongly shortened at middle; preglandular areas III-VI exceptionally short; lateral marginal areas III-V posteriorly distinctly narrowed; postglandular area VI long. Length of tongue about 4.04 mm.

Queen & Male. — Both unknown to the present writer.

Specimens examined. — Madagascar: Great Oriental Forest, 4 ♀; Tananarive (LAMBERTON), 1 ♀ (det. H. FRIESE); "Madagascar", 1 ♀ (ex coll. T. SHIRAKI).

Distribution. — Madagascar; Mauritius; Réunion.

Remarks. — This species is most closely approached by *A.* (*A.*) *remipes* in the shape of preglandular area II, but can be easily separated from the latter by its less thickened antecosta II. In certain respects, it also shows some affinities to *A.* (*A.*) *intermissa*, but the lateral marginal areas in the latter species are much broader. The wings are much darker than in any other species of the subgenus. The accompanying figures (34, 60, 93, 125) are based upon a specimen from Great Oriental Forest (No. Ap-057).

Apis (Apis) meda SKOR., 1929.

Distribution. — N. Iran (Lenkoran).

Remarks. — The species is unknown to the present writer.

Queen & Male. — Undescribed.

On the basis of its original description, it is chiefly characterized by very short sternum VI, and perhaps should be treated as a subspecies of *A.* (*A*) *remipes*.

Apis (Apis) intermissa (BUTT. - REEP.), 1906.

= *Apis mellifica unicolor* var. *intermissa* BUTT. - REEP., 1906.

1906. *Apis mellifica unicolor* var. *intermissa*, ENDERL.: 335 (E. Africa & Kamerun records), 342 (key to varr. ♀).

Worker. — POL: OOL about 13.5 : 14. Mandibles as in fig. 61. Tibiae and basitarsi III as in fig. 94; post-auricular scopal bristles (fig. 126) 8 rows. Abdominal sterna as in fig. 35. Length of tongue about 5.77 mm.

Queen & Male. — Both undescribed.

Specimens examined. — Algeria: Algiers, 6.vi.1933 (E. C. VAN DYKE), 1 ♀.

"Africa", 2 ♀ (ex coll. T. SHIRAKI).

Distribution. — Algeria. Originally described from Malta and many parts of continental Africa, as restricted and redefined here, this species occurs probably in NW. Africa only.

Remarks. — This species is chiefly characterized by the short preglandular area II together with very broad lateral marginal areas. It stands somewhat near *A.* (*A.*) *adansonii* and *A.* (*A.*) *lamarckii* on the one hand, and near *A.* (*A.*) *mellifera* on the other, forming more or less a connecting link between these three species. The accompanying figures (35, 61, 94, 126) are based upon the specimen from Algeria (No. Ap-061).

Apis (Apis) lamarckii (CKLL.), 1906.

= *Apis fasciata* LATR., 1804 (nom. praeocc.) = *A. mellifera lamarckii* CKLL., 1906 (nom. nov. pro *A. fasciata* LATR.).

1896. *Apis mellifera* var. *fasciata*, D.T.: 608 - 609 (bibliography).
1904. *Apis mellifera* var. *fasciata*, ASHM.: 121 (list).
1906. *Apis mellifica unicolor* var. *fasciata*, BUTT. - REEP.: 168 (list), 169 (key to varr. ♂), 171 (key to varr. ☿), 172 - 175 (descriptions; Egypt records) (excl. Himalaya & China records).
1906. *Apis mellifica unicolor* var. *fasciata*, ENDERL.: 342 (key to varr. ☿).
1929*a*. "Egyptian Bee", SKOR.: pl. 1 (distribution).

Worker. — Mandibles as in fig. 139. Tibiae and basitarsi III as in fig. 146; post-auricular scopal bristles (fig. 153) 9 rows, the 3rd row almost straight, a little more distant from 2nd than from 4th row. Abdominal sterna (fig. 133) rather similar to those in *A.* (*A.*) *adansonii*, but antecosta II slightly thicker, and very weakly divergent at middle from the corresponding glandulus; glandulus V more weakly curved at middle; antecosta VI more strongly curved. Length of fore wing about 8.2 mm, tongue 4.85 mm.

Queen. — Mandibles as in fig. 141. Prementum with L/B = 2.32; premento-palpal index 69.0. Cell *3r* (fore wings) with L/B = 6.00; radial index exceptionally high, 103.4; jugo-vannal index 187.5. Tibiae III (fig. 151) exceptionally short; basitarsi III in profile broadest at middle, apically weakly narrowed and emarginated almost on median line; auricles very poorly developed. Abdominal sterna (fig. 134), particularly the II, exceptionally long; apodemes relatively thick; lateral marginal areas, particularly the II, narrower than those in *A.* (*A.*) *mellifera;* preglandular area II very short; antecosta II slightly divergent at middle from the corresponding glandulus; postglandular area VI very long and narrow, and posteriorly deeply emarginated. Length of fore wing about 8.8 mm, tongue 3.15 mm.

Male. — Mandibles as in fig. 144. Prementum with L/B = 2.50; premento-palpal index 64.5. Cell *3r* (fore wings) with L/B = 7.82; radial index 79.2; jugo-vannal index 186.7. Tibiae III (fig. 148) short, "dorsal" margins in profile almost straight; basitarsi III in profile nearly evenly

broad, not distinctly narrowed apicad, "ventral" margins very weakly curved. Abdominal sterna (fig. 135) with glandulus II antero-laterally roundly curved, not angulated as in *mellifera* or *adansonii;* apodemes III-VI a little thinner than in *adansonii* but markedly thicker than in *mellifera*. Length of fore wing about 11.0 mm, tongue 2.20 mm.

Specimens examined. — Egypt: Giza, 27.ii.1913 (NEGUIT), 1 ☿ ; Meadi, 28.xii.1912 (L .H. G.), 1 ♀; same loc., 1.ii.1913 (L. H. G.), 2 ♂ (all from the collection of the Department of Agriculture, Egypt). "Africa", 3 ☿, 1 ♂ (ex coll. T. SHIRAKI).

Remarks. — Among the members of the subgenus, the 3 castes of *A. lamarckii* are unique in having very small body-size and very short tibiae III. The medially lengthened preglandular area II and very long sternum V in ♀, the very high radial index, particularly in ♀, as well as the relatively thick apodemes in ♀ and ♂, also deserve to be specially mentioned. The general structure of the legs III and abdominal sterna, however, clearly indicates its close affinities to *A.* (*A.*) *adansonii*. The accompanying figures (133 - 135, 139, 141, 144, 146, 148, 151, 153) are based upon a ☿ from Giza (No. Ap-102), a ♀ from Meadi (No. Ap-104) and a ♂ also from Meadi (No. Ap-106).

Apis (Apis) mellifera mellifera LINN., 1758.

= *Apis domestica* RAY, 1710 (nom. prae-Linn.) = *A. mellifica* LINN., 1761 = *A. gregaria* GEOFF., 1762 = *A. cerifera* SCOP., 1770 = *A. ligustica* SPIN., 1906 = *A. daurica* FISCH. - WALD., 1843 = *A. australis* KIESENW., 1860 (nom. nov. pro *A. ligustica* SPIN.) = *A. mellifica* var. *cecropia* KIESENW., 1860 = *A. cerifera* GERST., 1862 (nom. praeocc.) = *A. mellifica germanica* POLLM., 1879 = *A. mellifica carnica* POLLM., 1879 = *A. mellifica hymettea* POLLM., 1879 = *A. siciliana* GRASSI, 1880 = *A. mellifica* var. *nigrita* LUCAS, 1882 = *A. mellifica mellifica* var. *lehzeni* BUTT. - REEP., 1906 = *A. mellifica* var. *banatica* GROZD., 1926 = *A. mellifera mellifera* natio *tesquorum* SKOR., 1929 = *A. mellifera* natio *acervorum* SKOR., 1929 (nom. praeocc.) = *A. mellifera taurica* ALP., 1938.

1896. *Apis mellifera* + var. *cecropia* + var. *cerifera* + var. *daurica* + var. *ligustica* + var. *nigrita* (excl. varr. *adansonii, caffra, cerana, fasciata, japonica, nigritarum, remipes* & *unicolor*) + *A. siciliana*, D.T.: 595 - 609 & 612 (bibliography).

1904. *Apis mellifera* + var. *ligustica* (excl. var. *fasciata*), ASHM.: 121 (list).

1906. *Apis mellifica mellifica* var. *mellifica* + var. *ligustica* + var. *carnica* + var. *lehzeni* (excl. varr. *remipes* & *cypria*), BUTT. - REEP.: 122 - 123 (discussions on the terms *mellifica* vs. *mellifera*), 163 (evolution), 167 - 168 (synonymy), 168 (key to subspp. ☿), 169 (key to subspp. & varr. ♂), 171 - 172 (key to varr. ☿), 178 & 180 - 186 (descriptions; Europe records), text-figs. 2 (☿ tibia & basitarsi III), 5 (♀ tibiae & basitarsi III), 6 (☿ wings) & 8 (photograph of ♂ *carnica*).

1906. *Apis mellifica mellifica* typ. + var. *lehzeni* + var. *carnica* + var. *ligustica* (excl. var. *cypria*), ENDERL.: 341 (key to spp. ☿), 342 - 343 (key varr. ☿), text-fig. 1 (☿ labial palpus).

1929*a*. *Apis* (*Apis*) *mellifera*, SKOR.: 253 & 261 (descriptions), 254 & 263 (geographical variation), pls. 1 (distribution) & 6 (latitudinal variation of tongue length), text-figs. 11 (☿ abd. sterna), 17 (frequency curve of tongue length) & 18 (☿ abd. sternum II).

Worker. — POL: OOL about 13.5 : 14. Antennae as in fig. 3. Mandibles as in fig. 62. Relative lengths of segments I, II and III + IV of labial palpi about 40 : 17 : 9. Tibiae and basitarsi III as in fig. 95; post-auricular scopal bristles (fig. 127) 9 rows. Abdominal sterna as in fig. 36. Length of body about 12—13 mm, fore wing 9.5—10 mm, tongue 6.04 mm; relative breadths of head, thorax and abdomen about 100 : 110 : 113.

Queen. — POL: OOL about 14 : 14. Antennae as in fig. 6. KRÜGER's index 112. Mandibles as in fig. 70. Prementum with L/B = 2.62. Prementopalpal index 69.39. Cell *3r* (fore wings) with L/B = 6.69, radial index 81.25; jugo-vannal index 183.78. Tibiae and basitarsi III as in fig. 103. Abdominal sterna as in fig. 37. Length of body about 16—17 mm, fore wing 10—11.5 mm, tongue 3.46 mm; relative lengths of head, thorax and abdomen about 103 : 126 : 130.

Male. — POL: OOL about 13 : 1. Antennae as in fig. 9. KRÜGER's index 219. Mandibles as in fig. 76. Prementum with L/B = 2.06. Prementopalpal index 62.26; relative lengths of segments I, II and III + IV of labial palpi about 28 : 9.5 : 7. Cell *3r* (fore wings) with L/B = 8.29; jugo-vannal index 191.11. Tibiae and basitarsi III as in fig. 108. Abdominal sterna as in fig. 38. Length of body about 14—16 mm, fore wing 10—12.5 mm, tongue 2.81 mm; relative lengths of head, thorax and abdomen about 120 : 153 : 143.

Specimens examined. — Siberia: Gichiga (N. G. BUXTON), 2 ☿; Irkutsk (T. D. A. COCKERELL), 1 ☿; Tschita (V. J. TOLMACHOV), 1 ☿; Vladivostok, 1 ☿.

Manchuria: Kao-lin-tze, Kirin, 17—21.viii.1939 (M. VOLKOFF), 5 ☿, 1 ♀, 2 ♂.

Besides the above mentioned specimens, a few examples from France, Hungary and "Europe" and several hundred from China, Japan, Iraq, Congo, Australia (New South Wales), Tahiti, Society Is., Nuku Hiva, Pitcairn, etc. could be examined.

Distribution. — Europe (excluding Caucasus, Malta and possibly Sicily); Siberia; China (Sinkiang; Mongolia; Manchuria); Turkestan. Now occurring in most parts of the world as a result of artificial introduction.

Remarks. — The racial classification of this common and widely distributed subspecies is still in a chaotic condition, since all "local races" are of very doubtful status. It appears that none of them can be recognized

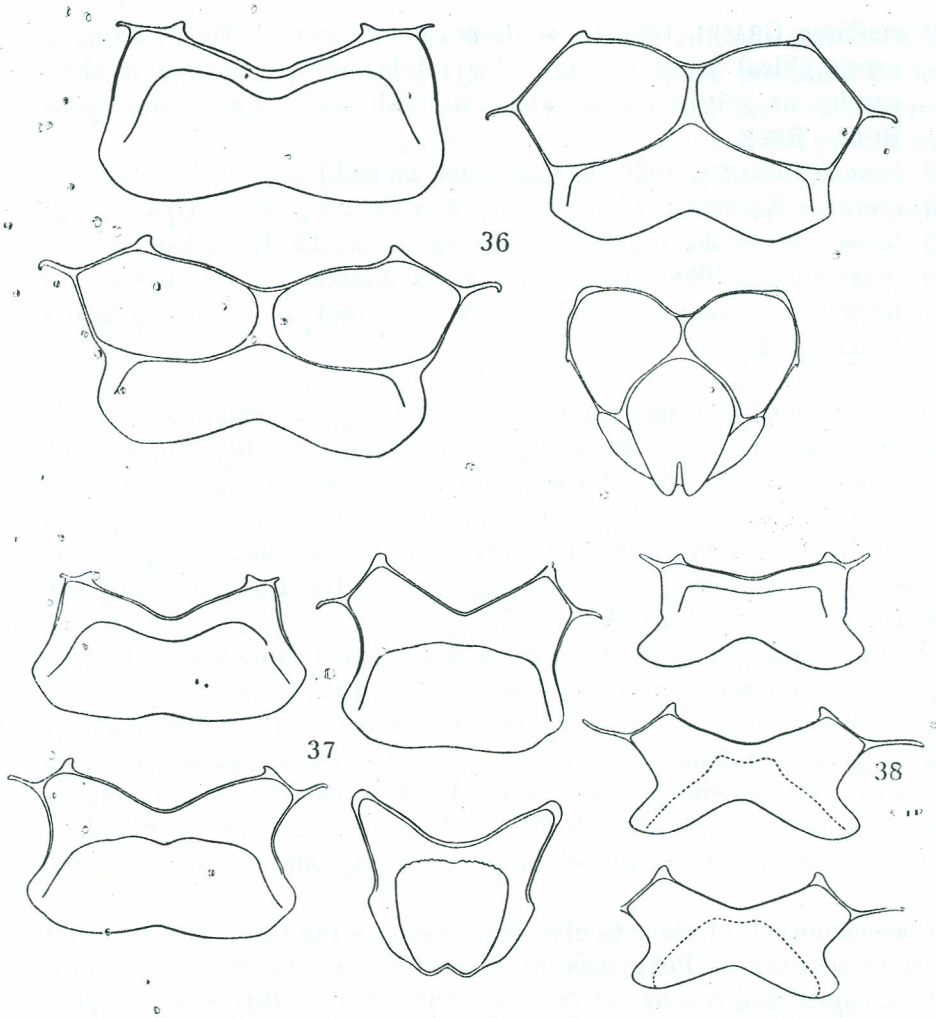


Fig. 36-38. *Apis* (*Apis*) *mellifera mellifera* LINN., abdominal sterna II, III, V and VI of ☿ (36), the same of ♀ (37), and abdominal sterna II, III and V of ♂ (38).

by any morphological characters, and any further intensive and authoritative study of this problem has to be left for some European investigator. For traditional reasons, they may perhaps most conveniently be termed nationes, for which the following "names" are available.

1) *lehzeni* BUTT.-REEP., 1906. N. Germany and Holland.
2) *carnica* POLLM., 1879 (= *carniolica*, nom. emend.) Carniola, Austria.
3) *ligustica* SPIN., 1806 (= *liguria*, nom. emend. = *ligurica*, nom. emend. = *australis* KIESENW., 1860). Liguria, N. Italy.

4) *siciliana* GRASSI, 1880 (= *siziliana*, nom. emend.) Sicily. From a geographical point of view this might either prove a distinct species or subspecies, or identical with *Apis* (*Apis*) *intermissa* BUTT. - REEP.
5) *banatica* GROZD., 1926 (*banata*, nom. emend.) N. Serbia.
6) *cecropia* KIESENW., 1860 (= *hymettea* POLLM., 1879). Greece.
7) *tesquorum* SKOR., 1929 (= *acervorum* SKOR., 1929). S. Russia.
8) *taurica* ALP., 1938. Crimea. Another available "name" for Russian honeybees (excluding *Apis* (*Apis*) *remipes*) is *daurica* FISCH. - WALD., 1843.

The name *mellifera* has priority over *mellifica*, although in Europe, the former name is less popular than the latter. VON BUTTEL - REEPEN (1906: 122—123) argued about these two names and preferred *mellifica* since this means honey-maker, whereas *mellifera* means honey-bearer, so that the former name would be more appropriate. Such a practice is not to be approved since it opens to objection to the International Code of Zoological Nomenclature, Article 32.

The abdominal terga of the ♀ from Siberia and Manchuria are uniformly black, the pubescence on head and thorax is intermixed with numerous black hairs, and the abdominal hair-bands are rather narrow and dirty yellowish. Superficially, they are thus indistinguishable from the so-called "Heidebiene" or var. *lehzeni* BUTT. - REEP. The accompanying figures (3, 6, 9, 36, 37, 38, 62, 70, 76, 95, 103, 108, 127) are prepared on the bases of specimens from Kaolintze (Nos. Ap-039 ♀, Ap-040 ♀, Ap-072 ♂).

It seems not out of place to give some notes on the very important but long neglected work by POLLMANN, in which 5 names (*germanica, carnica, hymettea, cypria* and *caucasica*) for subspecies of *A. mellifica* or *mellifera* were brought forth for the first time. A number of authors considered them as having no nomenclatural standing on the ground that they have not been "scientifically" described and published in a "scientific" publication. But what are the definite requirements of a "scientific" description or a "scientific" publication? Should POLLMANN, not VON BUTTEL - REEPEN (1906), be accepted as the author of these names, the questions before us are: (a) what is the year of publication of POLLMANN's work; and (b) what about the different pagination of the two editions of this work?

In this connection, quotations may be made from the opinion (*in litt.*) offered on request by Mr. K. V. KROMBEIN of the U. S. National Museum:

"The evidence afforded by the prefaces to the two editions and the table of contents, makes it most likely that pages 1—69 are the same in both editions. As a matter of fact, pages 1—64 (4 signatures) are on a different paper and may well be the actual first edition remainders. It appears that enough descriptive matter is included in the discussions to validate the names in a nomenclatural sense. Apparently POLLMANN had no intention of proposing new names in a nomenclatural sense or he would hardly have said' *'Apis mellifica cecropia* oder *Apis mellifica Hymettea'* on p. 50. *Cecropia* is an older valid name in a nomenclatural sense, while *Hymettea* is new'".

A series of fruitless enquiries by the present writer into the matter about the first edition were made to a number of European and American libraries and it appears that only the second edition is now still existing. What we can do at present is to assume that the first edition was published in 1879, and that pages 1-69 inclusive are identical in both first and second editions.[1])

The ☿ of typical *mellifera* can be distinguished from its relatives by the very weakly curved glandulus II, very ample wax-plates, and relatively broad sternum V; the ♀ by the exceptionally short and broad sterna (particularly the V), exceptionally thin apodemes (particularly the III), and relatively long and broad tibiae III; and the ♂ by the "ventrally" (in profile) distinctly curved basitarsi III, long and slim tibiae III, and comparatively thin apodemes.

Apis (Apis) mellifera cypria (POLLM.), 1879.

= *Apis mellifica cypria* POLLM., 1879.

1906. *Apis mellifica mellifica* var. *cypria*, BUTT.-REEP.: 168 (list), 169 (key to varr. ♂), 172 (key to varr. ☿), 176-177 (descriptions).

1906. *Apis mellifica mellifica* var. *cypria*, ENDERL.: 343 (key to varr. ☿).

1929*a*. *Apis* (*Apis*) *cypria*, SKOR.: pl. 1 (distribution), text-fig. 9 (☿ abd. sterna).

Differing from the typical subspecies in the following points:

Worker. — Mandibles (fig. 140) with "posterior" margins comparatively more weakly curved. Tibiae and basitarsi III as fig. 147, apical scopal bristle-rows arranged as in fig. 154. Abdominal sterna (fig. 136) with median third of preglandular area II evenly long; preglandular areas III-VI a little shorter; lateral marginal areas III-V narrower; postglandular area

[1]) Bibliotheca Bogoriensis, the Central Library of the Ministry of Agriculture at Bogor (Indonesia), possesses a bound copy of A. POLLMANN's "Werth der verschiedenen Bienenracen und deren Varietäten ....." &c., Verlag von HUGO VOIGHT, Berlin und Leipzig, without year. This copy, possibly the first edition, consists of viii and 70 pages, "*Apis mellifica Cypria*" being discussed on pp. 52-70. The "Vorrede" of this copy is dated: Bonn, im Januar 1879. — Ed. (M. A. LIEFTINCK).

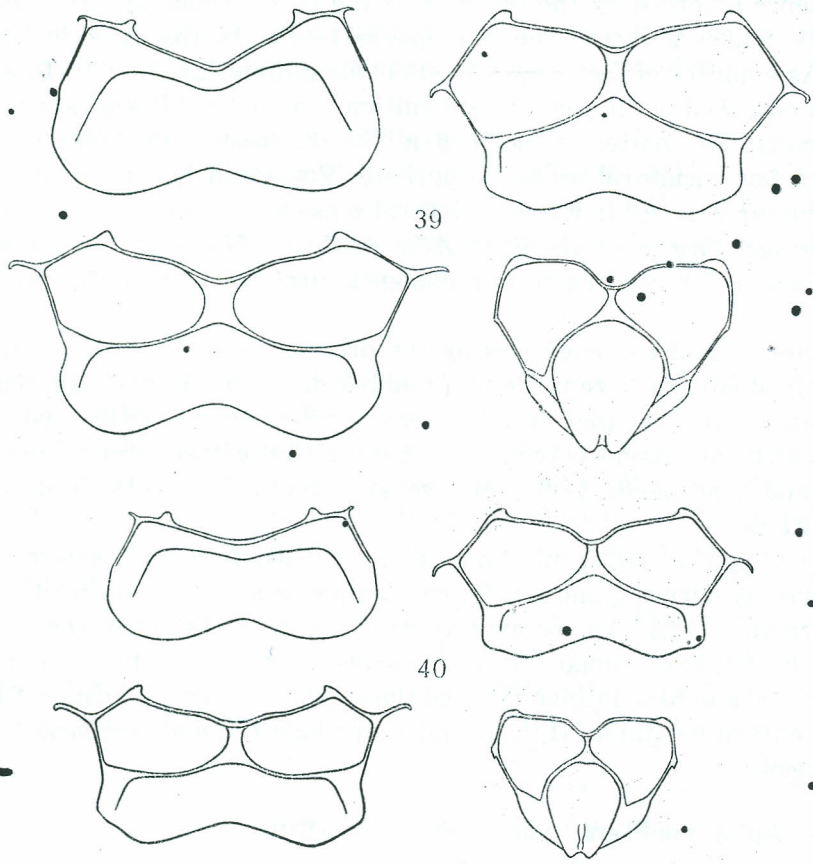


Fig. 39. *Apis* (*Apis*) *mellifera anatoliaca*, subsp. nov. ♀, abdominal sterna II, III, V and VI. Fig. 40. *Apis* (*Apis*) *remipes remipes* (GERST.) ♀, the same as in fig. 39.

1929*a*. *Apis* (*Apis*) *remipes* SKOR.: 254 & 262 (descriptions; infra-specific classification), pls. 1 (distribution) & 6 (geographical variation of tongue length), text-figs. 12 (♀ abd. sternum II), 16 (local distribution), 17 (frequency curve of tongue length) & 19 (♀ abd. sterna).

Worker. — POL: OOL about 14.5 : 14. Mandibles as in fig. 64. Tibiae and basitarsi III as in fig. 97; post-auricular scopal bristles (fig. 129) 9 rows. Abdominal sterna as in fig. 40. Length of fore wing about 9—9.5 mm.

Queen & Male. — Both unknown to the present writer.

Specimens examined. — U. S. A.: Amherst, Mass. (introduced), 10 ♀.

Distribution. — Caucasus. Introduced into many countries in Europe and America.

Remarks. — The "key character" of this species (☿♀) is the shape of the abdominal sternum II, of which the antecosta is medially suddenly thickened, and the preglandular area is medially suddenly shortened. The accompanying figures (40, 64, 97, 129) are based upon a specimen (No. Ap-101) kindly supplied by Prof. H. F. CHAO. It is slightly different from what is illustrated by SKORIKOV (1929*a*), and is possibly a hybrid of *A. mellifera* and *A. remipes*.

SKORIKOV (1929) credited the authorship of this species to P. S. PALLAS and produced the latter author's description. A search of literature revealed that PALLAS's description has never been published elsewhere and that it is GERSTÄCKER (1862) who, for the first time, made use of the name *remipes* and added a few words which may be counted as the original description.

Apis (Apis) remipes transcaucasica SKOR., 1929.

This subspecies is unknown to the writer. According to SKORIKOV (1929*a*), it differs from the typical subspecies in having a longer tongue, a little thinner antecosta II, and posteriorly a more broadly emarginated sternum II. By average tongue length, SKORIKOV divided it into 4 nationes:

(a) natio *absuana* SKOR., 1929 = *absuatna* SKOR., 1929. Abchasia.
(b) natio *siganica* SKOR., 1929. Mingrelia.
(c) natio *georgica* SKOR., 1929. Imeretia.
(d) natio *iberica* SKOR., 1929. Azerbaijan.

Apis (Apis) remipes armeniaca SKOR., 1929.

Distribution. — Armenia.

Remarks. — This is also unknown to the writer. According to the original description, it differs from the typical subspecies in having a little thinner antecosta II and posteriorly a more broadly emarginated sternum II; and from the subspecies *transcaucasica* in having a shorter tongue. It seems very problematical whether such slight differences deserve to be considered of subspecific value.

Micrapis andreniformis (F. SM.), 1858.

= *Apis andreniformis* F. SM., 1858 = *A. florea andreniformis* var. *sumatrana* ENDERL., 1906.

1896. *Apis florea* (partim), D.T.: 591 (bibliography).
1897. *Apis florea* var. *andreniformis*, BINGH.: 559 (description).
1906. *Apis florea* var. *andreniformis*, BUTT.-REEP.: 167 (list), 170 (key to varr. ☿), 197 (Siam & Kelantan records).
1906. *Apis florea andreniformis* typ. + var. *sumatrana*, ENDERL.: 339-340 (description; Sumatra records), 344 (key to varr. ☿).
1929. *Apis florea* form *andreniformis* + form *sumatrana*, DOVER: 66 (Ceylon, Malay Penin. & Borneo records), 67 (key to "forms" ☿), 69 (Malay Penin. records).

Worker. — Similar to *M. florea* as redescribed below. Abdominal terga I-II usually dominantly or entirely black. Wings very weakly and evenly stained with brownish. Hairs on vertex and tibiae and tarsi I-II (dorsal surfaces) brownish black; and on tibiae II (dorsal and "anterior" surfaces) and tarsi III (dorsal surfaces) stiff, pitchy black; abdominal terga I-II rather densely pubescent. POL: OOL about 10:7. Mandibles as in fig. 65. Relative lengths of segments I, II and III + IV of labial palpi about 15:7.5:8. Tibiae and basitarsi III as in fig. 98; pre-auricular scopal bristles 2 rows; post-auricular bristles (fig. 130) 9 rows, the 2nd zigzagged and equidistant from 1st and 3rd. Abdominal tergum II densely, finely, evenly punctate; sterna (fig. 41) with wax-plates shorter and glandulus II more strongly curved than in *M. florea*. Length of body about 8 mm, fore wing 6.5 mm, tongue 2.81 mm; relative breadths of head, thorax and abdomen about 60—65:58—60:65—67.

Queen & Male. — Both unknown.

Specimens examined. — Siam: Chum Het, Trong, 15.iv.1928 (A. F. G. KERR), 1 ♀

Sumatra: N. Sumatra, Atjeh, Pendeng, 400 m, ii-iii.1937 (A. HOOGERWERF), 7 ♀; Korintji, Serapai, vii.1915 (E. JACOBSON), 10 ♀; S. Sumatra, Lampong distr., Mt Tanggamus & Gisting, 350—600 m, ult. xii.1939 (M. A. LIEFTINCK), 1 ♀.

Bangka: Aer Mesu & Koba, 3.xii.1935 (J. VAN DER VECHT), 3 ♀.

W. Java: Palabuanratu, iii.1935 (Mrs M. E. WALSH), 1 ♀; Central N. Java, Mts Muria, 800 m, Tjolo, 20-24.x.1939 (M. A. LIEFTINCK), 1 ♀.

Distribution. — Ceylon; Siam; Malay Penin.; Sumatra; Bangka (new record); Java; Borneo.

Remarks. — Originally described as a distinct species, but sunk by all subsequent writers as an "extreme variety" of *M. florea*, from which, it was generally believed, it only differed by duller abdominal pattern. ENDERLEIN (1906), however, recognized it as a subspecies of *florea* and re-characterized it as: "Aderanhang an der Radialzelle des Vorderflügels *meist* ziemlich lang. Von mir vorliegenden Stücken haben nur 2 Exemplare einen kurzen höckerförmigen Aderstummel ähnlich wie typische *florea*. Trotz der 2 erwähnten Ausnahmen halte ich es doch nicht für ausgeschlossen, dass es sich um *eine besondere* Bienenart handelt, wie ja auch SMITH *andreniformis* als solche auffasst. Die Entfernung der hinteren Ocellen von den Augen *meist* so lang wie ihr Abstand von einander. 1. Abdominalsegment stets schwarz. ... Der Thorax etwa um die Breite einer Tegula schmäler als bei der typischen *florea;* ferner sind die Ocellen bei ihr *meist* wesentlich kleiner. ... Flügel hyalin, nur blass bräunlich angehaucht."

Among the 23 examples at hand, 12 are with abdomen entirely black, referable to the so-called var. *sumatrana* ENDERL.; 1 with the terga I-II entirely rufous, thus indistinguishable from the "typical form" of *M. florea;* and 10 others with the anterior half (and, usually a narrow band along posterior margin also) of tergum II rufous, referable to typical *andreniformis*. On the other hand, the distinctness of the appendiculate cell is by no means a reliable character, and the POL: OOL ratio and size of ocelli are only slight differences: — these are reasons why ENDERLEIN used the term "meist" in both cases. ASHMEAD (1900), SKORIKOV (1929*a*) and ROEPKE (1930) did not recognize this species, not even as a colour variety.

The habitat of this species is confined to the submontane region, whereas *florea* is a lowland insect. According to Dr M. A. LIEFTINCK (*in litt.*) "*florea* is a very common insect, locally, in the coastal zone of northern Java, but it is not (or only very rarely) found inland. I have only occasionally captured *andreniformis* in the hills up country, and this appears to be a much rarer insect, which is not known from the coast or the small coral reef islands off the mainland of Java". This well accords with NETOLITZSKY's (1916) second law, as *andreniformis* is decidedly darker than *florea*. On the other hand, the comparatively smaller body-breadth of *andreniformis* versus *florea* is not in harmony with BERGMANN's (1847) rule and provides still another negative proof that these two are conspecific. The accompanying figures (41, 65, 98, 130) are based upon a specimen from Pendeng (No. Ap-069).

Micrapis florea (FABR.), 1787.

= *Apis florea* FABR., 1787 = *A. semirufa* HOFFMG., 1818 = *A. lobata* F. SM., 1854 = *A. testacea* BINGH. 1898 (nom. praeocc.) = *A. florea* var. *rufiventris* BUTT.-REEP., 1906 = *A. florea florea* var. *fuscata* ENDERL., 1906 = *A. nursei* CKLL., 1911 (nom. nov. pro *A. testacea* BINGH.) = *A. florea nasicana* CKLL., 1911.

1896. *Apis florea* (partim), D.T.: 591 (bibliography).

1897. *Apis florea* (excl. var. *andreniformis*), BINGH.: 557 (key to spp. ☿) 559 (descriptions; India, Ceylon, Burma & Tenasserim records), text-fig. 187 (♀).

1904. *Apis* (*Micrapis*) *florea*, ASHM.: 122 (structure).

1906. *Apis florea* var. *florea* + var. *rufiventris* (excl. var. *andreniformis*), BUTT.-REEP.: 163 (evolution), 167 (synonymy), 168 (key to spp. ☿), 170 (key to varr. ☿; descriptions of ♀♂), 197 (descriptions; India, Java & Ceylon records).

1906. *Apis florea florea* typ. + var. *fuscata* + var. *rufiventris*, ENDERL.: 337-338 (infra-specific classification; India records), 341 (key to subspp. ☿), 343-344 key to varr. ☿), text-fig. 3 (☿ labial palpus).

1929*a*. *Apis* (*Micrapis*) *florea*, SKOR.: 250 & 259 (descriptions), pl. 2 (distribution), text-fig. 3 (☿ abd. sterna).

1929. *Apis florea* (*forma typica*, typica, typical form) + form *rufiventris* + form *fuscata* + form *nasicana* (excl. forms *andreniformis* & *sumatrana*), DOVER: 66 (India, Java, Tonkin, Tenasserim, Muscat & Arabia records), 67 (key to "forms" ♀), 69 (Malay Penin. records).

1930. *Apis florea*, ROEPKE: 7 (Java records; bionomics).

Worker. — Integument shining black; mandibles (apices), tegulae, knees I-II and particularly proboscis, tibiae III and tarsi III all more or less tinted with reddish. Wings clear hyaline, veins reddish brown, the costal ones and stigmata blackish. Abdominal terga variable in pattern, usually I-II and posterior margins of the remainder reddish. Pubescence whitish, rather long; that on face very short, dense, decumbent; on eyes short, yellowish; on vertex very long, brown; on dorsum of thorax very fine, relatively short; on venter of basitarsi II and "posterior" surfaces of III short, stiff, golden red; on anterior slope and posterior margin of abdominal tergum I whitish, long, very scattered; on terga III-VI black, decumbent, rather stiff; tergum II almost naked, with only a few brownish, short, decumbent hairs.

POL: OOL about 10: 6. Antennae as in fig. 4. Mandibles as in fig. 66. Relative lengths of segments I, II and III + IV of labial palpi about 19: 9.5 : 6. Tibiae and basitarsi III as in fig. 99; pre-auricular scopal bristles 2 rows; post-auricular bristles (fig. 131) 8 rows, the 2nd regularly arranged and more distinct from 1st rather from 3rd. Abdominal tergum II microscopically alutaceous, only with posterior half sparsely, coarsely, shallowly punctate; sterna (fig. 42) with wax-plates longer and less strongly curved than in the preceding species. Length of body about 8—10 mm, fore wing 7 mm, tongue 3.12 mm; relative breadths of head, thorax and abdomen about 64—71: 63—68; 70—77.

Queen. — Paler than ♀; labrum, mandibles, tegulae, apices of femora I-II and of tibiae I-II, legs III and abdominal terga I-II and posterior margins of III-V yellowish or reddish brown. Pubescence comparatively shorter, paler, denser and more decumbent. POL: OOL about 11 : 6. KRÜGER's index 150. Mandibles as in fig. 71. Prementum with L/B = 2.23. Premento-palpal index 90.62; relative lengths of segments I, II and III + IV of labial palpi about 16: 7.5: 4.5. Cell *3r* (fore wings) with L/B = 5.84, radial index 94.87; jugo-vannal index 114.3. Legs III (?). Abdominal tergum II densely and exceedingly finely punctate; sterna as in fig. 43. Length of body about 13 mm, fore wing 10 mm, tongue 2.08 mm; relative breadths of head, thorax and abdomen about 80: 108: 103.

Male. — Integument almost uniformly brownish black; face, labrum, tegulae, scutellum and legs a little paler; antennal segment V and succeeding joints testaceous; thorax proper pitchy black. Wings clear hyaline.

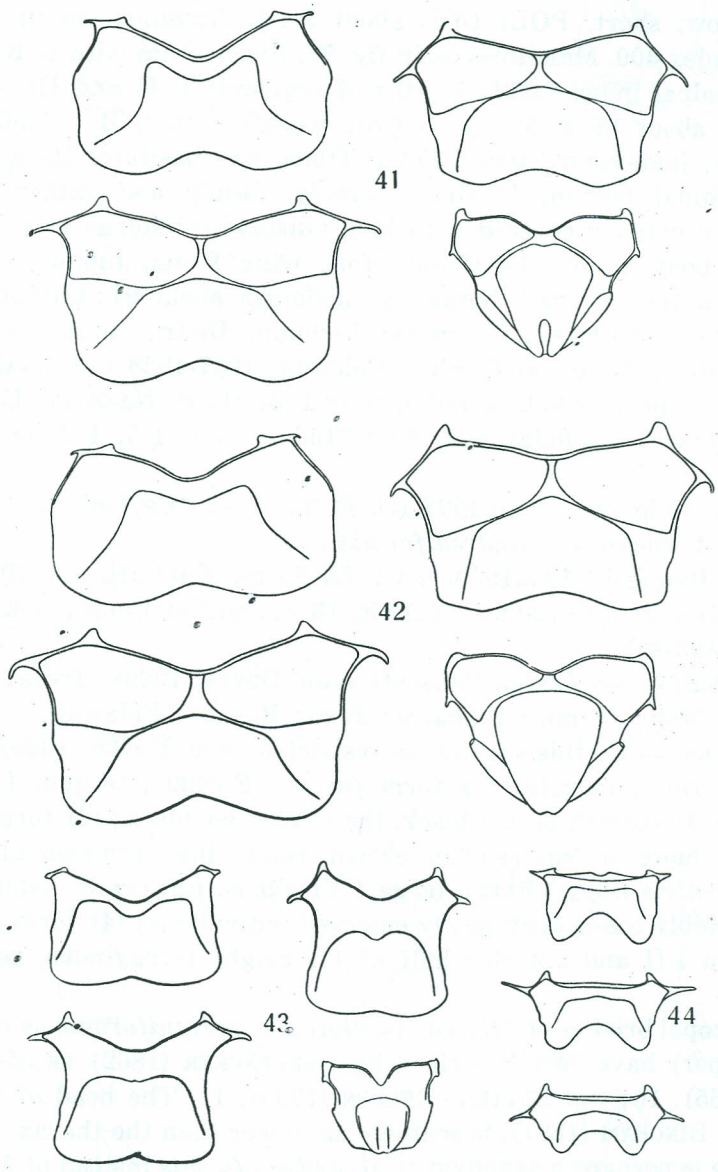


Fig. 41. *Micrapis andreniformis* (F. SM.) ☿, abdominal sterna II, III, V and VI. Fig. 42-44. *Micrapis florea* (FABR.), abdominal sterna II, III, V and VI of ☿ (42), the same of ♀ (43, magnification of sternum VI on slightly lower scale than of three preceding ones), and abdominal sterna II, III and V of ♂ (44).

Pubescence whitish, long and very dense; that on ventral surfaces of tarsi golden yellow, short. POL: OOL about 9 : 1. Antennae as in fig. 10. KRÜGER's index 400. Mandibles as in fig. 77. Prementum with L/B = 2.11. Premento-palpal index 64.52; lengths of segments I, II and III + IV of labial palpi about 15 : 8 : 5. Cell *3r* (fore wings) with L/B = 7.50, radial index 73.08; jugo-vannal index 174.4. Tibiae and basitarsi III as in fig. 109. Abdominal tergum II finely, evenly, deeply and rather densely punctate and entirely covered with long pubescence; sterna as in fig. 44. Length of body about 11—12 mm, fore wing 9 mm, tongue 1.77 mm; relative breadths of head, thorax and abdomen about 97 : 110 : 90.

Specimens examined. — India: Birbhum Distr., Bengal, x-xi.1937 (T. MAA), 30 ☿; Botanical Garden, Calcutta, 1937-1938 (T. MAA), 10 ☿; Kurum-Bagaram, Karikal, S. India, ii.-iii.1947 (P. S. NATHAN), 17 ☿ (det. H. F. SCHWARZ); Secundarabad, 2 ☿; "India", 3 ☿, 1 ♀, 1 ♂ (ex coll. T. SHIRAKI).

Ceylon: Colombo, 20.xii.1923 (O. PIEL), 1 ☿; "Ceylon", 2 ☿ (det. T. SHIRAKI as *A. florea* var. *andreniformis*).

Siam: Bangkok, 12.x.1920, 1 ☿; Ta Salva, Kanburi, 7.xi.1930, 1 ☿.

Java: Djakarta (Batavia), vii.1936, 13 ☿, and Tandjong Priok, ii.1937, 1 ☿ (C. FRANSSEN).

Distribution. — Arabia (Muscat) (vide DOVER, 1929); India; Ceylon; Indochina; Malay Penin.; Sumatra; Java; Borneo; Palawan.

Remarks. — Of this species, as restricted here, DOVER (1929) enumerated 4 "forms", namely: (1) form *fuscata* ENDERL., tergum I reddish rust-yellow, II reddish brown-black, the remainder black; (2) form *typica*, terga I-III more or less reddish brown, remaining brownish black; (3) form *rufiventris* BUTT. - REEP., terga I-VI almost uniformly reddish rust-yellow, possibly based upon newly emerged individuals; (4) form *nasicana* CKLL, terga I-II and anterior half of III bright ferruginous, remaining black.

The scopal bristles of "*florea*" (= *florea* + *andreniformis*, as redefined in this paper) have been described by GERSTÄCKER (1862) as of 9 rows; SMITH (1865), 10; VON BUTTEL - REEPEN (1906), 11. The head of the ♀, as figured by BINGHAM (1897), is scarcely narrower than the thorax. The var. *rufiventris* is perhaps a synonym of *M. andreniformis* instead of *M. florea*, or even represents the third species of the genus. It is originally described from Tonkin and Palawan and later on recorded by DOVER (1929) from Bengalore, Bombay and Selangor. The accompanying figures (4, 10, 42—44, 66, 71, 77, 99, 109, 131) are based upon specimens from Djakarta (No. Ap-068 ☿) and "India" (Nos. Ap-026 ♀, Ap-024 ♂).

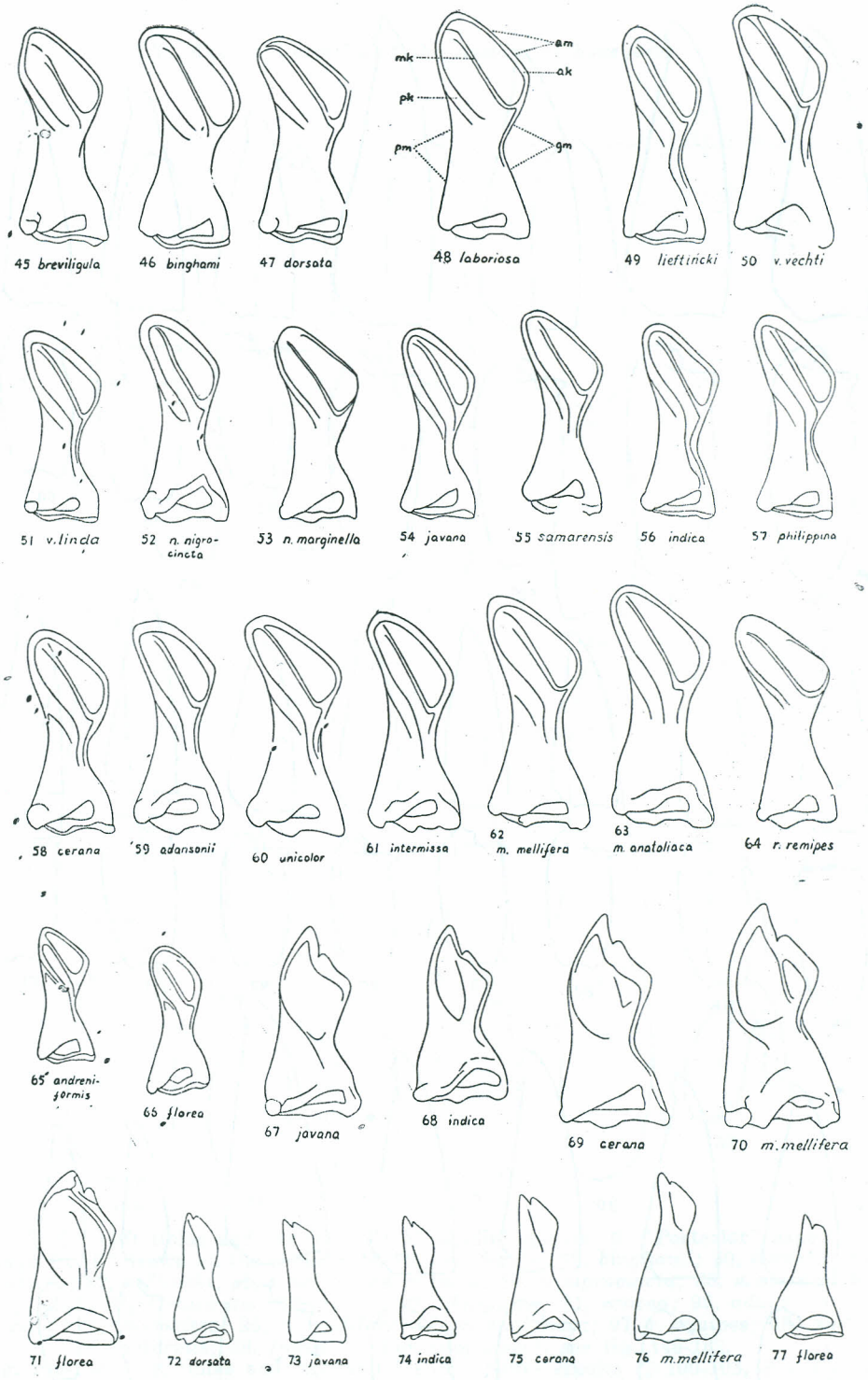
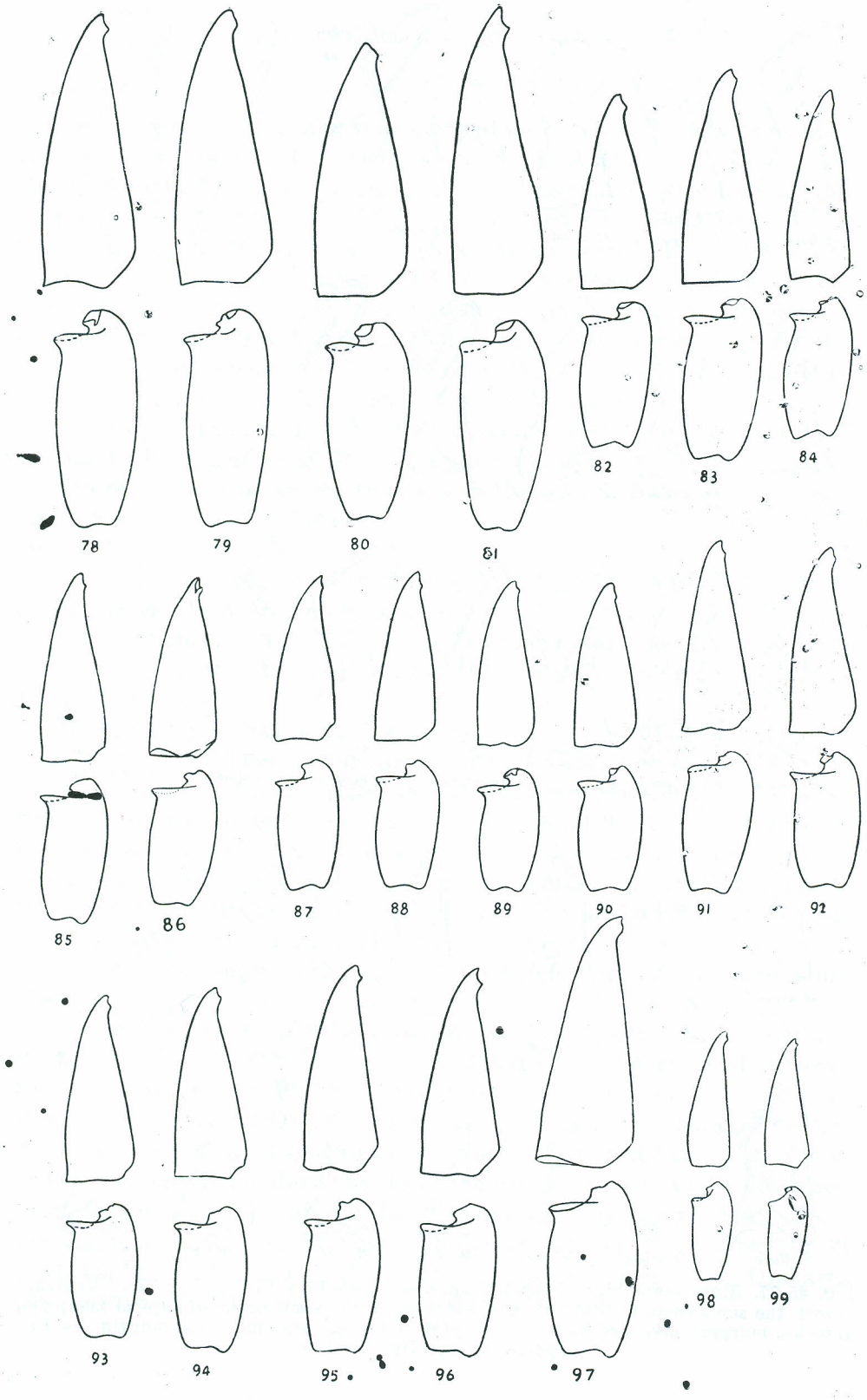


Fig. 45-77. Right mandibles of Apidini species (☿ 45-66, ♀ 67-71, ♂ 72-77). "Ventral" aspect, the same caste of the same genus drawn on the same scale. *ak*, apical keel; *gm*, anterior margin; *mk*, median keel; *pk*, posterior keel; *pm*, posterior margin. — For supplement, see fig. 139-145.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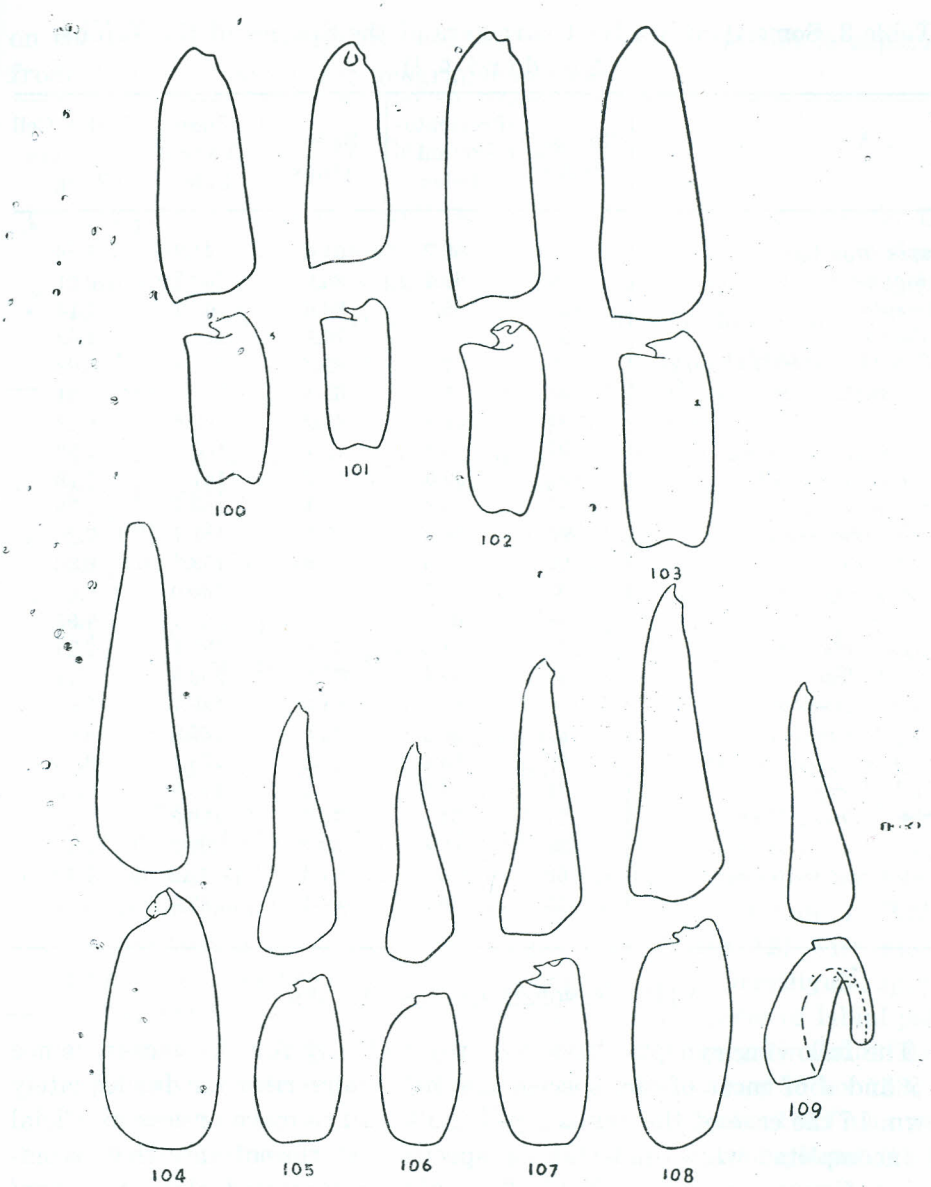

Fig. 78-99. Left tibiae and basitarsi III of Apidini species, ☿. "Posterior" aspect, all except fig. 97 drawn on the same scale. 78, *breviligula;* 79, *binghami;* 80, *dorsata;* 81, *laboriosa;* 82, *lieftincki;* 83, *v. vechti;* 84, *v. linda;* 85, *n. nigrocincta;* 86, *n. marginella;* 87, *javana;* 88, *samarensis;* 89, *indica;* 90, *philippina;* 91, *cerana;* 92, *adansonii;* 93, *unicolor;* 94, *intermissa;* 95, *m. mellifera;* 96, *m. anatoliaca;* 97, *r. remipes;* 98, *andreniformis;* 99, *florea.* — For supplement, see fig. 146-152.

Fig. 100-109. Left tibiae and basitarsi III of Apidini species (♀ 100-103, ♂ 104-109). "Posterior" aspect, the same caste of the same genus drawn on the same scale. 100, *javana;* 101, *indica;* 102, *cerana;* 103, *m. mellifera;* 104, *dorsata;* 105, *javana;* 106, *indica;* 107, *cerana;* 108, *m. mellifera;* 109, *florea.* — For supplement, see fig. 146-152.

Table 3. Some Quantitative Characters of the Species of the Tribus Apidini ☿ [1]).

	KRÜGER's Index	Premento-Palpal Index	Radial Index	Jugo-Vannal Index	L/B of Cell *3r* (Fore Wing)
Megapis breviligula	100	66.7	94.4	141.2	7.26
M. binghami	130	69.4	95.9	132.7	6.91
M. dorsata	125	65.3	88.6	147.7	7.14
M. laboriosa	90	67.1	76.8	141.5	7.63
Apis (Sigmatapis) lieftincki	93	54.9	62.8	128.1	6.92
A. (S.) vechti vechti	108	55.6	63.8	155.2	7.31
A. (S.) v. linda	84	68.4	68.2	159.3	6.73
A. (S.) nigrocincta nigrocincta	107	63.1	71.7	158.2	7.52
A. (S.) n. marginella	107	69.0	71.7	151.7	7.18
A. (S.) javana	93	63.6	94.4	160.7	7.79
A. (S.) samarensis	99	58.3	63.6	151.7	7.20
A. (S.) indica	90	69.3	62.8	153.3	6.36
A. (S.) philippina	93	62.5	67.4	150.0	6.86
A. (S.) cerana	88	67.3	56.5	165.7	7.95
A. (Apis) adansonii	117	61.2	77.8	189.1	7.27
A. (A.) unicolor	133	59.4	76.1	200.0	7.71
A. (A.) intermissa	108	63.2	61.5	189.7	7.64
A. (A.) lamarckii	84	59.0	78.8	165.2	8.00
A. (A.) mellifera mellifera	106	56.4	55.2	173.1	6.43
A. (A.) m. cypria	81	58.2	64.1	173.9	7.22
A. (A.) m. anatoliaca	121	54.1	70.6	190.3	7.25
A. (A.) remipes remipes	138	57.6	60.9	202.2	8.31
Micrapis andreniformis	55	74.3	61.4	72.2	7.10
M. florea	125	65.0	64.1	83.9	7.11

VIII. SYNOPSIS OF THE SPECIES

The following synoptic keys are prepared only for the ☿ caste, since the ♀ and ♂ of most of the species are still undescribed or inadequately known. In the case of the genus *Apis*, the keys are more or less artificial and incomplete; while undertaking specific determinations, the accompanying figures as well as Table 3 should be consulted also. *A. peroni* and *A. mellifera syriaca* are purposely omitted because of their doubtful status or the insufficiency of existing descriptions. *A. johni*, *A. meda*, *A. remipes transcaucasica* and *A. remipes armeniaca* are placed in the keys

[1]) Excluding *Apis* (*Sigmatapis*) *johni*, *A.* (*S.*) *peroni*, *A.* (? *S.*) *koschevnikovi*, *A.* (*Apis*) *meda*, *A.* (*A.*) *remipes transcaucasica* and *A.* (*A.*) *remipes armeniaca*, which are unknown to the present writer.

on the ground of SKORIKOV's descriptions. *A. koschevnikovi* is separated from *A. vechti* merely for geographical reasons.

(A) Genus **Megapis** ASHM.

1. Interspace of posterior ocelli scarcely raised; POL much shorter than OOL (*ca.* 10:17); malar areas slightly longer than broad; sternal glandulus II (fig. 16) weakly curved at its midpoint and antero-lateral portions; thorax entirely covered with dirty yellow hairs . . . . . **laboriosa** (F. SM.)
— Interspace of posterior ocelli more or less distinctly raised; POL usually longer than OOL, at most a little shorter than the latter (*ca.* 12:13); malar areas usually shorter than broad, at most as long as broad; sternal glandulus II (figs. 12-14) very strongly angulated at midpoint and narrowly rounded at antero-lateral portions; thorax anteriorly black-haired 2
2. Abdominal terga I-II, I-III or even I-IV covered with yellow hairs, POL slightly shorter than OOL (*ca.* 12:13); jugo-vannal index very high, 148; wax-plates V (fig. 14) posteriorly obliquely truncated . . . . . **dorsata** (FABR.)
— Abdominal terga entirely black-haired except for the very narrow, often concealed, anterior, silvery hair-bands; POL distinctly longer than OOL; jugo-vannal index much lower, 133 to 141; wax-plates V (figs. 12-13) posteriorly obliquely arcuate 3
3. Glossa slightly but distinctly shorter than labial palpi; interspace of posterior ocelli but weakly raised; malar areas as long as broad; jugo-vannal index 141; abdominal sternum V (fig. 12) with median length about 0.69 as great as posterior breadth . . **breviligula,** sp. nov.
— Glossa apically protruding much beyond level of apices of labial palpi; interspace of posterior ocelli very strongly raised; malar areas distinctly shorter than broad (*ca.* 13:17); jugo-vannal index 133; abdominal sternum V (fig. 13) with median length about 0.77 as great as posterior breadth . . . . . **binghami** (CKLL.)

(B) Genus **Apis,** subgenus **Sigmatapis** nov.

1. Anteglandulus II medially strongly convergent to antecosta II; glanduli III-IV antero-laterally weakly angulated and slightly produced cephalad; wings strongly infuscated as in *Megapis*-species . . . . . **johni** SKOR.

— Anteglandulus II parallel or subparallel to antecosta II; glanduli III-IV antero-laterally broadly rounded, almost always not produced cephalad; wings never so strongly infuscated as in *Megapis* species 2

2. Scape, notum I, legs and abdomen entirely bright reddish yellow, at most abdominal terga posteriorly narrowly, very slightly darkened; pubescence in fresh specimens uniformly reddish yellow except for a few erect, brown hairs on clypeus, supraclypeal area and vertico-occipital margin 3

— Colour-pattern much darker, at least notum I, legs and abdomen partly black or brownish black, and pubescence on frons and thorax more or less intermixed with black hairs 5

3. Species occurring in Kamerun, W. Africa . . . . . **koschevnikovi** (BUTT. - REEP.)

— Species occurring in Borneo, SE. Asia 4

4. Interspace of wax-plates very great, for instance, that on sternum III much greater than median length of preglandular area III; lateroglanduli V running remotely from and parallel to lateral sternal margins V (fig. 18); mandibles with "anterior" margins very shallowly incurved (fig. 50); body-size comparatively larger, for instance, posterior breadth of sternum III about 4.69 mm . . . . . **vechti vechti** sp. nov.

— Interspace of wax-plates very small, for instance, that on sternum III only about one-third as great as median length of preglandular area III; lateroglanduli V running closely and posteriorly weakly convergent to lateral sternal margins V (fig. 19); mandibles with "anterior" margins very deeply incurved (fig. 51); body-size comparatively smaller, for instance, posterior breadth of sternum III only about 4.38 mm . . . . . **vechti linda**, subsp. nov.

5. Postglandular area III much longer than wax-plates III (fig. 17); "dorsal" half of 2nd scopal bristle-row equidistant from 1st and 3rd rows (fig. 114); lateroglanduli V running closely and parallel to lateral sternal margins V. . . . . **lieftincki** sp. nov.

— Postglandular area III at most very slightly longer than wax-plates III (figs. 20—22, 25—26, 29—30); "dorsal" half of 2nd scopal bristle-row clearly more distant from 1st rather than from 3rd row (figs. 117-123), except for *A. samarensis* (fig. 120) which can be recognized by very broad lateral marginal areas and strongly incurved lateroglanduli II (fig. 25) as well as very small body-size 6

6. Lateroglanduli II not perceptibly incurved (figs. 20-21); post-auricular scopal bristles 9 rows; antecosta VI nearly straight . . . 7
— Lateroglanduli II (except in *A. javana* and typical *A. cerana*) distinctly incurved (figs. 25, 26, 29); post-auricular scopal bristles (except in *A. samarensis*) 8 rows; antecosta VI distinctly concavely curved at middle 8
7. Lateral marginal areas II-III (fig. 20) narrow, the II only about one-half of median length of sternum II; lateroglanduli III posteriorly distinctly convergent to lateral sternal margins III . . . . . **nigrocincta nigrocincta** F. SM.
— Lateral marginal areas II-III (fig. 21) broad, the II conspicuously more than one-half of median length of sternum II; lateroglanduli III subparallel to lateral sternal margins III . . . . . **nigrocincta marginella,** subsp. nov.
8. Post-auricular scopal bristles 9 rows and with 2nd row subparallel to and almost equidistant from 1st and 3rd rows (fig. 120) . . . . . **samarensis,** sp. nov.
— Post-auricular scopal bristles 8 rows and with 2nd row "dorsally" distinctly divergent to 1st and more distant from 1st rather than from 3rd row (figs. 119, 121-123) 9
9. Lateroglanduli II scarcely incurved; lateral marginal areas II moderately broad, as in fig. 22; wax-plates V much shorter than postglandular area V; radial index about 94. . . . . **javana** (ENDERL.)
— Lateroglanduli II strongly incurved (except for typical *A. cerana,* which can be distinguished from *A. javana* by much larger body-size); lateral marginal areas II very broad, as in figs. 26, 29, 30; wax-plates V not shorter than postglandular area V; radial index not more than 70 10
10. Body-size larger, for instance posterior breadths of sterna III and V, respectively, not less than 4.38 and 3.65 mm; sterna short, very broad; lateroglanduli III subparallel to the corresponding lateral sternal margins (fig 30) . . . . . **cerana** FABR.
— Body-size smaller, posterior breadths of sterna III and V, respectively, not more than 4.00 and 3.10 mm; sterna comparatively long, narrow; lateroglanduli III posteriorly distinctly convergent to the corresponding lateral sternal margins 11
11. Lateral marginal areas II and III (fig. 26) comparatively broad; wax-plates V much longer than the corresponding postglandular area . . . . . **indica** FABR.

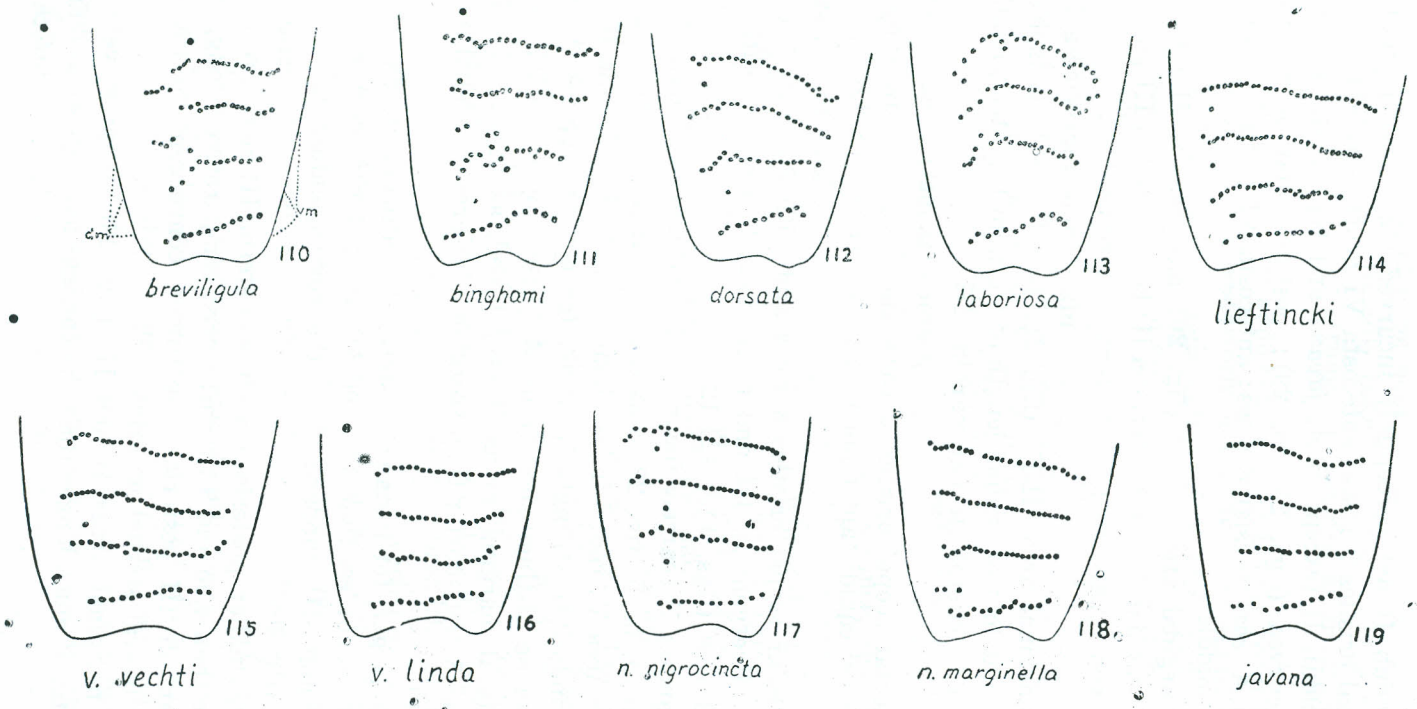

Fig. 110-119. Setal map of left scopae (apical portions) of *Megapis* and *Apis* species, ♀. "Posterior" aspect, the setae are represented by setigerous punctures. *dm*, dorsal basitarsal margin; *vm*, ventral basitarsal margin. — For supplement see fig. 153-154.

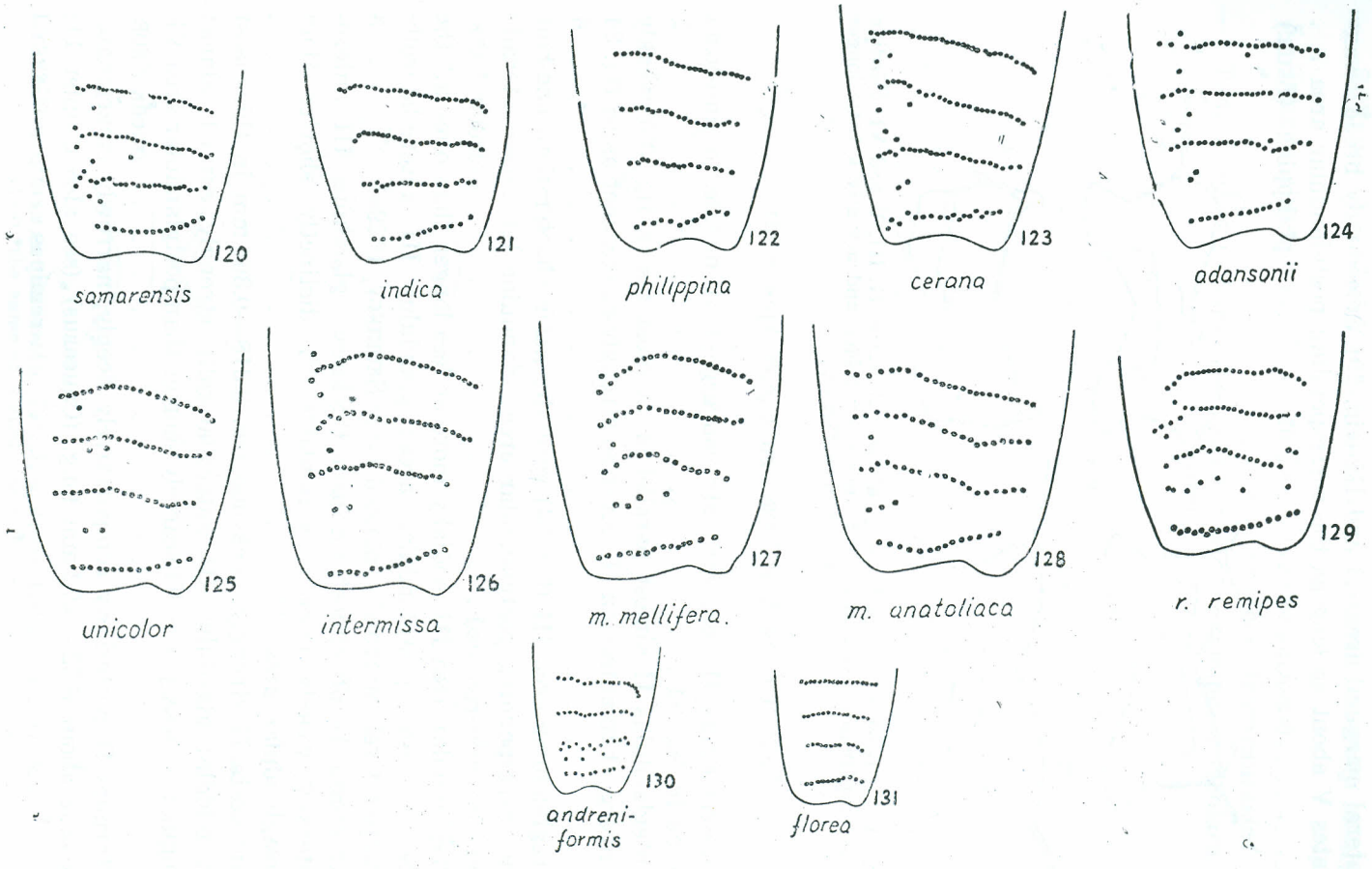

Fig. 120-131. Setal map of left scopae (apical portions) of *Apis* and *Micrapis* species, ☿. "Posterior" aspect, the setae are represented by setigerous punctures. Explanation as in fig. 110-119. — For supplement see fig. 153-154.

— Lateral marginal areas II and III (fig. 29) exceedingly broad; wax-plates V about as long as the corresponding postglandular area . . . . . **philippina** (SKOR.)

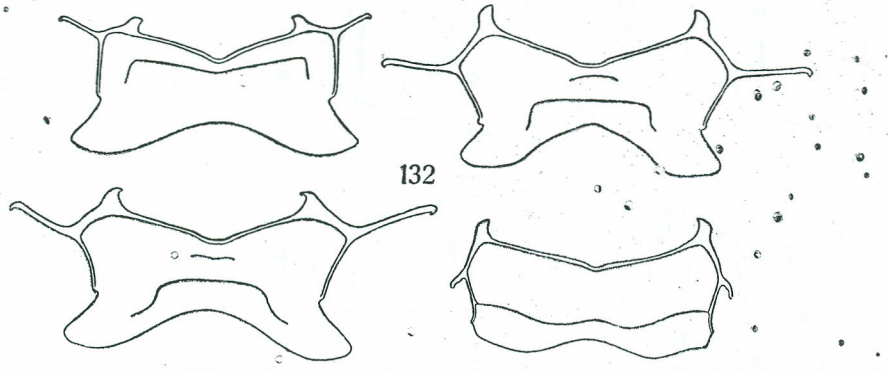

Fig. 132. *Apis* (*Apis*) *adansonii* LATR. ♂, abdominal sterna II, III, V and VI. (Median portion of preglandular area slightly transversely folded and actually a little longer than shown in figure.)

(C) Genus **Apis** LINN., subgenus **Apis**, s. str.

1. Anteglandulus II very strongly convergent at middle to antecosta II, as in fig. 34 2
— Anteglandulus II almost parallel or at most (as in fig. 35) weakly convergent to antecosta II, never so strongly convergent as in fig. 34 6
2. Preglandular area III (fig. 34) medially much shorter than one-half the corresponding postglandular area; glandulus III antero-laterally very broadly rounded . . . . . **unicolor** LATR.
— Preglandular area III medially more or less longer than one-half the corresponding postglandular area; glandulus III antero-laterally comparatively narrowly rounded (vide SKORIKOV, 1929*a*) 3
3. Antecosta II of almost uniform thickness; glandulus III antero-laterally weakly curved; wax-plates VI distinctly shorter than postglandular area VI. 4
— Antecosta II strongly thickened (*ca.* 0.318—0.364 mm in thickness) at middle; glandulus III antero-laterally strongly curved, almost angulated; wax-plates VI scarcely shorter than postglandular area VI. . . . . **meda** SKOR.
4. Sternum II posteriorly comparatively deeply, narrowly emarginate; tongue about 6.62—6.72 mm long. (Caucasus) (see also couplet 11) . . . . . **remipes remipes** (GERST.)

— Sternum II posteriorly comparatively shallowly, broadly emarginate 5

5. Tongue about 6.71—7.10 mm long. (Transcaucasus) . . . . . ♀ . . . . . **remipes transcaucasica** SKOR.

— Tongue about 6.65 mm long. (Armenia) . . **remipes armeniaca** SKOR.

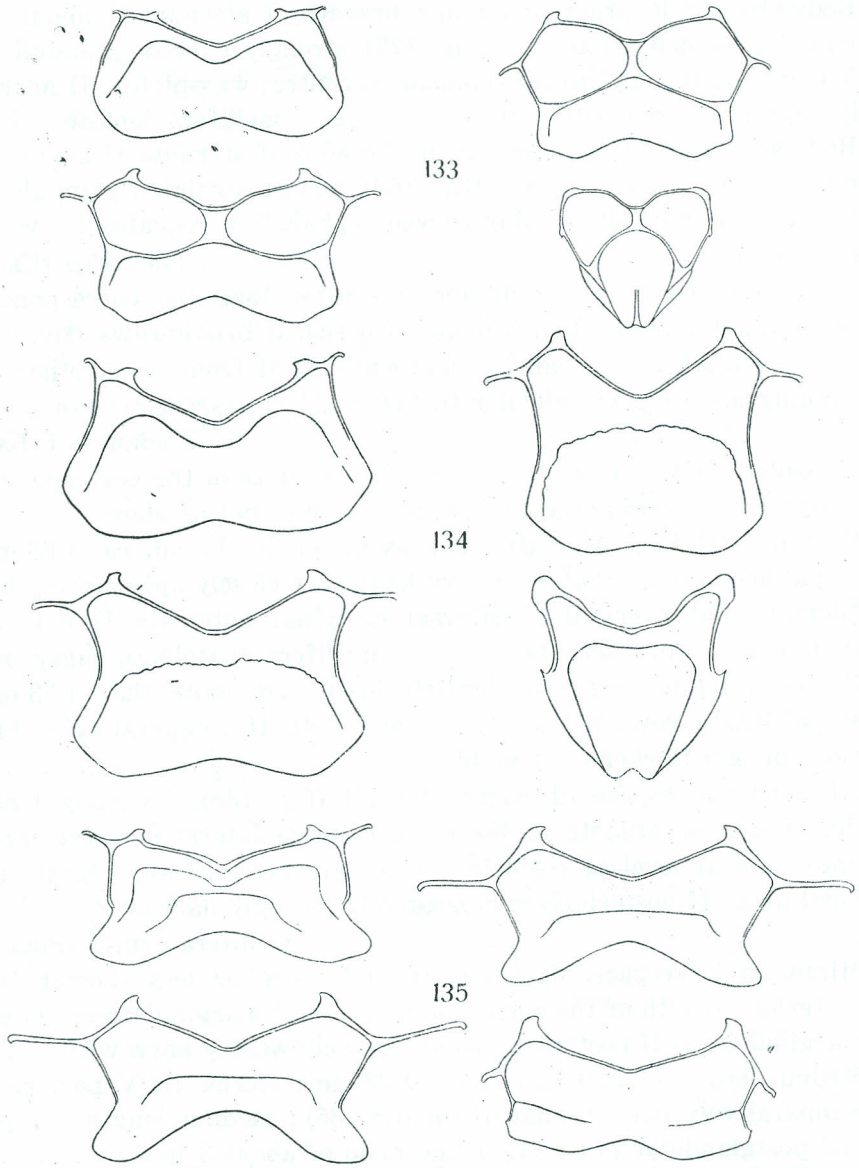

Fig. 133-135. *Apis* (*Apis*) *lamarckii* (CKLL.), abdominal sterna II, III, V and VI of ☿ (133), the same of ♀ (134), and the same of ♂ (135).

6. Anteglandulus II (figs. 36, 133) weakly but distinctly divergent at middle to antecosta II, thus making preglandular area II slightly lengthened at middle 7
— Anteglandulus II subparallel or even slightly convergent at middle to antecosta II 8
7. Body-size much larger, maximum breadth of sternum II about 4.80 mm; 2nd scopal bristle-row (fig. 127) strongly curved; glanduli III-V (fig. 36) strongly curved cephalad at centre; wax-plates III narrowly separated from each other . . . . . **mellifera mellifera** LINN.
— Body-size much smaller, maximum breadth of sternum II about 4.15 mm; 2nd scopal bristle-row (fig. 153) almost straight; glanduli III-V (fig. 133) medially weakly curved cephalad; wax-plates III widely separated . . . . . **lamarckii** (CKLL.)
8. Wax-plates III (fig. 53) distinctly shorter than the corresponding postglandular area; 2nd, 3rd and 4th scopal bristle-rows (fig. 124) almost straight, subparallel to and equidistant from one another and running almost perpendicular to "ventral" basitarsal margin . . . . . **adansonii** LATR.
— Wax-plates III more or less distinctly longer than the corresponding postglandular area; apical scopal bristle-rows not as above . . . 9
9. Basitarsi III in profile (fig. 96) exceptionally broad, *ca.* 1.68 mm; scopal bristle-rows (fig. 128) very long, very closely approaching both "dorsal" and "ventral" basitarsal margins; antecosta II (fig. 39) thin, of uniform thickness . . . . **mellifera anatoliaca,** subsp. nov.
— Basitarsi III in profile moderately broad, not more than 1.53 mm; scopal bristle-rows not as above; antecosta II comparatively thick, more or less thickened at middle 10
10. Minimum interspace of wax-plates III (fig. 136) distinctly longer than posterior breadth of the corresponding lateral marginal areas (measured at level of posterior glandular extremities); lateral marginal areas II posteriorly comparatively strongly narrowed . . . . . **mellifera cypria** (POLLM.)
— Minimum interspace of wax-plates III more or less shorter than posterior breadth of the corresponding lateral marginal areas; lateral marginal areas II posteriorly comparatively weakly narrowed . . 11
11. Median length of sternum II *ca.* 1.22 mm; sterna III-V posteriorly comparatively deeply emarginate (fig. 35); median lengths of pre- and postglandular areas III in the ratio of about 3 to 5 . . . . . **intermissa** (BUTT. - REEP.)

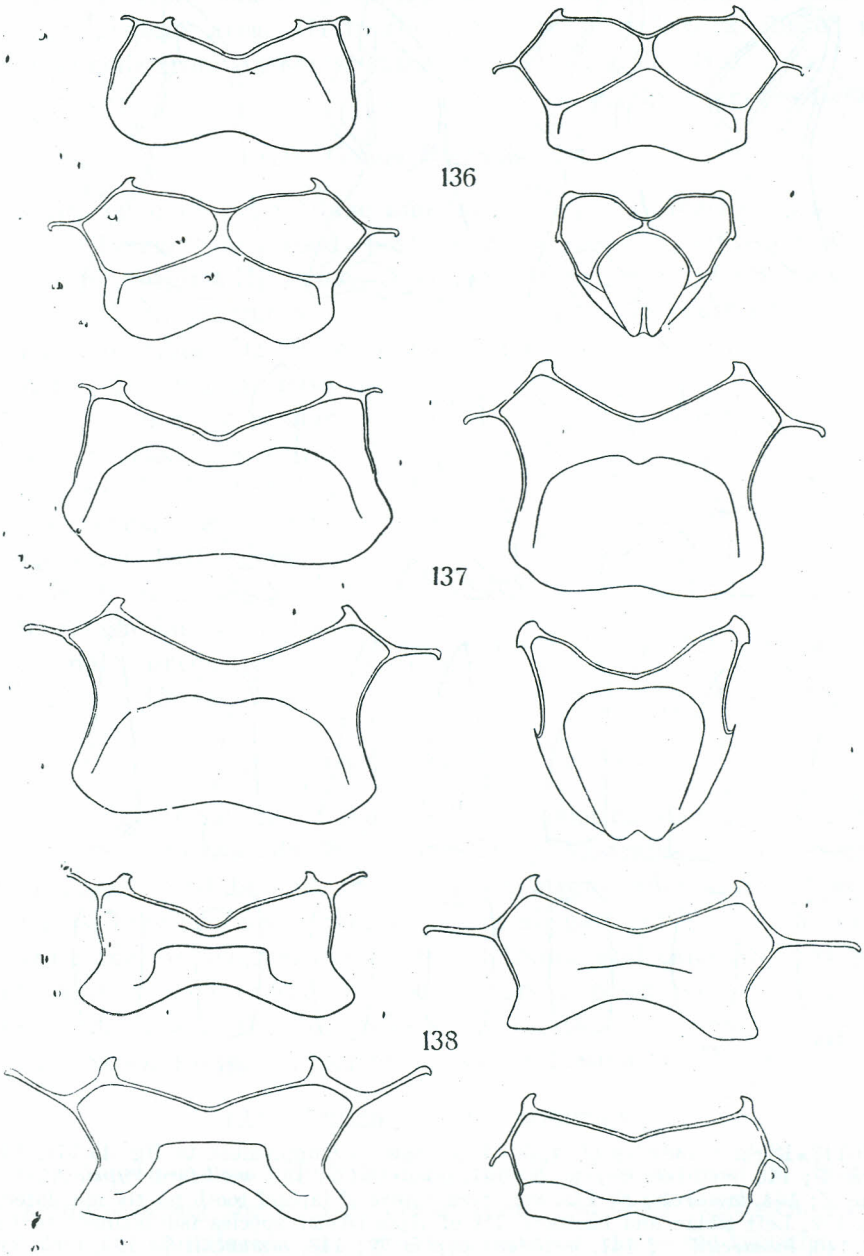

Fig. 136-138. *Apis* (*Apis*) *mellifera cypria* (POLLM.), abdominal sterna II, III, V and VI of ☿ (136), the same of ♀ (137), and the same of ♂ (138).

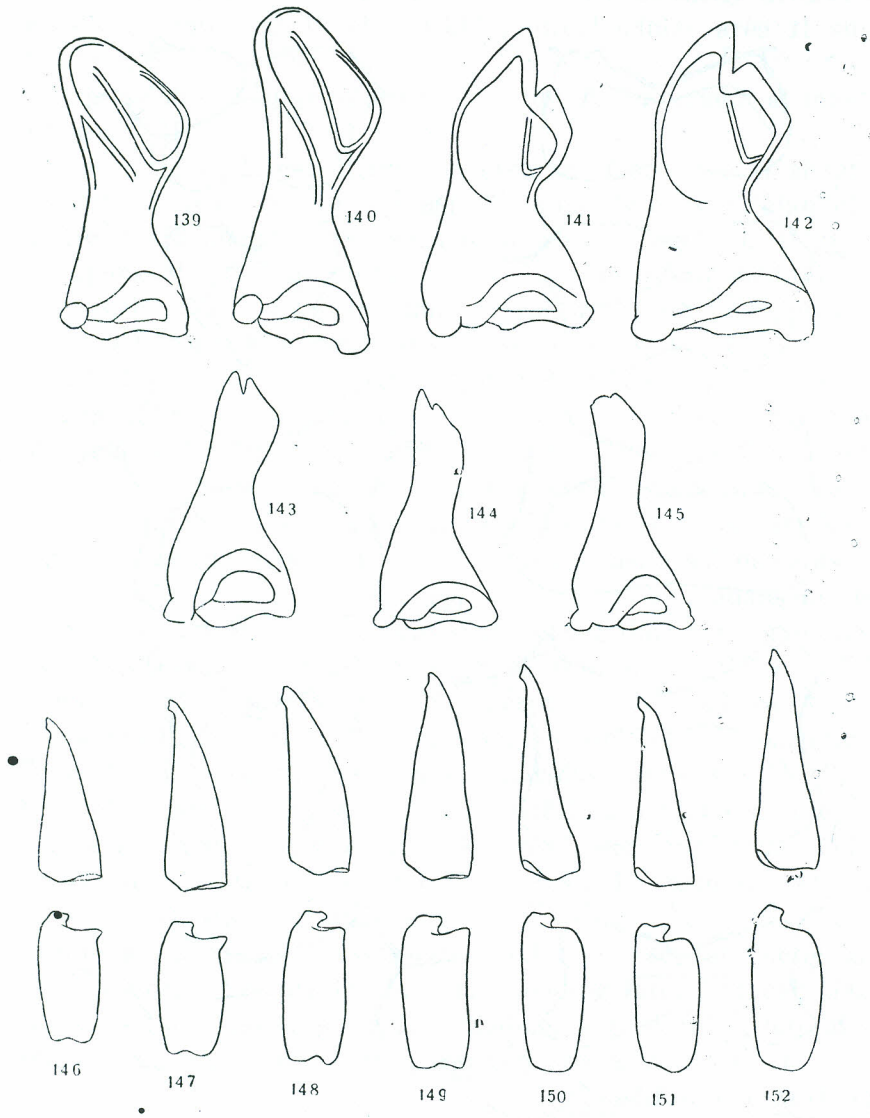

Fig. 139-145. Right mandibles of *Apis* (*Apis*) species (supplement to fig. 45-77). 139, *lamarckii* ☿ ; 140, *mellifera cypria* ☿ ; 141, *lamarckii* ♀; 142, *mellifera cypria* ♀; 143, *adansonii* ♂; 144, *lamarckii* ♂; 145, *mellifera cypria* ♂ (apical tooth partly mutilated). Fig. 146-152. Left tibiae and basitarsi III of *Apis* (*Apis*) species (supplement to fig. 78-109). 146, *lamarckii* ☿ ; 147, *mellifera cypria* ☿ ; 148, *lamarckii* ♀; 149, *mellifera cypria* ♀; 150, *adansonii* ♂; 151, *lamarckii* ♂; 152, *mellifera cypria* ♂ (apical tooth partly mutilated).

— Median length of sternum II *ca.* 1.44 mm; sterna III-V posteriorly comparatively shallowly emarginate; median lengths of pre- and postglandular areas III in the ratio of about 1 to 2. (based upon specimens from Amherst, Mass.) (see also couplet 4) . . . . . **remipes remipes** (GERST.)

(D) Genus **Micrapis** ASHM.

1. Hairs on dorsum of tibiae and tarsi III pitchy black; malar areas much longer than broad; post-auricular scopal bristles 9 rows; abdominal tergum II densely, finely, evenly punctate; glandulus II very strongly curved (fig. 41) . . . . . **andreniformis** (F. SM.)

— Hairs on tibiae III and on dorsum of tarsi III whitish; malar areas distinctly shorter than broad; post-auricular scopal bristles 8 rows; abdominal tergum II alutaceous, only with posterior half sparsely, coarsely, shallowly punctate; glandulus II less strongly curved (fig. 42) . . . . **florea** (FABR.)

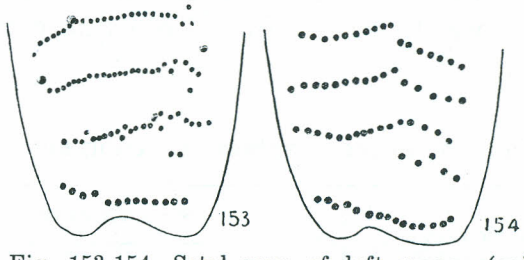

Fig. 153-154. Setal map of left scopae (apical portions) of *Apis* (*Apis*) *lamarckii* ♀ (153) and of *mellifera cypria* ♀ (154). (Supplement to fig. 110-129).

IX. GEOGRAHICAL DISTRIBUTION

The original habitat of the modern or existing species of honeybees was restricted to the Old World, excluding Australasia. As a result of human agency and because of their own strong adaptability to varied conditions, they are now found almost in all parts of civilized countries, and their real or original distributional trends and capacities are somewhat obscure. The following accounts are derived merely from fragmentary data, and the conclusions drawn therefrom may be greatly modified when further information should become available.

(A) HORIZONTAL DISTRIBUTION

The northernmost distributional limit of honeybees is more or less running along the 0° isothermal zone, and their southern, eastern, and western boundaries are great oceans or deep see-troughs. Their zoogeographical distribution is shown in Table 4, from which we can easily conclude that:

(1) the primary distributional centre is in the Malaysian Subregion, where not only the number of species is greater than elsewhere, but also the species of various degree of specialization co-exist, and where the members of the genus *Micrapis* and of the subgenus *Sigmatapis* are sharply diversified from one another.

(2) the secondary distributional centre is the Mediterranean Subregion, where the species of the subgenus *Apis* s. str. are most prolific and constitute a compact "Formenkreis".

(3) species occurring in regions more isolated, or more distant from the equator or from distributional centres, are more highly specialized. This fact is most beautifully exemplified by the species of the subgenus *Sigmatapis*.

(4) species occurring in regions topographically more complicated are less widely distributed and often have more chances to give rise to local races.

Table 4. Zoogeographical Distribution of the Tribus *Apidini* [1])

Region and Subregion	Number of species and subspecies [2])				
	Megapis	*Sigmatapis*	*Apis*, s. s.	*Micrapis*	Total
Malagasian	—	—	1	—	1
Ethiopian	—	— (1)	1	—	1 (1)
Palaearctic	—	1	7 (3)	— (1)	7 (4)
Mediterranean	—	—	6 (3)	— (1)	6 (3)
Euro-Sibirian	—	—	2	—	2
Turkmenian	—	—	1	—	1
Manchurian	—	1	—	—	1
Oriental	4	10 (1)	—	2	16 (1)
Indian	1	1	—	1	3
Ceylonese	1	1	—	1	3
Indochinese	2	2	—	2	6
Malaysian	1	5	—	2	8
Philippine	1	2	—	—	3
Austro-Oriental	2	2 (1)	—	—	4 (1)
Total	4	11 (2)	9 (3)	2	26 (5)

[1]) The divisions of the Regions and Subregions are adopted from K. HOLDHAUS (1929. *In* C. SCHRÖDER's Handbuch der Entomologie. Jena. 2: 592-1056, 1 colour chart). However, the subdivisions of the "Malayan Subregion" auctt. of the Oriental Region are after C. BODEN KLOSS (1929. Bull. Raffles Mus. Singapore. 2: 1-10, 4 maps).

[2]) The number of species and subspecies of doubtful status or doubtfully recorded from any region are placed between parentheses.

It may be noted that BERGMANN's (1847) rule, originally proposed for homoiothermal animals, and despite certain exceptions, is also applicable to honeybees. Furthermore, vicariism or geographical replacement in the horizontal distribution of honeybees, particularly in the extensive genus *Apis*, is far more significant than in altitudinal distribution. Of course, this phenomenon is not necessarily restricted to species, but is also applicable to subspecies and nationes. For instance, *A. indica, A. javana, A. samarensis, A. philippina* and *A. cerana*, as mentioned elsewhere in the present paper, are apparently derived from a common ancestral type. Of these, *samarensis* and *philippina* are more highly specialized because of geographical isolation; while the three other species have their intermediate forms occurring in the E. Himalayas, Indochina and Hainan. On the other hand, some of the species do not exhibit noteworthy geographical variation, and others (such as *A. mellifera, A. cerana*, etc.) have certain more or less well defined geographical races.

(B) ALTITUDINAL DISTRIBUTION

The altitudinal distribution of honeybees is more or less correlated with the vertical isothermal zonation. For example, ROEPKE (1930) recorded *A. javana* (under the name "*A. indica*") from an altitude of more than 3000 m in Java, but its related species, *A. cerana* is not found above 2500 m in Formosa. The distributional range of a given species of honeybee appears to be also connected with seasons. ROEPKE (1930) noted that *Megapis dorsata* usually dwelled at an altitude of 2—300 m in Java and Sumatra, but its swarms were sometimes noticed at 900—1200 m. Although these creatures are primarily lowland dwellers, an analysis of the available data discloses that most of the species tolerate a wide range of elevation and have not very restricted altitudinal habitats. For convenience' sake we may group the species together under 3 categories:

(1) Lowland forms. — A few of the more primitive species, such as *Megapis dorsata, Apis indica, A. lamarckii, Micrapis florea*, etc. fall into this category.

(2) "Pan-altitudinal" forms. — Most of the species come under this category. For instance, *A. nigrocincta, A. javana, A. cerana*, and many others.

(3) Montane and submontane forms. — These are usually darker in pattern, more highly specialized and less widely distributed than their lowland counterparts. *Megapis laboriosa, Apis remipes* and *Micrapis andreniformis* are the outstanding representatives.

(C) DISTRIBUTIONAL CAPACITIES

Honeybees are very strong eurythermal animals. According to HESSE's [1]) plan of treatment of terrestrial animal habitats, these creatures are found in the following habitats; forest, dry open lands, islands and cultivated lands, but not in moist open lands, high mountain chains, polar areas and caves. The first step of the distribution or spreading of these insects is the dispersal of a colony; the second, establishment of the colony; and the last, establishment of the species. In all other insects, except the *Meliponini,* the first and second steps of spreading of a species, respectively, are dispersal and establishment of individual or individuals. These distributional units — individual and colony — probably represent two different phylogenetic stages. The dispersal of the species of honeybee may be put arbitrarily under two items, voluntary or active, and accidental or passive. The voluntary dispersal — migrating or swarming — relieves the pressure of home population, aims at the pursuit of a new, and more adequate habitat, or the escape from predominant competitors or enemies. Swarming is practised by all species under favourable environmental conditions. Migration, on the other hand, occurs only when adverse conditions prevail, e.g., when a colony is severely attacked or violently disturbed by enemies. Nevertheless, the primitive species *Megapis dorsata* is said to be nomadic, and migrates in response to the blossoming of plants. The accidental dispersal is mostly, if not entirely, accomplished by human agency. Other agencies such as wind, water, logs, ships, seaweeds, etc. never play an important part in the honeybee dispersal, which is mainly governed by:

(1) Ecological succession of plants, since the latter provide their food and nesting material — nectar, pollen, honey-dew, sweet juice, propolis, etc. — and, to a less extent, their shelters. The quantity and seasonal periodicity of flowers have direct influence on the honeybee population. Although they are not oligolectic insects, the "quality" of flowers is usually a rather substantial factor.

(2) Ecological succession of other animals, which may be competitors or enemies.

(3) Physiological limit of endurance to adverse environmental factors, particularly temperature.

(4) Availability of proper shelter.

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[1]) HESSE, R. 1924. Tiergeographie auf oekologischer Grundlage. Jena. 12 + 613 pp., 135 text-figs. (Revised edition in English by W. C. ALLEE and K. P. SCHMIDT. 1937. Ecological Animal Geography. New York, 14 + 597 pp., 135 text-figs.) *cf.* Chapter xx.

X. PHYLOGENETIC INTERPRETATIONS

According to the scheme recently proposed by MICHENER (1944), the tribus Apidini belongs to the superfamily Apidoidea, family Apididae, subfamily Apidinae, which represent the highest systematic categories of the ordo Hymenoptera. The Apidoidea were divided by him into Colletidae, Andrenidae, Halictidae, Melittidae, Megachilidae and Apididae, and the last mentioned family into the Fideliinae, Anthophorinae, Xylocopinae and Apidinae. The last subfamily, the Apidinae, was again divided into 4 tribes of which the chief differences and affinities may be tabulated as follows (Table 5):

Table 5. Comparison of the 4 Tribes of the Subfamily *Apidinae*.

Euglossini	*Bombini*	*Apidini*	*Meliponini*
Malar areas (♀) short. Eyes naked.	Malar areas (☿ ♀) long. Eyes as in *Euglossini.*	Malar areas (☿ ♀) as in *Bombini.* Eyes hairy.	Malar areas (☿ ♀) rather short. Eyes as in *Euglossini.*
Fore wings with generalized venation of Apidoidea; cell *3r* long, completely closed; *1r* and *2r* weakly but completely separated; *1m* and *2m* well defined; vein icu_1 always postfurcal.	Fore wings with similar venation as in *Euglossini;* cell *3r short.*	Fore wings with similar venation as in *Euglossini;* cell *3r* exceedingly long; *1r* and *2r* not or scarcely separated; vein icu_1 always prefurcal.	Fore wings with highly specialized venation; cell *3r* short, apically open or faintly closed; *1r* and *2r* not separated; *1m* and *2m* very ill defined; vein icu_1 pre- or postfurcal, or interstitial.
Hind wings with vestigial jugal lobes; cells *m* and *sm* basally well separated from each other by 2nd abscissa of vein M_{3+4} which is always long and distinct; veins icu_1 and $Cu_2 + 1A$ forming a very obtuse interior angle.	Hind wings without jugal lobes; cells *m* and *sm* and vein M_{3+4} as in *Euglossini;* veins icu_1 and $Cu_2 + 1A$ forming an obtuse interior angle.	Hind wings with well developed jugal lobes; cells *m* and *sm* entirely confluent or basally well separated; vein M_{3+4} with or without a 2nd abscissa; icu_1 and $Cu_2 + 1A$ forming a more or less acute interior angle.	Hind wings with well developed jugal lobes; cells *m* and *sm* always entirely confluent; vein M_{3+4} never present as an independent branch of *M*-stem; icu_1 and $Cu_2 + 1A$ forming an obtuse or right interior angle.

Table 5. Comparison of the 4 Tribes of the Subfamily *Apidinae* (cont'd).

Euglossini	*Bombini*	*Apidini*	*Meliponini*
Tibiae III with apical spurs; pectines and corbiculae present in ♀ (non-parasitic forms), the former in single series and lying on apical margins of "posterior" tibial surfaces.	Apical spurs III and pectines as in *Euglossini;* corbiculae present in ♀ and ♀ (non-parasitic forms).	Tibiae III lacking apical spurs; pectines (in single series) and corbiculae present in ♀, absent in ♀.	Tibiae III lacking apical spurs; pectines and corbiculae present in ♀, absent in ♀, pectines usually in 2 series, one on "anterior" and another on "posterior" tibial surface; rarely ♀ with well developed, curled, marginal, fringing hairs and thus bearing an appearance of vestigial corbiculae.
Auricles well developed in ♀ (non-parasitic forms); scopal bristles (♀) irregularly arranged.	Auricles well developed both in ♀ and ♀ (non-parasitic forms); scopal bristles (♀ ♀) as in *Euglossini.*	Auricles well developed in ♀, not or scarcely developed in ♀; scopal bristles (♀) regularly arranged in rows.	Auricles not developed both in ♀ and ♀; scopal bristles (♀) as in *Euglossini.*
Claws cleft.	Claws as in *Euglossini.*	Claws as in *Euglossini.*	Claws in ♀ and ♀ simple.
Sting (♀) well developed.	Sting (♀ ♀) as in *Euglossini.*	Sting (♀ ♀) as in *Euglossini.*	Sting (♀♀) vestigial, functionless.
—	Wax produced from terga and sterna both by ♀ and ♀.	Wax produced from sterna only by ♀.	Wax produced from terga only by ♀.
Male genitalia strongly sclerotized, penis simple, weakly eversible, claspers fully developed.	Male genitalia as in *Euglossini.*	Male genitalia very weakly sclerotized, penis complicated, strongly eversible, claspers greatly reduced.	Male genitalia moderately strongly sclerotized, penis and claspers as in *Euglossini.*
—	Worker not differentiated from queen in structure, except for smaller size and less developed internal reproductive system.	Worker rather markedly different from queen in structure.	Worker very markedly different from queen in structure.
Non-social, without worker caste.	In non-parasitic forms, social, with worker caste.	Social, with worker caste.	Social, with worker caste.

Table 3. Comparison of the 4 Tribes of the Subfamily *Apidinae* (cont'd).

Euglossini	*Bombini*	*Apidini*	*Meliponini*
Mass-provisioning of the young.	Progressive provisioning of the young.	Larval provisioning as in *Bombini*.	Larval provisioning as in *Euglossini*.
—	Colony usually annual, started by a gravid queen only.	Colony permanent, started by a swarm.	Colony as in *Apidini*.
Nest entrance of non-parasitic forms without special device of protection.	Nest entrance of non-parasitic forms as in *Euglossini*.	Nest entrance as in *Euglossini*.	Nest entrance often with cerumen spout, funnel or covering, forming the so-called flight hole.
Nest with only undifferentiated queen and male brood cells.	Nest without royal cell; worker cell not differentiated from male cell.	Nest usually with royal cell; worker cell usually differentiated from male cell.	Nest usually with royal cell (*Trigona*); worker cell not differentiated from male cell.
Brood cells elliptical, facing upwards, placed vertically and in a vertical series along side wall of nest.	Brood cells elliptical, facing upwards, in single layer, placed vertically on floor of nest, usually not regularly arranged as a horizontal or vertical comb, but as heaps or clusters.	Brood cells hexagonal in cross-section and polyhedral at base, facing laterad, placed horizontally, arranged in one or more vertical combs, each consisting of 2 layers, base to base.	Brood cells cylindrical, facing upwards, usually arranged into a series of horizontal combs either in superimposed tier type or in spiral staircase type; occasionally irregularly clustered.
—	Male tolerated by their worker sisters to stay in the same nest.	Male slaughtered or thrown out of the nest by worker.	Male treated as in *Apidini*.
—	Young daughter queen tolerated by mother to stay in the same nest.	Young daughter queen not tolerated by mother.	Young daughter queen usually treated as in *Bombini*.
Inquiline forms: *Aglae, Exaerete*.	Inquiline forms: *Psithyrus*.	No inquiline forms.	No inquiline forms.
Primary habitat: Neotropical, secondary habitat Nearctic (*Euglossa*); not occurring in Australasia.	Primary habitat: Holarctic, secondary habitat Neotropical and Oriental (*Bombus*); not occurring in Australasia.	Primary habitat: Palaeotropical, secondary habitat Malagasian and Palaearctic (*Apis*, s.s.); not occurring in Australasia.	Primary habitat: Neotropical, secondary habitat Palaeotropical [1]); occurring in Australasia.

[1]) VON IHERING (1911) maintained that the eocene centre of the Meliponini was in Indo-Europe; later on, it dispersed in two directions, one to Ethiopia, the other to Central America, extending to South America during the miocene epoch.

Both from morphological and biological evidences, Euglossini is certainly the most primitive tribus of Apidinae, and stands far apart from any of the others. Bombini is the next primitive one and is closer to Apidini and Meliponini rather than to Euglossini. It appears, however, that there is no intimate relationship to any of the latter three. On the other hand, there exists a close relationship between Apidini and Meliponini as their lines of development run parallel in many ways, but their relative antiquity is not so clear. Morphologically, the latter tribe is the most highly specialized one, particularly on account of its degenerated venation and very strong differentiation of the ♀ from ♀; and geographically, it has the widest longitudinal and latitudinal distribution. In certain biological respects, especially the mass provisioning of the larva practised by all known species, and the cluster-typed brood cells in certain species, the Meliponini appear to be in a more primitive phylogenetic stage than the Apidini. Some authors maintained that Meliponini should constitute an important biological link between Bombini and Apidini. In this connection, STÖCKHERT's [1]) conclusion may be quoted: "Wenn schliesslich im Vorstehenden die Gattungen *Apis, Bombus* und *Halictus* bezüglich ihrer biologischen Entwicklungsstufe, insb. der verschieden hohen Ausbildung sozialer Instinkte, öfters miteinander verglichen wurden, so sollte dadurch keineswegs etwa irgendeine engere Verwandtschaft derselben behauptet oder angedeutet werden, wie ich in Anlehnung an v. Buttel-Reepen (1915, p. 64) vorsorglicher Weise bemerken möchte. Denn diese drei Gattungen haben sich zweifellos völlig unabhängig voneinander entwickelt, sodass die sozialen *Halictus*-Arten nicht etwa als direkte Vorfahren der Hummeln in Betracht kommen, ebensowenig wie letztere als Vorfahren der Honigbienen; vielmehr sind wir über die solitären Vorfahren der Hummeln und Honigbienen noch völlig im Unklaren, sie dürften wohl grösstenteils ausgestorben sein". The independent and polyphyletic origin of social instinct may also be evidenced by the nest architecture of the homogeneous genus *Trigona* of Meliponini. A few of the members of this genus build nests of the cluster- instead of the comb-type, and a new "biological genus", *Friseomelitta* VON IHERING, 1912, was erected for these supposedly primitive species. It has subsequently been found that this primitive nesting habit is also shared by some species belonging to the subgenera *Plebia, Hypotrigona* and *Tetragona,* which clearly exhibit varying degrees of relative antiquity. Thus it seems justified to leave well alone our preconceived idea of indicativeness of the social instinct and put Meliponini on the top of the family-tree of Apidinae.

[1]) STÖCKHERT, E. 1924. Konowia, Vienna 2: 239-240.

The discussions on the phylogeny of social bees by VON BUTTEL-REEPEN (1906) and VON IHERING (1911) are based exclusively on biological evidences and palaeogeographical hypotheses. TILLYARD's (1925) paper on the same subject is not available to the writer, so that no comparative notes can be made thereon.

(A) MORPHOLOGICAL EVIDENCE

The following is a list of those morphological characters of Apidini which are believed to be of phylogenetic significance. They are arranged in 2 columns, which represent the two extremes of the degree of specialization.

Table 6. Extremes of Morphological Specialization in the Tribus *Apidini*.

Generalized Type	Specialized Type
POL (☿ ♀) much shorter than OOL.	POL (☿ ♀) much longer than OOL.
Posterior ocelli (♀) lying on posterior orbital line.	Posterior ocelli (♀) lying much anteriorly to posterior orbital line.
Anterior ocellus (♂) rounded, as large as posterior ones.	Anterior ocellus (♂) transverse, much larger than posterior ones.
Frontal line (♂) ridged anteriorly.	Frontal line (♂) foveated throughout.
Antennal sockets (♀) widely separated.	Antennal sockets (♀) narrowly separated.
Antennae of ♂ not shorter than those of ☿ or ♀, and most of the flagellar segments each longer than thick.	Antennae of ♂ very distinctly shorter than ☿ or ♀, and most of the flagellar segments each shorter than thick.
Malar areas long.	Malar areas short.
Mandibles long and narrow.	Mandibles short and broad.
Glossa (☿) not longer than labial palpi.	Glossa (☿) much longer than labial palpi.
Prementum long and narrow.	Prementum short and broad.
Labial palpi with a false subapical annulet on segment II; IV moderately long, weakly curved.	Labial palpi without a false subapical annulet on segment II; IV very long, strongly curved.
Cell *r* (fore wings) with a false, transverse vein; cell *3r* not narrowed apicad.	Cell *r* (fore wings) without a false, transverse vein; cell *3r* narrowed apicad.
Cell *m* (hind wings) basally well separated from *sm;* veins icu_1 and $Cu_2 + 1A$ forming a narrowly acute interior angle; jugal lobes long.	Cell *m* (hind wings) entirely combined with *sm*; veins icu_1 and $Cu_2 + 1A$ forming a broadly acute interior angle; jugal lobes short.
Basitarsi III in ☿ long and narrow, in ♀ with rather prominent auricles, in ♂ simple.	Basitarsi III in ☿ short and broad, in ♀ with very inconspicuous auricles, in ♂ bilobed.
Apical scopal bristles (☿) regularly arranged, the 2nd row running parallel to 1st and 3rd and equidistant from both.	Apical scopal bristles (☿) more or less irregularly arranged, the 2nd row not running parallel to the 1st or 3rd and more distant from 1st than from 3rd.

Table 6. Extremes of Morphological Specialization in the Tribus *Apidini*. (cont'd).

Generalized Type	Specialized Type
Abdominal tergum I in ♂ visible in dorsal aspect, in ♀ with posterior breadth subequal to that of II.	Abdominal tergum I in ♂ invisible in dorsal aspect, in ♀ with posterior breadth greater than that of II.
Abdominal sterna (☿ ♀) long; antecosta II thin; preglandulus II (☿) medially sharply angulated; lateral marginal areas (☿) narrow; postglandular areas (☿) long; wax-plates VI (☿) long.	Abdominal sterna (☿, ♀) short; antecosta II thick; preglandulus II (☿) medially weakly curved; lateral marginal areas (☿) broad; postglandular areas (☿) short; wax-plates VI (☿) short.
Caste polymorphism weak.	Caste polymorphism strong.

It must be pointed out that not all characters listed above are necessarily co-specialized in the same direction and to the same extent. A few of them, such as the prominence of ocelli in *Megapis* (♀ *binghami* and ♂ *dorsata*), the strongly curved tibiae III in ♂ *Sigmatapis*, etc. seem to have been secondarily degenerated in higher species.

(B) BIOLOGICAL EVIDENCE

Although about 28 species of honeybees are enumerated in the foregoing chapters, their comparative physiology as well as psychology are still very little known. The following tabulation deals only with the representatives of genera and is compiled from scattered and incomplete data.

Table 7. Comparative Biology of the Genera of the Tribus *Apidini*

Megapis	*Apis*	*Micrapis*
Nest single-combed, exposed.	Nest multi-combed, usually concealed.	Nest single-combed, exposed.
♂ cells same in size as ☿ cells.	♂ cells a little larger than ☿ cells.	♂ cells much larger than ☿ cells.
♀ cells same in size, shape and location as ☿ cells.	♀ cells larger than ☿ cells, conical, always attached to free border of comb.	♀ cells same as in *Apis*.
Honey-storing cells a little large and deeper than ☿ cells.	Honey-storing cells as large and as deep as ☿ cells.	Honey-storing cells much larger and deeper than ☿ cells.
Swarming in the absence of males.	Swarming in the presence of males.	Swarming in the presence of males (?).

Table 7. Comparative Biology of the Genera of the Tribus *Apidini* (cont'd).

Megapis	*Apis*	*Micrapis*
Nest with guard-bees ("Schutzbienen").	Nest without guard-bees.	Nest without guard-bees.
Nomadic, nest deserted after blooming season.	Non-nomadic.	Non-nomadic.
Aggressive.	Non-aggressive.	Non-aggressive.
Living males concealed under bee-mass on comb except in early morning.	Living males always exposed on comb.	Living males always exposed on comb.

(C) PALAEONTOLOGICAL EVIDENCE

Only a few fossil honeybees, all of the ♀ caste and from Europe (Miocene and Oligocene), have so far been unearthed and described. Most of them have been assigned at one time or another to the genus *Apis* in the broadest sense. In fact, some are so poorly preserved that it is problematical whether they are really members of the tribus Apidini. In the following list, quotation marks are added to indicate such cases in which the systematic status appears to be doubtful:

"*Apis*" *aquitaniensis* DE RILLY, 1949. Nature, Paris 3168: 125, 2 figs. Oligocene. Aquitan, France. Original not seen; probably belonging to the genus *Synapis*.

"*Apis*" *armbrusteri* ZEUNER, 1931. Fortschr. Geol. & Palaeont., Berlin 9: 292, pl. 8, fig. 1, text-fig. 21. Upper Miocene. Böttingen marble, Swabia, S. Germany. Almost certainly representing a new genus. ARMBRUSTER (1938. Arch. Bienenk.; Berlin 19: 46) suggested that it might be a species of *Hauffapis*.

"*Apis*" *cuenoti* THEOBALD, 1940. Ins. foss. terr. oligoc. France: 401, figs. Oligocene. France. Probably belonging to the genus *Synapis*.

"*Apis mellifera*" LINNÉ, 1758. Recorded by COCKERELL (1909. Entomologist, London 42: 317) from Yarmouth, England (?), contained in amber or copal (?). This is perhaps a *Synapis*, since the vein mcu_1 in fore wing was stated to be falling far short of icu_1.

"*Apis*" *oligocenica* MEUNIER, 1915. Zts. deuts. geol. Ges., Berlin 67: 210, pl. 21, fig. 40, text-fig. 4. Aquitanian. Siebengebirge, Germany. Synonym of *Synapis henshawi* (CKLL.).

"Apis" proava MENGE, 1856. Progr. Petrischule Danzig 1856: 26. Ligurian. Prussian amber. Original description very poor. It is said to be very like the modern honeybee, but with bare eyes and the body being only 7 mm long.

Hauffapis scharmanni ARMBRUSTER, 1938. Arch. Bienenk., Berlin 19: 44. This and the following *Hauffapis* species are somewhat improperly described from upper Miocene, Randecker lake-crater, Germany.

Hauffapis scheeri ARMBRUSTER, 1938. *Tom. cit.* : 43.

Hauffapis scheeri var. *gallauni* ARMBRUSTER, 1938. *Tom. cit.* : 45.

Hauffapis scheeri var. *rahdei* ARMBRUSTER, 1938. *Loc. cit.*

Hauffapis scheuthlei ARMBRUSTER, 1938. *Tom. cit.* : 43.

Hauffapis scheuthlei var. *seemanni* ARMBRUSTER, 1938. *Tom. cit.* : 45.

Hauffapis scheuthlei var. *zeuneri* ARMBRUSTER, 1938. *Loc. cit.*

Synapis dormitans (VON HEYDEN), 1862. Palaeontogr. Stuttgart 10: 76, pl. 10, fig. 8. Aquitanian. Rott, Siebengebirge, Germany. Originally described under the genus *Apis*, redescribed and assigned to *Synapis* by STATZ (1934. Arch. Bienenk., Berlin 15: 3, fig. 8).

Synapis henshawi (COCKERELL), 1907. Entomologist, London 40: 227. Oligocene. Rott, Siebengebirge, Germany. Originally described under the genus *Apis* subgenus *Synapis*. An excellent redescription was given by STATZ (1934. Arch. Bienenk., Berlin 15: 5, figs). *Apis oligocenica* MEUN. is its synonym.

Synapis kaschkei STATZ, 1931. Wiss. Mitt. Ver. Natur- & Heimatk. Köln 1: 50, figs. Oligocene. Rott, Siebengebirge, Germany.

Besides the above-enumerated forms, the genus *Electrapis* CKLL., 1909 (orthotype: *Apis meliponoides* BUTT. - REEP., 1906), originally placed near *Apis*, is definitely not of Apidini, and possibly not of Apidinae. In the ♀ (or "☿"), the apical margin of mandibles is said to bear 2 notches, maxillary palpi apparently two-segmented, antennal segment III almost as long as IV + V, stigma in fore wing very small and triangular, marginal cell ending rather bluntly, all 3 submarginal cells subequal to one another in length and breadth on marginal vein (M_{1+2}), 2nd submarginal cell (*1m*) with costal margin (M_{1+2}) subequal in length to basal or apical margin, or 1st abscissa of vein M_{3+4}, and costal and basal margins almost perpendicular to each other, 3rd submarginal cell (*2m*) with costal margin at most half as long as anal, basal vein with lower section (mcu_1) at least 4 times as long as upper (*M*-stem), 1st discoidal cell (*1sm*) fully as long as marginal (*3r*). The ♂ is said to be similar to the ♀ (or "☿"), with eyes far apart, facial quadrangle about square, antennal segments II-VI

with their relative lengths about 12:24:17:46:51, and last antennal segment obliquely truncate. All these characters are more or less foreign to Apidini.

It seems that none of the described fossil honeybees can be positively referred to any of the modern genera [1]). Probably all of the Oligocene ones should be assigned to the genus *Synapis*, Miocene ones to *Hauffapis*, and "*Apis*" *armbrusteri* represents a third genus, which perhaps does not belong to the true Apidini. Summarizing the available data, we see that the fossil honeybees differ from their recent allies in the following points:

Eyes bare, hairless, (in *A. armbrusteri*) oval, not kidney-shaped; mouth-parts (in *A. armbrusteri*) not particularly strongly developed, nearly as in the genus *Bembix* FABR. (Sphecidae); mesopleura and mesonotum (in *A. armbrusteri*) very strongly swollen, the latter overlapping scutellum; propodeum (in *A. armbrusteri*) much more flattened; coxae II (in *A. armbrusteri*) long and narrow; free margin beyond cell *3r* in fore wing (in *S. henshawi*) greatly shortened; cell *ap* always absent; *1sm* very broad, even broader than *r*; *3sm* broader than long; vein mcu_1 about twice as long as *M*-stem; mcu_2 very strongly angulated near midpoint; mcu_3 basally lying far more basad to im_2 (in *S. dormitans*, mcu_3 almost originating at the midpoint between apices of im_1 and im_2); icu_1 interstitial or nearly so; vein *M* in hind wing (in *A. armbrusteri*) apically simple, as in *Apis*, s. s. or *Micrapis*; icu_1 almost perpendicular to or forming an obtuse interior angle with $Cu_2 + 1A$; abdominal terga II-V (in *A. armbrusteri*) with ventral extensions very narrow; and sterna II-IV with posterior margins almost straight and with wax-plates separated from each other.

STÄTZ (1931) published a rather long paper on the phylogeny of fossil honeybees, but the original is not available to the present writer.

(D) RELATIVE ANTIQUITY OF THE GENERA

On discussing the relative antiquity of the existing genera, we have to argue largely on the bases of comparative morphology, as other evidences are too meagre or unavailable. The genus *Megapis* beyond doubt includes the most primitive forms. This assumption is fully supported

[1]) BEQUAERT, J. & CARPENTER, F. M. (1941. Psyche, Cambridge, Mass. 48: 50-54) gave the following statement: "The oldest bees known are from the Baltic amber (Oligocene) and some of these belong to highly social families (Bombidae, Apidae). None of the described amber bees, however, can be placed in existing genera of these social families". COCKERELL, T. D. A. (1909. Entomologist, London 42: 314): "All of the Prussian amber bees, so far as seen by me, are of extinct genera; but the Miocene bees, whether of Europe or America, include various living genera."

both by morphological and biological facts. The relative positions of *Apis* and *Micrapis*, however, are open to controversy (*cf.* Table 2). Most of the earlier authors maintained that *Micrapis* is more primitive than *Apis* and is intermediate between *Megapis* and *Apis*. In so far as the biological evidences are concerned, *Apis* and *Micrapis* are standing almost on the same phylogenetic stage. On the other hand, the degree of caste polymorphism and of structural specialization clearly disprove the assumptions made by earlier authors. On comparing *Megapis laboriosa* and *Apis* (*Sigmatapis*) *johni*, we can very easily realize that these two genera are closely allied, *Sigmatapis* being more primitive than *Apis*, s. s. Among the fossil genera, *Synapis* and *Hauffapis* are somewhat closely related to *Megapis*, and *Synapis* is definitely more primitive than *Hauffapis*. The third fossil genus, represented by "*Apis*" *armbrusteri*, is a side-branch of the main ancestral stock.

XI. ANNOTATED BIBLIOGRAPHY [1])

ca. 2000. (B. C.). SHEN NUNG (Emperor Divine Agriculturist): Pen-tsou (Materia Medica). — Medical value of honey discussed; said to be the earliest literature on the honeybee.

1710. (A. D.). RAY, J. Historia Insectorum (Opus posthumum) . . . . London, CHURCHILL. 15 + 400 pp. — *Apis domestica* named; this is the first binominal for honeybees, although being a pre-Linnean one.

1758. LINNÉ, C. Systema Naturae, sive regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Holmiae, LAUR. SALVII. 10th Ed. (1st Ed., 1735). Tom. I. 2 + 824 pp. — *Apis* erected for the reception not only of *mellifera* and all other bees then known to him, but also of three species of wasps referable to the genera *Zethus*, *Sapyga* and *Bembix* of modern authors. Type of *mellifera*, ♂, in Linnean Soc., London.

1761. LINNÉ, C. Fauna Suecica. Stockholmiae, LAUR. SALVII (also published by Lugduni Batavorum, C. WISHOFF). 26 + 411 pp., 2 pls. — *A. mellifica*, sp. nov., type, ♀, in Linnean Soc., London.

1762. GEOFFROY, E. L. Histoire abrégée des Insectes qui se trouvent aux Environs de Paris, dans laquelle ces Animaux sont rangés suivant un Orde méthodique. Paris, DURAND. Vol. II. 690 pp., color pls. 11 - 22. — *A. gregaria*, sp. nov., type in Antun Mus.

1770. SCOPOLI, J. A. Annus historico naturalis. Lipsiae, HILSCHER. Ann. IV, 150 pp. — *A. cerifera*, sp. nov., type lost.

[1]) The exact date of publication of papers by earlier authors is sometimes a question of dispute. In such cases, the original literature, the Zoological Record and W. HORN et S. SCHENKLING's index (1928-1929. Index Litteraturae Entomologicae. Serie I. Die Welt-Literatur über die gesamte Entomologie bis inklusive 1863. Berlin. 21 + 1426 pp., 4 pls.) have been carefully compared. Some misprints in DE DALLA TORRE's (1896) and VON BUTTEL - REEPEN's (1906) work are corrected in the present paper.

1787. FABRICIUS, J. G. Mantissa Insectorum . . . Hafniae, PROFT. Vol. I, 20 + 348 pp. — *A. florea*, sp. nov., types 2 ☿, in Kiel Mus., further 2 ☿, without locality, labelled "*Anthophora florea*", in Copenhagen Mus.

1793. FABRICIUS, J. C. Entomologia Systematica . . . . . Hafniae, PROFT. Vol II. 8 + 519 pp. — *A. cerana, dorsata*, spp. nov.; type of the former, 2 ☿, without locality, in Copenhagen Mus.; of the latter, ☿, in Kiel Mus.

1798. FABRICIUS, J. C. Supplementum Entomologiae Systematicae . . . . Hafniae, PROFT & STORCH. 2 + 572 pp. — *A. indica*, sp. nov.; types, 2 ☿, in Kiel Mus., other 3 ☿, labelled "Ex Ind. or. et Cap. b. sp. Daldorff", in Copenhagen Mus.

1804. LATREILLE, P. A. Mémoire sur un Gâteau de Ruche d'une Abeille des Grandes-Indes, et sur les Différences des Abeilles proprement dites, vivant en grande Société, de l'ancien Continent et du nouveau. Ann. Mus. Paris 4: 383-394. — 2 *Apis* spp. enumerated, of which *socialis* is new; type, ☿, in Oxford Mus.

1804*a*. LATREILLE, P. A. Notice des Espèces d'Abeilles vivant en grande Société, ou Abeilles proprement dites, et Description d'Espèces nouvelles. Ann. Mus. Paris 5: 161 - 178, pl. 13, figs. 1-11. — 8 spp. of *Apis* enumerated, of which *unicolor, nigripennis, fasciata, adansonii* & *peroni* are new; types in Turin, Geneva or Oxford Mus.; his *indica* being a misidentification for *florea*.

1806. SPINOLA, M. M. Insectorum Liguriae species novae aut rariores, quae in agro Ligustico nuper detexit, descripsit et iconibus illustravit. Genuae. Vol. I, 159 + 17 pp., 2 pls. — *A. ligustica*, sp. nov. types, ☿ ♀, in Turin and Berlin Mus.

1807. KLUG, J. C. F. Species Apiariarum familie novas descripsit; generumque characteres adjecit. Magaz. Ges. naturf. Freunde Berlin 1: 263 - 265, 1 pl. — *A. bicolor*, sp. nov. type, ☿, in Berlin Mus.

1818. VON HOFFMANNSEGG, J. C. G. Entomologische Bemerkungen bei Gelegenheit der Abhandlungen über amerikanische Insekten . . . WIEDEMANN's Zool. Magaz., Kiel 1 (2): 49 - 110. — *A. semirufa*, sp. nov., type, ☿, in Berlin Mus.

1822. ESCHSCHOLTZ, J. F. Entomographien. Berlin, REIMER, Vol. I, 128 + 3 pp., 2 colour pls. — *A. capensis*, sp. nov., type in Dorpot or Moscow Mus.

1833. GUÉRIN - MÉNEVILLE, F. E. Insectes. *In* C. BÉLANGER: Voyage aux Indes-Orientales. Paris, Zoologie: 441 - 512, 5 colour pls. — *A. zonata*, sp. nov., type in Paris or Genoa Mus.

1836. LEPELETIER, A. L. M., Comte de Saint Fargeau. Histoire naturelle des Insectes. Suites à BUFFON. Hyménoptères. Paris, RORET. Vol. I, 547 pp. — 12 spp. of *Apis* enumerated, of which *caffra, scutellata* & *nigritarum* are new; types in Paris or Turin Mus.; the genus being first subdivided, although "artificially", into two groups, one having the scutellum concolorous with thorax proper, the other not so.

1841. LE GUILLOU, E. J. F. Catalogue raisoné des Insectes Hyménoptères recueillis dans le voyage de circumnavigation des Corvettes l'Astrolabe et la Zeleé. Ann. Soc. ent. France 10: 311 - 324. — *A. gronovii*, sp. nov., type in Paris Mus.

1843. FISCHER VON WALDHEIM, G. Observata quaedam de Hymenopteris Rossicis. Magas. Zool. Anat. comp. & Paleon., Paris (2) 5 (122): 1 - ?, 1 colour pl. — *A. daurica*, sp. nov., type in Moscow or Leningrad Mus.

1844. GUÉRIN - MÉNEVILLE, F. E. Iconographie du règne animal de G. CUVIER . . . . Paris, J. B. BAILLIÈRE. Vol. VII, 576 pp., 104 pls. — *A. perrottetii, delessertii*, spp. nov., types in Paris, Munich or Genoa Mus.

1854. SMITH, F. Catalogue of Hymenopterous Insects in the Collection of the British Museum. 2 (Apidae): 199 - 465, 6 pls. — 15 spp. of *Apis* listed, of which *lobata* is new; type in British Mus., London.

1858. SMITH, F. Catalogue of the Hymenopterous Insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. WALLACE. J. Proc. Linn. Soc. London Zool. 2: 42 - 130, 2 pls. — *A. andreniformis, testacea*, spp. nov.; types in Oxford Mus.

1859. SMITH, F. Catalogue of Hymenopterous Insects collected at Celebes by Mr. A. R. WALLACE. J. Proc. Linn. Soc. London Zool. 3 : 4 - 27. — *A. zonata*, sp. nov., type in Oxford Mus.

1860. VON KIESENWETTER, E. A. H. Über die Bienen des Hymettus. Berlin. ent. Zts. 4: 315 - 317. — *A. mellifica cecropia*, var. nov., type in Mus. d. Naturwiss. Ges. "Isis", Bautzen; *australis*, nom. nov. for *A. ligustica* Spin.

1861. SMITH, F. Descriptions of new Species of Hymenopterous Insects collected by Mr. A. R. WALLACE at Celebes. J. Proc. Linn. Soc. London Zool. 5 (supplement to 4, of 1860) : 57 - 93. — *A. nigrocincta*, sp. nov., type in Oxford Mus.

1862. GERSTÄCKER, C. E. A. Über die geographische Verbreitung und die Abänderungen der Honigbiene nebst Bemerkungen über die ausländischen Honigbienen der alten Welt. Festschr. XI. Wander-Vers. deut. Bienenwirthe. Potsdam, KRAEMER. 75 pp. — English translation: 1863. Ann. Mag. n. Hist., London (3) 11: 270 - 283, 333 - 347. — Reproduction: 1906. Mitt. zool. Mus. Berlin 3: 124 - 154. — Occurrence of honeybees in various parts of the world comprehensively reviewed, both for the past and present; the species of the genus *Apis*, for the first time, put on morphological basis, and merged into 4 distinct species, which are again segregated into 2 natural groups by the ratio of POL *vs.* OOL, shape of abdomen, number of rows of scopal bristles and cubital index; in his group I, *dorsata* is subdivided into 3 varr.; in group II, *mellifica* is subdivided into 6 "Hauptvarietäten" (*sine nom.*), and *indica* into 3, but *florea* not subdivided into distinct varieties.

1865. SMITH, F. On the Species and Varieties of the Honey-Bees belonging to the Genus *Apis*. Ann. Mag. n. Hist., London (3) 15: 372 - 380, pl. 19. — GERSTÄCKER's work reviewed and his system of species-grouping adopted; but the shape of abdomen and the number of rows of scopal bristles not considered as subgeneric characters; 8 spp. enumerated, of which *sinensis* is new, type in British Mus., London; 5 varieties of *dorsata* recognized; legs III of all the spp. figured.

1871. SMITH, F. *in* MOORE, F., WALKER, F. & SMITH, F. Descriptions of some new Insects collected by Dr. ANDERSON during the Expedition to Yunnan. Proc. zool. Soc. London 1871: 244 - 249, pl. 18. — *A. laboriosa*, sp. nov., type in British Mus., London.

1877. RADOSZKOWSKI, O. I. Hyménoptères de Kovée. Hor. Soc. ent. Ross., Petersburg 21: 428 - 436. — *A. mellifica japonica*, var. nov., type in Krakau Mus., destroyed.

1879. POLLMANN, A. Wert der verschiedenen Bienenrassen und deren Varietäten bestimmt durch Urteile namhafter Bienenzüchter. Leipzig. 69 pp. — *carnica, cecropia, hymettea & germanica*, subspp. nov. of *A. mellifica*, briefly described; types untraceable. — 2nd edition, 100 pp., published in 1889, *A. mellifida* (!) *caucasica*, subsp. nov. For discussions about this work, see remarks under the review of the species *A. mellifera mellifera* in Chapter VII.

1880. GRASSI, B. Saggio di una Monografia delle Api d'Italia. Milano. — *A. siciliana*, sp. nov., type untraceable.

1881. DE KELLER, A. Elenchus Librorum de Apium Cultura. Bibliographia Universale de Apicultura. Mailand, U. HOEPLI. 222 pp. — Comprehensive bibliography.

1882. LUCAS, H. Une Note relative à un Hyménoptère social. Bull. Séances Soc. ent. France 1882: 62. — *A. mellifica nigrita*, var. nov., type in Paris Mus.

1896. DE DALLA TORRE, C. G. Catalogus Hymenopterorum hucusque descriptorum systematicus et synonymicus. Lipsiae, G. ENGELMANN. Vol. X: Apidae (Anthophila), 643 pp. — Synonymic catalogue; 185 spp. of *Apis* listed, of which 2 being fossil & 177, species incertae sedis; 3 varr. under *dorsata*, 3 under *indica*, 13 under *mellifera*, excluding the *formae typicae*.

1897. BINGHAM, C. T. Fauna of British India including Ceylon and Burma. Hymenoptera. Vol. I, Wasps and Bees. London, TAYLOR & FRANCIS. 29 + 579 pp., 4 pls., 189 text-figs. — 3 spp. & 5 varr. (excluding *formae typicae*) of *Apis* recognized from the Orient; key to spp.

1898. BINGHAM, C. T. On some new Species of Indian Hymenoptera. J. Bombay Nat. Hist. Soc. 12: 115 - 130, pl. A, figs. 4-12. — *A. testacea*, sp. nov., type in coll. C. NURSE, destroyed.

1899. ASHMEAD, W. H. Classification of the Bees, or the Superfamily Apoidea. Tr. Amer. Ent. Soc., Philadelphia, Pa. 26: 49 - 100. — Keys to the families, subfamilies & genera of Apidoidea.

1900. KOSCHEVNIKOV, G. A. Material for the Natural History of the Honeybee. (In Russian). Nachr. Ges. Freunde Naturw. & Ethnogr., Moscow 99 (Abt. Zool. 14): 1 - 144. — Variation of the races of *mellifera* discussed; *carniolica*, *cypriaca*, nomm. emend.

1904. ASHMEAD, W. H. Remarks on Honey Bees. Proc. ent. Soc. Washington 6: 120 - 123. — GERSTÄCKER's & SMITH's species-groups treated as 2 distinct genera, *Megapis*, gen. nov. (2 spp.) & *Apis* (7 spp.), & 2 varr. under each of *dorsata* & *mellifera*; *Micrapis*, subgen. nov. for *A. florea*.

1905. DU BUYSSON, R. Rectification synonymique. Bull. Soc. ent. France 1905: 122. *A. mellifica* var. *nigrita* LUCAS is only a discoloration.

1906. VON BUTTEL - REEPEN, H. Apistica. Beiträge zur Systematik, Biologie, sowie zur geschichtlichen und geographischen Verbreitung der Honigbiene (*Apis mellifica* L.), ihrer Varietäten und der überigen *Apis*-Arten. Mitt. zool. Mus. Berlin 3: 117 - 201, 8 figs., 1 graph. — Known spp. of *Apis* reduced to 3; 3 varr. (including *forma typica*) under each of *dorsata* & *florea*; 3 subspp. & 17 varr. under *mellifica*; *friesei*, *intermissa*, *koschevnikovi*, *lehzeni*, *picea*, *syriaca*, varr. nov. of *A. mellifica* subspp., *rufiventris*, var. nov. of *A. florea*, types in Berlin Mus.; keys to spp., subspp. & varr.; biology, historical & geographical distribution, evolution & bibliography also discussed; together with reproduction of GERSTÄCKER's (1862) paper.

1906. ENDERLEIN, G. Neue Honigbienen und Beiträge zur Kenntnis der Verbreitung der Gattung *Apis*. Stett. Ent. Ztg., 67: 331 - 334, 4 figs. — VON BUTTEL - REEPEN's scheme of classification revised; *indica* recognized as distinct sp.; *florea* subdivided into 2 subspp.; keys to spp., subspp. & varr.; 3, 10, 7 & 5 varr. (including *formae typicae*), respectively, recognized for *dorsata*, *mellifica*, *indica* & *florea*; *indica* var. *javana*, *florea florea* var. *fuscata*, *florea andreniformis* var. *sumatrana*, varr. nov.; types in Stettin Mus.

1906. COCKERELL, T. D. A. New Rocky Mountain Bees, and other Notes. Canad. Ent., Ontario 38: 163 - 166. — *A. dorsata binghami*, nom. nov. for *zonata* F. SM., *mellifera lamarckii* nom. nov. for *A. fasciata* LATR.

1911. VON IHERING, H. Phylogenie der Honigbienen. Zool. Anz., Leipzig 30: 129 - 136, 1 text-fig.

1911. COCKERELL, T. D. A. Descriptions and Records of Bees. XXXV. Ann. Mag. Nat. Hist., London (8) 7: 310 - 319. — *A. nursei*, nom. nov. for *A. testacea* BINGH.

1911*a*. COCKERELL, T. D. A. New and little known Bees. Tr. Amer. ent. Soc., Philadelphia, Pa. 37: 217 - 241. — *A. florea nasicana*, subsp. nov., type in Washington Mus.

1914. COCKERELL, T. D. A. Descriptions and Records of Bees. LX. Ann. Mag. Nat. Hist., London (8) 14: 1 - 13. — *A. binghami sladeni*, subsp. nov., type in British Mus., London.

1916. GORBATSCHOV, K. A. The Caucasian Bee (*Apis mellifera* var. *caucasica*). (In Russian). Tiflis. 40 pp., tables, charts.

1919. BÖRNER, C. Stammesgeschichte der Hautflügler. Biol. Zentralbl., Leipzig 39: 145 - 186. — Reclassification of the families, subfamilies & tribes of the order Hymenoptera.

1924. TILLYARD, R. J. Some Remarks on the Evolution of the Bee. N. Z. Fruitgrower & Apiarist, Auckland 17th Nov. 1924, reprint 2 pp., 2 figs.

1925. HANDLIRSCH, A. Geschichte, Literatur, Technik, Paläontologie, Phylogenie, Systematik. *in* C. SCHRÖDER; Handbuch der Entomologie. Jena, G. FISCHER. Vol. III, 8 + 1201 pp., 1040 figs.

1926. TILLYARD, R. J. Insects of Australia and New Zealand. Sydney, ANGUS & ROBERTSON. 11 + 560 pp., 44 pls., many text-figs. — Revised venational notation of Hymenoptera.

1926. GROZDANIC, S. S. Die "gelbe" banater Biene. (in Serbian with German summary). Acta Soc. ent. Serb., Belgrade 1: 45 - 60. — Varr. of *A. mellifica* discussed; *banatica*, var. nov., type untraceable.

1927. RICHARDS, O. W. The specific Characters of the British Humblebees (Hymenoptera). Tr. ent. Soc. London 75: 233 - 268, pls. 22 - 25, 5 text-figs.

1927. WILSON, H. F. Dr. CHARLES C. MILLER Memorial Apicultural Library, University of Wisconsin, News Letter 3: 1 - 3 (mimeographed). — Estimation of the number of bee journals.

1929. SKORIKOV, A. S. Beiträge zur Kenntnis der kaukasischen Honigbienenrassen. I-V. (In Russian with German summary). Repts. Appl. Ent., Leningrad 4: 1 - 60, 28 figs. — Geographical variation of the Caucasian and Transcaucasian bees intensively studied; *absuatna*, *siganica*, *georgica*, new "races" of *remipes*; *tesquorum*, new race of *mellifera;* types in Leningrad Mus.

1929*a*. SKORIKOV, A. S. Eine neue Basis für eine Revision der Gattung *Apis* L. (In Russian with German summary). Repts. appl. Ent., Leningrad 4: 249 - 264, 6 pls., 6 text-figs. — Reclassification of the genus based on morphology; sterna of 14 spp. & subspp. illustrated; ASHMEAD's genera accepted as subgenera; subgen. *Apis*, s.s. subdivided into 3 sections; 9 spp. recognized, of which *johni* & *meda* are new; *indica philippina*, *remipes transcaucasica*, *remipes armeniaca*, subspp. nov.; *abeuana*, *siganica*, *georgica*, *iberica*, new nationes of *remipes transcaucasica; acervorum*, new natio of *mellifera;* types in Leningrad Mus.

1929. DOVER, C. Wasps and Bees in the Raffles Museum, Singapore. Bull. Raffles Mus., Singapore 2: 43 - 70. — Revision of VON BUTTEL - REEPEN's keys to "forms" of *A. dorsata*, *mellifica indica* & *florea;* status of *nursei* discussed.

1930. ROEPKE, W. Beobachtungen an indischen Honigbienen, insbesondere an *Apis dorsata* F. (In German, with summary in Dutch). Meded. Landbouwhoogeschool

Wageningen 34 (6): 1 - 28, pls. 1 - 6, 4 text-figs. — Observations on habits; discussions on synonymy and geographical distribution.

1931. STATZ, G. Eine neue Bienenart aus Rott am Siebengebirge. Ein Beitrag zur Kenntnis der fossilen Honigbienen. Wiss. Mitt. Ver. Natur. u. Heimatk. Köln 1: 39 - 60, 11 figs. — Geological evidences of evolution of social bees.

1934. KOMAROV, P. M. & ALPATOV, V. V. Contribution to the Study of the Variation of Honey Bees. I. The Variation of the body Weight and of the reproductive System of the Queen as racial Characteristics. (In Russian with English summary). Zool. J., Moscow 12: 87 - 95, 5 figs.

1935. RAYMENT, T. A Cluster of Bees. Sydney, Endeavour press. 752 pp., 75 pls., 128 text-figs. — *A. aexigmatica* described.

1938. ALPATOV, V. V. Contribution to the Study of Variation in the Honey Bee. VI. (In Russian with English summary). Zool. J., Moscow 17: 473 - 481. — *A. mellifera taurica*, subsp. nov., type in Moscow or Leningrad Mus.

1944. MICHENER, C. D. Comparative external Morphology, Phylogeny, and a Classification of the Bees (Hymenoptera). Bull. Amer. Mus. Nat. Hist., New York 82: 157 - 326, 246 figs., 13 diagrams. — Detailed morphological description of *Anthophora edwardsii* CRESS.; comparative notes on *Apis*, etc.; phylogeny & reclassification of the superfamily Apidoidea.

1944. MAA, T. On the Classification and Phylogeny of the Chinese Honeybees (Abstract). (In Chinese). Ent. Shaowuana 1: 4 - 5. — *A. himalayana*, sp. nov., *indica skorikovi*, subsp. nov., nomina nuda.

Note. — Although not primarily intended for use by systematic apidologists, the following list of publications dealing with S. E. Asiatic honeybees is here appended with the author's consent for the benefit of those especially interested in the honeybees of the Indo-Australian region, chiefly of Indonesia. — M. A. LIEFTINCK (Ed.)

1939. FLUITER, H. J. DE. Beobachtungen an javanischen Hymenopteren. I. *Apis dorsata* F. Ent. Med. Ned. Indië, Buitenzorg, 5: 45 - 49, 1 fig., 4 photographs of nest.

1931. FRANSSEN, C. J. H. Bijenteelt op Java en de biologie van *Apis indica* F. Natuurh. Maandbl. Limburg, Maastricht, 20: 44 - 48, 56 - 64, 71 - 74. — Deals with *A.* (*Sigmatapis*) *javana* END.

1931*a*. FRANSSEN, C. J. H. Aanteekeningen over de biologie van *Apis indica* F. De Trop. Natuur, Weltevreden, 20 : 187 - 193, 7 figs. — Deals with *A.* (*Sigmatapis*) *javana* END.

1931*b*. FRANSSEN, C. J. H. Eierproductie van de *Apis indica* koningin. Ibid., 20: 231. — Egg-production by queen of *A.* (*Sigmatapis*) *javana* END.

1932. FRANSSEN, C. J. H. Aanteekeningen over *Micrapis florea* F. Natuurk. Tijdschr. Ned.-Indië, Batavia, 92: 55 - 63, 4 pls.

1932*a*. FRANSSEN, C. J. H. De beteekenis van *Apis indica* als bloembestuivend insect. De Bergcultures, Batavia, 6: 1417 - 1423. — Notes on the life-history, biology and ecology of *A.* (*Sigmatapis*) *javana* in Java; enumeration of cultivated and wild flowering plants frequented, and discussion of the significance of pollinating various cultivated plants.

1933. MOL, G. A. DE. Inzameling van was en honig in het merengebied van de westerafd. van Borneo (Collecting wax and honey in the lake region of western Borneo). With English summary. Landbouw, Buitenzorg, 9: 80 - 86, 3 figs. — Enumeration of flowering trees visited by *M. dorsata;* notes on migration.

1926. OTANES, F. Q. Honey bees and how to raise them. Philipp. Agric. Review, Manila 19: 149 - 173, 18 pls.

1926. POILANE. Notes sur les Abeilles de l'Indochine. Bull. Econ. Indochine, Hanoi, 2me partie, 461 - 464, 1 pl. — Descriptions, geographical distribution and biological notes on *Megapis dorsata*, *A.* (*Sigmatapis*) "*indica*" and *Micrapis florea*.