STUDIES ON THE HONEY BEE, WITH SPECIAL REFERENCE TO THE JAPAESE HONEY BEE.

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(With plate I & II.)

蜜蜂特に日本種に關する研究

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INTRODUCTORY.

Setting aside the brief accounts of the Japanese honey bee given by the Japanese writers such as TAMARI (1889) and others, RADOSZKOWSKY (1887) was the first who deals with the systematic position of the bee and regards it as *Apis mellifica* L. var. *japonica*, as following lines show: "Elle se distingue de l'abeille ordinaire en ce que les bases des segments portent des bandes formées de poils couchés blanchâtres et que les segments ventraux sont d'une couleur pâle et garni de poils long sâles. Cette variété se trouve aussi aux environs de Wladiwostok. Jokohama."[1]

According to v. BUTTEL-REEPEN (1906) *Apis mellifica* is classified into 3 subspecies: 1) *mellifica* proper, 2) *unicolor* from Africa, and 3) the Asiatic which merits the name of *indica*, and our native bee is regarded by him as a variety of the last named subspecies, i. e. as *Apis mellifica*, st. *indica-japonica* Rad[2] This view on *indica* is based chiefly upon the criterion to this variety, as pointed out by KOSCHENIKOW (1900), which consists in the plorongation of the cubital

1) Probably *et* is dropped between the two localities, Wladiwosock and Jokohama, by misprint.

2) v. BUTTEL-REEPEN (1906) says that he found in the collection from Japan in the Zoological Museum of Berlin, etc., some examples of *indica-peroni*, 6 of *indica-sinensis* and 3 of *indica-japonica*, and regards the latter as the bastard between *sinensis*-variety and a dark variety of *indica*-subspecies.

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vein beyond the medial cell in the hind wings, as his lines go: "Hintetflügel Kubitalader über Medianzelle bedeutend hinausrangend" (p. 170). In addition to this the author gives two further characteristics of *indica*: 1) "Männchen: Tibie III an der dorsalen Seite ausgebuchtet und seitliche äussere Wölbung abgeplattet" (p. 169); 2) "Mandibeln und Labrum stets heller (meist rostrot) gefärbt als der Thorax" (p. 190).

From the statement given above, we see that the Japanese bee has been put by v. BUTTEL-REEPEN for the first time in relation to *indica* established by FABRICIUS (1798) as the independent species. BINGHAM (1897), KOSCHEVNIKOW (1900), MATSUMURA (1911) and recently v. BUTTEL-REEPEN (1915, 1918) also recognise *indica* as the independent species.

According to BINGHAM (1897), however, *indica* can not sharply be distinguished from, but "merges into common *A. mellifica* Linn., the honeybee par excellence of Europe." KOSCHEVNIKOW (1900) also says: "*A. indica* und *A. mellifica* zeigen viele Ähnlichkeiten miteinander; die Varietäten dieser beiden Arten zeigen noch mehr Übereinstimmung als die typischen Formen." FRIESE (1920, 1922) puts *indica* among *mellifica* on account of his opinion, according to which in the honey bee only 3 species are to be admitted. If I understand correctly the lines given by FRIESE in this regard, his view, by which various forms of the honey bee are comprised in the 3 species known as *dorsata*, *florea* and *mellifica*, is established on 2 points: firstly, the alterations affected by the domestication and adaptation are so great that celebrated systematists such as BINGHAM, SMITH and RADOSZKOWSKY put *unicolor* from Africa together with the Asiatic *indica* (BINGHM) and classify likewise the Asiatic *sinensis* (SMITH) and *japonica* (RADOSZKOWSKY) with the European *mellifica;* secondly, the 2 forms of the 3 specise, *dorsata* and *florea*, which stand morphologically very distinct not only from each other, but also from *mellifica*, can not be crossed with the last named species, while *indica* is crossed with *mellifica* successfully. He also says: "*Apis indica* und *mellifica* sich derart auch biologisch nahestehen, dass wir sie auch unter einen morphologischen Speziesnamen vereinigen können" (1923, p. 344). "Die Honigbiene *(A. mellifica)* ist nur wenig grösser als die *A. indica*, der sie namentlich in ihren afrikanischen Abaraten wie *A. adansoni* und *unicolor* täuschend ähnlich sieht" (loc. cit., p. 357).

The specific value of *indica* and *mellifica* is, therefore, still not clear enough. The present investigation has been carried out with the Japanese bee, and so far as possible, extended to the Corean, Chinese and European bees, so as to enable to compare the anatomical as well as the biological data of the insects from these localities with one another. According to the results arrived at, there is recognised a great similarity among the bees of Japan, Corea and China on one hand and among those from Europe on the other, while the eastern bees show a sharp contrast against the western, so that the latter represented by *A. mellicfia* can by no means be mixed with the former which is accordingly to be recognised as a distinct species and signifies as *A. indica* according to BINGHAM (1887), especially to FABRICIUS (1798). As the descriptions show, to the species criterions of *indica* pointed out by KOSCHEVNIKOW and v. BUTTEL-REEPEN are to be added further distinct characteristic made out in our bee in the present work: the abdominal down bands, a peculiar pore on the drone cocoon, the modification of male organs, etc., inasmuch as there is no room to doubt in recognizing the Japanese bee as a variety of *A. indica.*

The present author is placed in a convenient position in procuring the material not only from the colonies of the bees kept by himself in the Experiment Station, but also because he has connections with his friends and beekeepers affording to him the specimens from several localities of this country. He is moreover well acquainted with several races of the European species, *A. mellifica*, such as the Italian, Carniolans and Dutch bees imported from America and their native places by beekeepers as well as by the Government Industry Department.

In addition to this, Dr. L. H. GOUGH, Director of the Entomological Section, the Ministry of Agriculture, Cairo, Egypt, was so kind to send me 6 specimens of the queen, worker and drone of the Egyptian bees, collected by himself in 1912 and 1913, so as to enable me to extend the anatomical comparison of the present results into the Egyptian bees.

The author will be permitted to express in this place his hearty thanks to DR. S. HATTA, the professor of the Imperial University, Sapporo, for his kindness in giving voluable advices in the course of the work. My obligations are also due to several other gentlemen for their kindness shown to me in sveral ways.

I. MORPHOLOGICAL CHARACTERISTICS

1. Color of the Skin

As is well known, the workers of the Japanese bee are generally blackish in color with brown markings of several systems, which are not other than the zones of the ground color turned lighter. The shade of the colors varies according to the age and also to the localities, from which the specimens are collected: young individuarls are lighter in color, and the specimens from some localities are so dark that the brown markings come forth hardly.

In the *head* which comes first in notice, the mandible and labrum are rust-red in color as v. BUTTEL-REEPEN (1906) mentions of all varieties of *indica*, including *japonica;* some examples have the labrum of lighter color extending to the clypeus. The *scutellum* of the mesothorax ranges in color from yellowish to black; even the individuals from one and the same hive differ in this respect, although sometimes there are found colonies which contain uniformly black bees.

Secondly, the *abdomen* is pale yellowish ventrally, as described by RADOSZKOWSKY (1887), v. BUTTEL-REEPEN (1906) and MATSUMURA (1911), shading lighter into the ventral parts of the dorsal plates. It is worth of notice that in some examples the ventral side of abdomen is turned into blackish when killed, while in life it is brownish. I mention this, because this change of color misleads often one to recognize the black abdomened specimen of the Japanese race as a normal example; v. BUTTEL-REEPEN (1906), who has 6 examples of *sinensis* from Japan, seems likely to have been misled by this abnormality.[1] In realty, the pale coloring on the ventral side is to be recognized as one of the important characteristics of the Japanese bee.

Turning to the dorsal plates of abdomen, 2 transverse zones are distinguished on each plate: the posterior broad zone is blackish, while the anterior narrow patch is lighter in color, so far as it is usually overlapped, so as to be hidden by the hind margin of the preceding plate, and becomes visible only when the abdmen is much distended (Fig. 1), so that the characteristic markings are in

1) I have experienced that some yellowish examples from a central locality (Kanagawa), for instance, have become deep black when they are dead; furthemore black types from a northern locality (Aomori) were stiil further blackened when killed.

the ordinary position of the body out of notice of an observer, especially in the case of specimens which are shrinked. BINGHAM (1897) notes on *indica* simply: "The scutellum and basal five segments of the abdomen testaceous yellow"; BENTON (1896) says, on the other hand, "The abdomen is yellow underneath. Above it presents a ringed appearance, the anterior part of each segment being orange yellow, while the posterior part shows bands of brown of greater or less width and covered with whitish-brown hairs; tip black." The observation of the last named author is accordingly in this respect in accordance with the results of the present investigation.

The markings on the dorsal plates just referred to are the constant occurence to all the worker bees, though there are naturally some divergencies in shading of color. The second plate is excepted in its being furnished with a striking brownish mark of varying shape and area which occupies the larger or smaller part of the black area (see *k*, Fig. 2), but is entirely lost not unfrequently. There are rarely colonies, the whole members of which lack the mark in question.

Thirdly, the *legs* are black, with a brown oblique streak on the outside of the middle portion of the tibia of hind legs. The black pigment grows more scanty towards the proximal joints, especially on their inner side, being caused by lacking the pigment. The coxa, trochanter and femur of the legs, especially those of the hind legs, look on this account more or less translucent and are turned brownish and opaque, when the bees are dead and dried. The above mentioned streak as well as the brown shading just referred to are not constant; some individuals have legs lacking entirely the streak and brown areas, the whole body being blackened.

The following table (Table I) is intended to show the number of bees with the markings from several localities of this country as well as those from Corea and China. In some examples the brown markings are extremely distinct because the fundamental black color is lighter, while in another lot they are diffused owing to the latter which is intensified; there are of course individuals standing in this respect in the midway between the two lots, ranging to both the extremities. The variation is to some extent due to the geographical position of the localities. So far as proved, the bees from the southern localities such as Fukuoka and Kumamoto are lighter in color, as compared with those

from Hondo or the Main land and from Shikoku (Kôchi and Tokushima).

TABLE I. The worker bee individuals with markings, from sveral localities.

Localities	Total number of the worker bees observed	Individuals with scutellum brownish	Individuals with brownish marking on the 2nd abdominal segment	Individuals with brownish markings on the 3rd tibia
Hondo:				
Aomori	510	0	4	0
〃	20	19	17	14
〃	7	7	7	7
Akita	5	5	5	1
Fukushima	5	0	2	0
Ibaraki	2	2	2	1
Nagano	17	5	6	1
Mie	15	10	11	10
〃	11	11	7	8
〃	9	8	9	8
Kanagawa	15	3	2	3
Gifu	6	3	3	2
Yamaguchi	9	1	8	4
Shikoku:				
Tokushima	24	1	4	2
〃	100	0	0	100
Kôchi	693	0	0	0
〃	6	2	0	0
Kyushû:				
Tsushima Is.	7	7	4	7
Fukuoka	64	61	59	55
Kumamoto	22	0	22	18
Miyasaki	23	0	18	10
Corea:				
Seoul	24	24	24	15
Kôryo	20	19	15	3
China:				
Manchuria (Chiko-shan)	7	7	7	5
Peking	9	9	9	1
〃	7	7	7	7
Hankau	21	20	21	14

Next come in consideration the queen and drone, in which the coloring is generally simple. In the *queen*, the head, thorax and abdomen are brownish black; legs are translucent, fuscous and sometimes mottled blackish. Scapus of antenae is often dark brown. Scutellum is black. The anterior half of the abdominal segment is shiny black; its posterior half exposed is not shiny, being covered with finest brownish pubescence. The ventral plates of the abdomen are black, each ranging posteriorly into fuscous. The *drones*: the head, thorax, abdomen and legs are all black, excepting the surroundings of the anal opening which are brown.

2. Pubescence of the Jappanese Bee

The hair bush between compound eyes is not scanty in the Japanese bee, as compared, for instance, with *A. mellifica*. In this respect, our bee can not be distinguished from the specimens from Corea (Seoul and Kôryo), Manchuria (Chiko-shan), Peking and Hankau, which agree again in resembling each other. This fact disproves the statement by v. BUTTEL-REEPEN (1906), which runs as follows, "Das Fehlen des Stirnhaarschopfes und spärlichere Behaarung sowie die hellere Abdomen-Unterseite (in the Japanese bee) unterscheiden sie von der *Sinensis*." About the color the blackishness of the ventral plates of the abdomen can not be accepted, as we have already dealt with in the preceding paragraph; what the hair-tuft is concerned, I do not hesitate to assume that it is lost or diminished owing to some artificial causes.

The second lot of hairs are represented by the hair bands of the abdomen, which are of constant occurence and merit accordingly the valuable species criterion. According to the previous authors these hair bands are present in the varieties, such as *peroni*, *picea*, *sinensis* and *japonica* only three in number, occuring on respective segments from the 3rd to 5th. I have detected one more band on the 6th segment of the Japanese bee (*b*, Fig. 1); this band may probably be overlooked in shrinked specimens, because it is found on the hindmost segment of the body which is often concealed in such spesimens. Nevesthless, it is an important characteristic not only of the Japanese bee, but also of the bees from Corea and China, in which I have proved this, while *mellifica* is destitute of it. This result suggests further that all other varieties

of *indica* possess the same structures. The hair band in question is yellowish in color and narrow in shape and is found on the basal margin of the black region of each segment.

Now we have in total 4 hair bands distributed respectively on the segments from the 3rd to 6th; it is these white hair bands by which a ringed appearance of the abdomen is distinctly expressed, especially when the abdomen is distended by some causes.

As the third lot of hairing I am going to describe the hairs of the remaining parts of the body. The hairs of the thorax are brownish gray on the backside, becoming whitish on its ventral side and on the legs. From the coxa to the tibia whitish hairs are present; the tarsus is provided with brownish hairs.

As to the hairing of the *queen* the caput is provided with long brownish black hairs, but on the face short black hairs are seen; on the dorsal and ventral sides of the thorax as well as on the legs brownish hairs are present; the abdomen is grown with brownish finest pubescence.

The *drone:* the face is provided with black, the thorax with brownish black, the distal end of the thorax and the basal margin of the abdomen with grayish white hairs; the abdomen is grown with whitish hairs ventrally and with long brownish hairs distally. The coxa, trochanter and femur of the foreand middle legs are provided with whitish hairs, the tibia and tarsus being furnished with brownish long hairs; the hind legs lack hairs from femur to the tip.

3. Wings

The wings are in the three forms hyaline; in the queen they are often more or less darker in color. The wings of drones are irridescent.

The criterion given by KOSCHEVNIKOW (1900) of the venation on *indica*, that consists in the prolongation of the radial and cubital veins beyond the medial cell in the hind wings, is also valid of the hind wings of all over the worker, queen and drone bees (Figs. 3, 4, 5).

Hooklets of the hind wings of the Japanese bee show greatly numerical divergence. The following table (Table II, a, b, c) are intended to show the number of these hooklets in the workers, queens and drones of the Japanese bees from several localities.

3. On the Siza and Shape of the Body.

The Japanese bee is in the dry specimens 9–12 mm in length. But the plump bees attain so greater length, that they are 14 mm or more in total length.

TABLE II.

a.—Workers [1)]

	Aomori		Mie		Tokushima		Fukuoka	
	Left	Right	Left	Right	Left	Right	Left	Right
1	16	18	18	18	18	17	15	16
2	18	18	19	18	18	17	16	15
3	18	18	18	19	17	19	16	17
4	18	18	17	20	17	19	16	17
5	18	19	17	20	18	18	17	17
6	17	21	20	18	18	19	18	16
7	19	19	19	20	19	18	18	17
8	19	20	20	19	19	19	18	18
9	20	20	21	18	19	19	17	20
10	20	21	22	20	20	20	18	20

b.—Queens

	Mie		Fukuoka		Kôchi	
	Left	Right	Left	Right	Left	Right
1	18	17	15	15	16	16
2	—	—	19	19	—	—

c.—Drones

	Gumma		Kôchi		Tokushima		Aomori	
	Left	Right	Left	Right	Left	Right	Left	Right
1	17	17	16	17	17	17	17	17
2	17	19	20	22	20	20	—	—
3	—	—	20	21	18	18	—	—

1) The figures are from 10 bees taken at random.

In an example of the Japanese bee it is 0.0636 gr[1] in weight, in another one 0.07835 gr,[2] while a bee of the Italian race weighs 0.0725 gr[3] and another one of the latter 0.0875 gr.[4]

The queen of the Japanese bee is relatively large; it is on the dry specimens 13–17 mm in length; during spawning season, living queen grows as large as 20 mm in length, weighing 0.21185 gr for instance. The drone, on the other hand, is relatively small in size; it is 12–13 mm in length on the dry specimens, but in living ones it is 14.8 mm and 0.124 gr.[5]

The tongue of the worker is 3 mm in length, 0.5 mm or more shorter than that of the Italian.

BUTTEL–REEPEN (1906) mentions that the distal, dorsal margin of the third tibia is in the drone of *indica* strikingly projected (j, Fig. 7), while it is in the mellific drone almost straight (Fig. 8). The stiff hairs of the planta of the first tarsal joint are in 12 rows, 2 of which are obscure.

4. On the Male Copulatory Organs.

Now let us turn to the male copulatory organs which show a great deal of characteristics distinguishing our bees from *mellifica*. For the sake of convenience the description will be commenced with the organ everted. It is simply not other than a membranous, tubular, hollow pouch bent dorsally, and consists of 2 portions, the proximal and the distal: the latter is smooth on its surface (except *mellifica* in which a pair of so–called symmetrical chitinous plates (*s*, Figs. 16, 18) are to be seen in the wall of the pouch, at the dorsal aspect of the bending); the former is provided, on the other hand, with a series of appendages which are named by SHAFER (1917) respectionely as the doubly pinnate-lobed projection, the cross-striped chitinous ridges, the ventral quadrangular plate, the triangular plate and a pair of pneumophyses.

In the distal part, the Japanese drones are distinguished from *mellifica*, in the first place, by the neck–like narrowance of the tube (*c*, Figs. 14, 15, 17), by which the proximal portion is demarkated against the distal, while in *mellifica* they pass from one to the other; in the second place, the so–called

1, 2, 3, 4) The bees alarming at the entrance were taken to the weight.

5) It is the average number of 11 drones.

symmetrical chitinous plates are sometimes nearly lost in the Japanese bee (Figs. 15, 17), or are represented simply by a group of slight thickenings of the membranous wall (*s*, Figs. 14, 20), which are melt together in *mellifica* into a pair of hard chitinous plates in the dorsal wall of the penis tube (*s*, Figs. 16, 18). In this respect, the Chinese drone can not be distinguished from the Japanese, showing a slight thickenings of the membranous wall instead of the hard symmetrical chitinous plates. The thickenings are only a ring zone formed of minute outgrowths of the penis wall. The lateral and dorsal views of the zone are shown in Figs. 14 and 20 (*s*) respectively.

In the proximal portion the so-called pinnately lobed projection shows a fan-shaped arrangement of lobes around the axis (*l*, Figs, 15, 21), instead of the pinnate structure in *mellifica*, in which the lobes are arranged principally on each side of the axis, whence the terminology of the organ is derived (*l*, Figs. 16, 22). What is the cross-striped ridges concerned, the grooves separating them are more depressed than in *mellifica*. so that the ridges are expressed distinctly (*r*, Figs. 14, 15, 17). The ridges are furthermore provided with the spinules or hairs, the growth of which is in particular denser and more vigorous towards those in the proximal part; in *mellifica* they are separated not only by the relatively inconspicuous depressions, but the spinules are most vigorous in the middle ones, as seen in the penis everted. The ventral quadrangular region is very thin in structure and clad with spinules very weakly (*q*, Figs. 15, 17), connecting with the well developed proximalmost ridge (r_1, Figs. 15, 17), while in *mellifica* the former is thick and vigorously haired and set off from the latter by a strong constriction (*q*, *c*, Fig. 16). The dorsal triangular region, on the other hand, is larger and more haired in the Japanese drone than in *mellifica* (*t*, Figs. 14, 15, 17).

In the pneumophyses I have detected great divergencies from those of *mellifica*. They are represented by a pair of conical tubes found on each side (*p*, Figs. 14, 15, 17, 23, 24). They have 3 likewise conical, tubular, accessory outgrowths of unequal length at its basal part ($p_{2,3,4}$ Figs. 14, 15,1 7, 23, 24); the proximal one is the longest (p_2, Figs. 23, 24) and produces some minute accessory outgrowths, while the distal as well as the shortest middle tubes are simple. The homologous structures are rudimentary in *mellifica*, being repre-

sented simply by 2 wart-like elevations at the corresponding part of each pneumophysic tube everted. In the resting state, the principal horns are 4-6 mm in length, which are only 3-4 mm in *mellifica*.

Now the bees from Fgypt, Madagascar and Mauritius come in consideration; they are altogether taken by v. BUTTEL-REEPEN (1906, 15) as *unicolor*, a subspecies of *A. mellifica*, whereas those from the two latter localities BINGHAM (1897) puts in *A. indica*. According to the present investigation the Egyptian bee can hardly be, however, distinguished from *mellifica* proper, so far as the structure of the male copulatory organ is concerned (Fig. 19).

II. BIOLOGICAL CHARACTERISTICS

1. Habit of Life

The colony of the Japaness bee is inferior to *mellifica* in population. The hive or box is built accordingly abot 33 × 33 × 100 cm. Besides the fixed hive, a mavable hive was offered by TAMARI (1889), but is not in usual use, for the experience has proved the bees like better the fixed hive. When taken in a new box, the colony established very fine combs from ceiling downwards, arranged vertically and in parallel. According to our old custom, a honey dealer who visits the bee-yard, takes out the honey, cutting across the height of the upper half the combs of the honey store opened from the roof. The remaining half of the store is left for the bees' support. In each hive the honery harvest is said to yield about 1 to 3 *kwan* (4-12 kg) of honery per colony.

If the ecological conditions are unfavourable, the bees abandon frequently their hive. I observed case of the migration of the colony from Kumamoto, the members of which were prepairing to abandon the hive in the course of about a month in the summer dearth. Almost all cells were full of honey, but the queen was very small in body size and no brood was found. The bees were placed in so restless condition to run out of the entrance when the hive was opened. I found after about 30 days that the hive was vacant, when the day of August 21st of 1922 broke. The propensity of migration may be taken

as a characteristic of the Japanese bees and shows a similarity to the Indian bees, as GHOSH (1920?) gives on the bees of Ceylon; he says: "These bees are very prone to swarming and are found to migrate as well to some extent." Our bees cast only 2 or 3 swarms a year, though they build often 10 or more queen cells. The absconding is very often caused by the wax moths which attack almost always the hive of our bees.

As to the mode of ventilation, our bees differ from *mellifica*. Whilst the latter fan at the alighting board facing inwardly, our bees sit likewise at the entrance, but their heads are turned away from it (Fig. 6). This has been well known in our country, and recently the same habit of *indica* in Ceylon is reported by DRIEBERG (1922). According to my observation, the fanning bees are resting, however, rather more in number on the upper vertical wall of the hive body than on the bottom board in front of the entrance, as shown in Fig. 6. In addition to this, those of the outside from unbroken rows together with those of inside which are likewise fanning, scattered on the bottom and combs.

Another contrast of the Japanese bee to *mellifica* consists in that in the case destitute of their queen the workers are not capable to rear a queen from a worker egg or larva. It is not long after departure of the queen that many fertile workers lay eggs in cells (especially, soon the bees from Fukuoka) which produce always the drone bees. If fertilized eggs or larvae are experimentally put in cells before fertile wokers appear, they are not cared. But I have met with several cases of queen cells which are built on the drone larvae layed by the fertile workers. If the introduction of a queen is done in a queen cage, she is usually abandoned without regards. It follows that a colony once left by the queen is connected with a great difficulty to recover its previous normal condition. Some one reports on the other hand on *indica* of Ceylon that the bees "are able to raise queens from eggs or larvae when suddenly deprived of the reigning queen."[1] If this is proved true, our bees diverge in this respect from those of Ceylon. The union of the Japanese bee with *mellifica* in a colony, whether the latter is introduced in the former or inversed, is likewise by no means easy, although sometimes a few of cases of success are

1) Reffer to DRIEBERG (1922).

reported. I have an experience, that the mellific intruders in autumn were shut in a colony of the Japanese bees accidentally by snowfall and cold climate and were found living in harmony with each other in the colony in the following spring.

Lastly, our bee is contrasted to *mellifica* concerning the position of the eggs deposited in the cells. The eggs lie, in the Japanese bee, so inclined on the bottom of the cell that they are almost in parallel with the comb surface with their tip pointed downwards, while in *mellifica* the tip of the eggs is directed towards cell mouths, so as to be placed vertical to the surface referred to.

In connection with the behavior of the workers against the queen, on that against the drone a brief accounts will be given, as seen during a dearth of nectar. Usually the drones are not more reared in the season of a dearth and meantime they disappear in the hive. Among others, I mention a case in which a few drone larvae were reared; they were found crushed at the head before their maturity is attained; the waxy covers were scraped off, and the characteristic cocoons were gnawed roundly at the cell mouths, falling in the shape of a small disc, smaller than those cut down by the emerging drones themselves; this is in the case in the bees from Kumamoto and Kôchi. On the contrary, I observed a single case in the bees from Aomori, in which a few drones were almost always being raised up beyond the flowering season until late autumn or early winter.

Still further contrast of our bee to *mellifica* is seen in a queen in which the anterior half of the fore wing is clipped in order to keep her in the colony at swarming time; meanwhile she disappears, probably being killed and cast away from the nest by the workers. It is, therefore, obvious, that in the Japanese bee the artificial enforcing in the treatment of the queen is not easily accepted by the workers of a colony.

As already referred to, FRIESE (1920, 1922) and others maintain that *indica* crosses with *mellifica*. We can not, however, confirm this statement from our experience with the Japaneses bee in more than twenty years, during which we did not recognise the successful results of the crossing.

The Japanese bees are mild in nature and shy and timid in character. They rarely sting weakly and bite their tormentor in some measure, often

crawling in the inside of the clothes. They avoid enemies instead of struggling against them, though they sometimes dash upon. And also GHOSH (1920?) says of *indica:* "They can not defend themselves against enemies so well as the Italian bees, and the Wax Moth plays hevoc among them." During a dearth *mellifica* invade the colony of the Japanese bee without much resistance and rob away all the store. The Japanese bees disregard the invaders, even show no sight of hate or struggle against them inside of the hive as if they know nothing about the matter and leave in fact their store upon deprivance of the robbers.

There is a further fact that *mellifica* and the Japanese bee do not flourish with harmony in one and the same locality. The government statistics gives the following numbers, showing the Japanese bee diminishing year after year in number of the colonies in consequence of the struggle against *mellifica;* it is principally due to the deprivance of the store by the latter.

	Japanese bee	*millifica*
1913	84.997	48.054
1916	63.735	49.703
1917	46.000	52.604
1918	44.946	58.865

The Japanese bees produce a peculiar noise of wings like *ss* all at once at every slight stimulation. This may be assumed as their mutual alarm and is naturally due to timid or irritable nature. They are placed in restless movement, when the irritation is strong; they run about, leaving the brood nest, to hang then at the edge of comb or at the entrance in group. In this respect, the bees from Fukuoka are more irritable than from Aomori and Kôchi.

The Japanese bees defend themselves against the ferocious enemy *Vespa mandarina,* which is a malignant foe of them in this country. *Mellifica* fights against the enemy, but receives nothiag else than disastrous damage, being massacred and annihilated; our Japanese bees behave themselves in this regards quite profitable, taking advantage of their timid character; they withdraw inside the hive, as soon as visited by the enemy, and hide themselves, so long as the latter watches. And, further, the offenders are balled and killed by the

bees, as soon as they dare to intrude the inside of the hive.

2. Wax Secretion and Comb-Building.

Our tribe of bee excels *mellifica*, as it seems to me, in the ability of wax-secretion. Their habit to leave their nest at trifle obstacles seems to stand in connection with this ability of the skillful builders; the cell wall of the combs is gnawn down when not satisfied and the old shallow comb-cells are very often found left unused. In this regard they stand in contrast to *mellifica* which are extremely tenacious to take care for the preservation and utilization of any combs. Peculiar it is that they are very often bearing in their wax pockets wax scales considerably thick, more than 1 mm in thickness, bulging outward the covering plates, while this is not so common in *mellifica*.

If supplied with food, our bees build combs readily in the warm climate when no honey is coming in from natural sources. The newly built combs are white or yellow in color and regular in shape and arrangement and of freshy appearance. The cell wall of the new comb is so thin that it is only 32 μ in thickness. The bees do not use propolis. They disregard mellific combs, when given to them, but use often as those of honey or sometimes as those for the drone brood. The comb foundations of mellific type are usually also disregarded, but rarely utilized by them, building up the cells narrowing the cell mouths; thus intermediate froms of cells are left here and there between the groups of the narrowed ones.

In the followings table I have endeavoured to compare the value of 3 diameters of one cell in the Japanese bee with those in *mellifica*.

TABLE III.

Diameter from side to side	Worker cells		Drone celle	
	Japanese bee (80 cells)	Dutch bee (120 cells)	Japanese bee (60 cells)	Dutch bee (30 cells)
1	4.65 mm	4.98 mm	5.42 mm	6.48 mm
2	4.62 "	4.18 "	5.37 "	6.45 "
3	4.68 "	4.15 "	5.25 "	6.40 "
Mean	4.65 "	5.10 "	5.36 "	6.45 "

From the above figures we see that the drone cells surpass slightly the worker cells of *mellifica* in dimensions.

Queen cells resemble in form those in *mellifica*; in one case I measured it is 18.7 mm in depth and is 9.8 mm in the maximum inside diameter.

It is well known in this country that wax dealers appreciate the Japanese beeswax owing to its superior quality. The chemical and physical properties are seen in the study by SHIBASAKI (1900).

3. On the Peculiar Pore of the Drone Cocoon.

As the characteristic of the drone cocoon comes next in consideration a fine circular pore which I have made out at the elevated out tip of it; it comes into view, when the nurse bees take off the waxy cap sealing each cell which covers the cocoon (Fig. 9). This pore is not detected in *mellifica* at all (Fig. 12), but in our bees it rudiment is already obvious in the cocoon just formed; it is inconspicuous at first, but is recognized at ease by artificial exposition of the tip of the cocoon.

The young drones come out, cutting round the outer cocoon wall circularly, so that it falls in circular disc (Fig. 10, 11). Seen on median transverse section through its pore (Fig. 13), the disc consists of about 10 layers of silky substance which are diminished in number towards the periphery, so as to decrease the disc in thickness, until its sharp edge is brought about. A dark brown substance of unknown matter is deposited along the inner surface of the layered structure just described: it is thicker near the passage of the pore and is thinned out towards the periphery, penetrating probably between lhe layers of the disc.

The pore is nothing other than the outer opening of the passage communicating the interior of the cocoon with exterier. The passage is a straight canal, but becomes constricted at the neck which is surrounded by the dark brown body, so as to be transformed into the funnel-shaped passage which is 0.4 mm in length, 0.4 to 0.6 mm in diameter at outer and 0.25 mm at the inner opening.

Instead of thin and loose structure of the cocoon wall in *mellifica*, it is of a considerable thickness in our bees; the reason why the pore of the cocoon is confined to the latter consists, as I dare to assume, in this thickness of cocoon

wall to facilitate the aeration in the inside of the small chamber.

CONCLUDING REMARKS.

A scope of the external features brought forth in the foregoing descriptions, among which the brown color of the mouth-parts, the distinct banding on the dorsal plates of the abdomen, the pale yellowish coloring of its ventral surface, the peculiar markings and the tibial projection of the drone legs as well as the criterion of the wing-venation are to be enumerated, are so characteriostic to the Japanese bee that it can not be classified with, but is put against *A. mellifica*. A new fact that the toment bands which are made out in the present investigation to be extended into the 6th abdominal segment, enforces furthermore us to assume this view.

What is the anatomical details concerned, there are a series of new facts of prime importance which have been added by the present investigation; in particular they are made out in the male copulatory organ. Striking is the constriction which marks off the proximal portion of the penis from its distal part. The simple thickenings of the penis wall is seen instead of the hard chitinous plates of the dorsal wall in *A. mellifica;* not unfrequently they are even nearly lost. The conspicuous structure is seen in the pneumophyses which are not only represented by the principal horns prolonged, but consists also of the 3 well developed accessory conical tubes of unequal length. The deep grooves separating the cross-ridges from one another as well as the characteristic spining on them and on the ventral quadrangular region stand back by no means to the new facts just mentioned. The palmated structure of the so-called doubly pinnate-lobed projection with the well-developed dorsal triangular region must be added to these important facts.

In the biological habitude of life there is a series of sharp contrast in which the Japanese bees stand to *A. mellifica*. First of all our bees are so coward and helpless that they are defeated, without intending a defence, by formidable offence turned by *A. mellifica* upon. The latter are in their turn offended and damaged by dreadful attack of wild wasps which are, however, powerless on the Japanese bees, because at the offence these shy creatures

retire into the inside of the box instead of risking the struggle and exterminate those fellows of the varacious enemy, which dare to intrude thereinto. It occurs not unfrequently that the cell wall of the old combs is gnawn down by themselves. They abandon their hive at trifle circumstance unfavorable for them; on the other hand, they are skillful in building the nest, each cell of which is in mean 4.65 mm in diamenter and 5.36 mm in depth for the drones, being the latter about equal to that of the worker cell of *A. mellifica*. They are often seen bearing so thick wax-scales, more than 1 mm in thickness in their wax-pockets. The worker bees do not intend to raise the queen either from fertilized egg or from worker larva and become fertile soon, when the latter is lost from their hive. It is, therefore, beyond doubt that a nest in which the queen is once lost, can never be maintained further, so that there happens nothing else than decomposition of the colony.

As further peculialities of the Japanese bees the forward direction of their heads at the entrance of the box, in which they are fanning, and the parts of the latter they rest at fanning are to be mentioned; the arrangement of the eggs along the midrib of the comb, in which they are deposited, is also a striking contrast to that in *A. mellifica*. The circlar pore at the front wall of the drone-cocoon is finally as one of the striking characteriostic of our tribe of bee.

All these prominent biological facts gathered from the facts described prove that our bees stand inferior to *A. mellifica* in the zoological scale and can accordingly be not taken together with, but are to be distinguished from the latter. It is, furthermore, reported and has been experienced by myself that crossing of our male and female with those of *A. mellifica* is unsuccessful.

In connection with the anatomical characteriostics, among which the construction of the male copulatory organ is worth of notice, the biological date just referred to afford us the ground which is strong enough to put the Japanese bees on it against *A. mellifica*. On the other hand, our native bees show a series of characteristics in common with *Apis indica*, as pointed out by recent observers such as KOSCHEVNIKOW (1900), v. BUTTEL-REEPEN (1906) and others. FRIESE (1920, 1922, 1923) puts *indica* among *A. mellifica*, but only because his view advanced in order to condense the conception of the species. The results

of the present investigations are, therefore, proved not only to have elucidated the anatomical and biological details which have yet remained obscure, but also to afford the absolutely solid ground, on which the variety of *A. indica* is established for the Japanese honey bee.

LITERATURE

BENTON, F., 1896: The Hony Bee, a Manual of Instruction in Apiculture. Washington.

BINGHAM, C., 1897: The Fauna of British India. Hymenoptera, Vol. 1. London.

BISHOP, G. H., 1920: Fertilization in the Honey Bee. 1. The Male Sexual Organs: Their Histological Structure and Physiological Functioning. Jour. Exp. Zool., Vol. 31, No. 2, pp. 225–265.

BLANFORD, E. J., 1923: Chinese Bee. Americ. Bee Jour., Vol. 63, No. 7, July, pp. 343–344; No. 8, August, pp. 405–406.

BUTTEL-REEPEN, H. v., 1906: Apistica, Beiträge zur Systematik, Biologie, sowie zur geschichtlichen und geographischen Verbreitung der Honigbiene (*Apis mellifica* L.), ihrer Varietäten und der übrigen Apis-Arten. Mitt. zool. Museum Berlin, 3. Bd., 2. Ht., pp. 119–201.

_____, 1915: Leben und Wesen der Bienen. Braunschweig.

_____, 1918: Einiges über Bienenrassen. Bienenwirtsch. Zentralbl., Nr. 23/24, Hannover. s. ZANDER, 1921: Das Leben der Bienen, Stuttgart, p. 10.

DEEGNER, P., 1913: Geschlechtsorgane. SCHRÖDERS Handbuch der Entomologie, Bd. 1, pp. 467–523.

DRIEBERG, C., 1922: Indian Bees. Bee World, Vol. 3, No. 12, May, pp. 291-292.

FABRICIUS, J. C. 1798: Supplementum Entomologiae. Systematicae, No. 59.

FRIESE, H., 1920, 1922: Die verschiedenen Rassen der Honigbiene. In LUDWIGS Unsere Bienen. 1920, 1922.

_____, 1923 Die europäischen Bienen (*Apidae*), das Leben und Wirken unserer Blumenwespen. Berlin u. Leipzig.

GERSTÄCKER, A., 1862: Über die geographische Verbreitung und die Abänderungen der Honigbiene nebst Bemerkungen über die ausländischen Honigbienen der alten Welt.

GHOSH, C., 1920?: CLARIDGES, Differentiating Races of Bees, Bee World, Vol. 2, No. 5/10, Oct. 1920–Apr. 21, pp. 119–120.

GOLDING, C. G., 1921: The Native Chinese Bee. Americ. Bee Jour., Vol. 91, No. 2, Feb., pp. 61–62.

GOUGH, L. H., 1916: Notes on the Egyptian Honey-Bee. Bulletin Soc. Entom. d'Egypte, No. 1, pp. 22–32.

KOSCHEVNIKOW, G. A., 1891: Zur Anatomie der männlichen Geschlechtsorgane der Honigbiene. Zool. Anzeiger, Bd. 14.

———, 1900: Beiträge zur Naturgeschichte der Biene *(Apis mellifica* L.). Zool. Zentralbl., Nr. 12/13, 1901.

MATSUMURA, S., 1911: *Illustrated Thousand Insects of Japan (in Japanese).* Supplement 3. Tokyo.

MICHAELIS, G., 1900: Bau und Entwickelung des männlichen Begattungsapparat der Honibiene. Zeit. für wissen. Zool., Vol. 67.

RADOSZKOWSKY, O., 1887: Hyménoptères Korée: BUTTEL-REEPEN (1806).

SHAFER, G., 1917: A Study of the Factors which Govern Mating in the Honey Bee. Michigan Agr. Coll. Exp. Stg., Div. of Entom, Techn. Bulletin 34.

SHIBASAKI, S., 1909: *on the Japanese Beeswax (in Japanese), Kôgyoshikenjo-hôkoku,* 1909, No. 4, pp. 157–165, Tokyo; LEWKOWITSCH, J. and WARBURTON, G. H., 1922: Technology and Analysis of Oils, Fats and Waxes, Vol. 2, Ed. 6, p. 942, London.

SMITH, F., 1861: BUTTEL-REEPEN (1906).

SNODGRASS, R., 1910: The Anatomy of the Honey Bee. U. S. Dept. Agr., Bureau of Entom. Techn. Series 18. Washington.

TAMARI, Y., 1889: *How to Improve the Bee-Culture (in Japanese).* Tokyo.

ZANDER, E., 1901: Beträge zur Morphologie der männlichen Geschlechtsanhänge der Hymenopteren. Zeit. wissen. Zool., Bd. 67, pp. 461–489.

———, 1922: Der Bau der Biene. Stuttgart.

EXPRANATION OF PRATES

List of Abreviations

a. alighting board of the hive.
b. hair band of 6th segment.
c. constriction.
j. projection.
k. marking.
l. lobed projection.
m. brown mass.
o. prore.
p. pneumophyses:
  1. principal horn.
  2. main branch.
  3,4. side branches.
q. ventral quadrangular region.
r. cross striped ridges.
  1. proximalmost ridge.
s. symmetrical chitinous plates or slight thickenings of penis wall.
t. dorsal triangular region.
w. vertical wall of the hive.

Plate I

Fig. 1. Individual of Japanese worker bee, abdomen distended, from right side. × 2.5
Fig. 2. Do., bearing a brownish markings on the 2nd segment, dorsal view. × 2.5
Fig. 3. Venation of hind wing, Japanese worker. × 6.6
Fig. 4. Do., Japanese queen. × 6.6
Fig. 5. Do., Japanese drone. × 6.6
Fig. 6. Do., Japanese bee fanning at the entrance of a hive.
Fig. 7. Hind leg, Japanese drone. × 5
Fig. 8. Do, Dutch drone. × 5

Fig. 9. Pore of drone cocoon, exposed by nurse bees, scraping off waxy cover, natural size.

Fig. 10. Scaly cocoon discs cut down by emerging drones themselves, natural size.

Fig. 11. A cocoon disc magnified; Japanese bee. × 5.5

Fig. 12. Do., Italian bee. × 5.5

Fig. 13. Median transverse section of cocoon disc × 16

Plate II

Fig. 14. Copulatory organ of Japanese drone, protruded, lateral view, bearing group of minute outgrouths of distal penis wall. × 9

Fig. 15. Do., showing nearly total absence of minute outgrowths on penis wall. × 9

Fig. 16. Copulatory organ, Dutch drone, everted state. × 7.4

Fig. 17. Do., Japanese drone, resting state. × 11

Fig. 18. Do., Dutch drone. × 7.7

Fig. 19. Do., Egyptian drone. × 7

Fig. 20. Penis-bulb spreaded out, to show distribution of minute outgrowths on penis wall in Japanese drone, dorsal view. × 15

Fig. 21. Pinnately-lobed projection, Japanese drone, facial view. x 10

Fig. 22. Do., Dutch drone. × 10

Fig. 23. Pneumophyses, Japanese drone, resting state. × 11.5

Fig. 24. Do., everted state. × 12.7

摘　　要

本研究ハ日本土產蜜蜂(以下之ヲ日本蜂ト稱ス)ノ利用ヲ圖ランカ爲メニ、先ツ其ノ特徵及特性ノ他種ニ比シテ顯著ナル差異ノ存スル諸點ヲ明ニシ、且ツ其ノ分類學上ノ位置ヲ確立セントシタルモノナリ。

抑モ日本蜂ニ就テハ玉利氏(1889 其ノ他本部諸家ノ之ニ關シ記載セル無キニ非ルモ、之カ分類學上ノ位置ニ付キ初メテ手ヲ染メタルハRadoszkowsky (1887) ヲ以テ嚆矢トス。即チ氏ハ之ヲ Apis mellifica L. var. Japonica Rad. ト命名シ、依テ以テmellifica種ノ一變種ト認メタリ。然ルニ von Buttel-Reepen (1906)ハ先ツmellifica種ヲ分チテmellifica, unicolor, indicaノ三亞種トナシ、Apis mellifica st. indica-japonica Rad. ト命名セリ。即チ氏ハ日本蜂ヲ indica ノ一變種トナシタルコトニ於テ R. 氏ト異ナルモ、此 indica ヲ mellifica ノ一亞種トナシタルカ故ニ、氏モ亦日本蜂ヲmellifica 種ニ編入シタルモノト謂フヘシ。

元來indicaヲ獨立ノ種トナシタルハFabricius(1798)ニシテ、Bingham(1897) 松村氏(1911)亦之ヲ採用シ v. Butte-Reepen ハ 1906年ニ於テ前記ノ如ク之ヲ mellifica 種ノ一亞種トナシタルモ、1915年、1918年ニハ同シク之ヲ獨立ノ種トナセリ。獨リFriese (1920) ハ依然トシテ indica ヲ mellifica ニ包含セシムヘキコトヲ主張シ、此意見ハ1922年ニ至ルモ變ラズ。斯ノ如ク論義ノ一致セサルハ indica ノ特徵カ未タ十分明瞭ナラサルニ因ルモノニシテ、之カ爲メニナホ分類學諸家ヲシテ、例ヘハ Bingham (1897) ハ亞非利加產 umicolor ヲ indica ノ變種トナシ、Smith (1861) ハ Sinensis ヲ mellifica ノ變種トセルカ如キ誤謬ニ陷ラシメタリ。

本著者ハ日本蜂標品ヲ各地ヨリ蒐集シ、且ツ數地方ヨリ其ノ蜂群ヲ得テ自ラ飼養ヲ試ミ、更ニ朝鮮、支那、等ヨリ其ノ土產密蜂ノ標品ヲ得、一方ニ於テハ歐羅巴產 mellifica ノ內 Carniolan, Italian, Dutch Bee 等ヲ飼用シ、又亞非利加產 unicolorノ標品ヲ得、以テ彼此相比較シ、其ノ間極メテ顯著ナル差異ノ存スルコトヲ明ニシ、斯學ノ欠陷ヲ補フヲ得ルニ至レリ。以下其ノ概要ヲ記サントス。

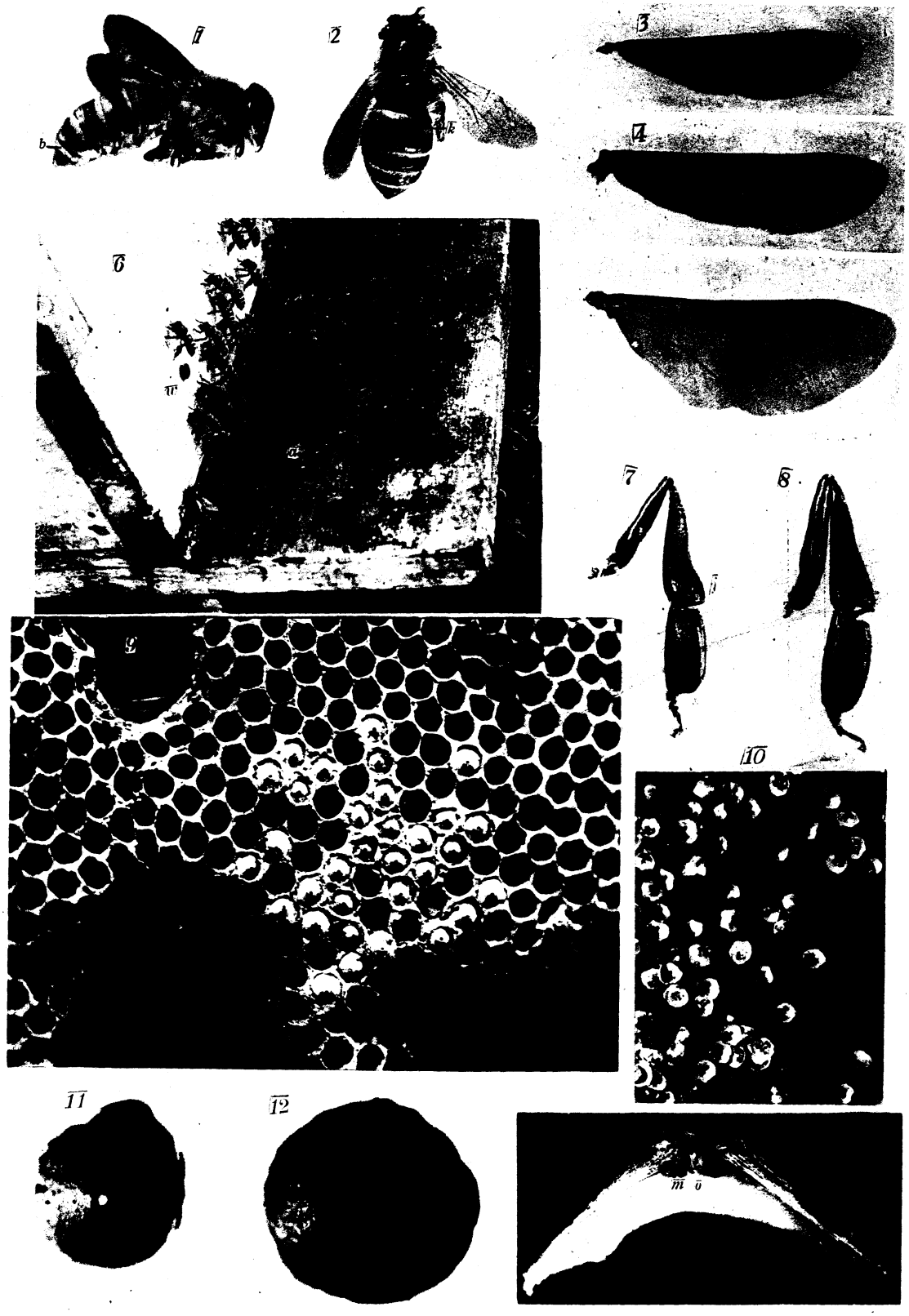
日本蜂ノ体色ニハ其ノ黑色ト相介在セル褐色ノ標徵アリ。其ノ常存スルモノハ口部ノ錆赤色ヲ呈スルコト、腹板ノ淡黃ナルコトノ外、背板各葉ノ前半カ褐色ニシテ後半黑色ナルコトナリ。而シテ屢〻存在スルモノニハ、第二

ニ於ケルヤヤ大形ノ褐斑、第三肢脛節外緣中央ノ褐條、肢ノ基部數節殊ニ其ノ內面ノ淡褐ナルコト等ヲ擧クヘシ。被毛ニ就テハ頭頂ニ叢毛尠シトスルノ說ハ謬ニシテ、第六腹環節背板ニ必ズ一毛條ヲ存スルハ mellifica トノ大ナル差異點ナリトス。日本蜂ノ後翅ニ於テ肘肌ガ中室ヲ越エテ延長スルコトハ朝鮮、支那產ニ於ケルト同樣ナリ。日本蜂ノ働蜂ハ体長 10–13mm, 王蜂 13–17 mm, 雄蜂 12–13 mm ナリ。働蜂ノ舌ノ長サハ 3 mm ニシテ、即チ Italian ノソレヨリモ約 0.5 mm 短シ。雄蜂ノ第三脛節外緣末端ノ凸隆スルハ事實ナリ。雄蜂ノ生殖器ハ日本及支那產ノモノニ於テ相一致シ、又歐羅巴及埃及產ノモノ亦相一致シ、而シテ此二組ノ間ニハ顯著ナル差異アリ。先ツ其ノ体外ニ突出スル時屈曲ノ度ハ日本蜂ノ方鈍角ヲ呈ス、mellifica ニアリテハ陰筒ノ脊面ニ著ク發達セル對稱キチン板 (Symmetrical chitinous plate) アリ、日本蜂ニアリテハ之ヲ缺クノミナラス該部ニ近ク括ビレアリ。mellifica ニ於ケル羽狀突起 (Doubly pinnate-lobed projection) ハ日本蜂ニアリテハ掌狀ヲ呈ス。又橫隆 (Cross-ridges) ハ mellifica ニ於ケルヨリモ各ノ間ニ深キ溝アリ、且ツ其ノ最基端ノモノ其ノ棘毛ト共ニ最モヨク發達シ、末端ニ進ムニ從ヒ漸次微ナリ。下面方形板 (Ventral quadrangular plate) ハ mellifica ニアリテハ其ノ次ニ位スル橫隆ト顯著ナル溝ニ依リテ境セラルヽノミナラズ、其ノ棘毛ヨリ發達セルニ反シ、日本蜂ニアリテハ橫隆ノ最基端ノモノト連續シ且ツ棘毛モ著シカラス。脊面三角板 (Dorsal triangular plate) ハ日本蜂ニ於テハ mellifica ニ於ケルヨリモ比較的大形ニシテ其ノ棘毛モ多シ。又囊狀突起 (Pneumophyses) ハ日本蜂ニ於テハ分岐スルヲ特徵トシ、其ノ主要部ハ体內ニアルトキ 5–6 mm ニシテ甚ダ長ク、之カ体外ニ突出スルトキハ三對ノ小突起ヲ其ノ基部ニ副生ス。

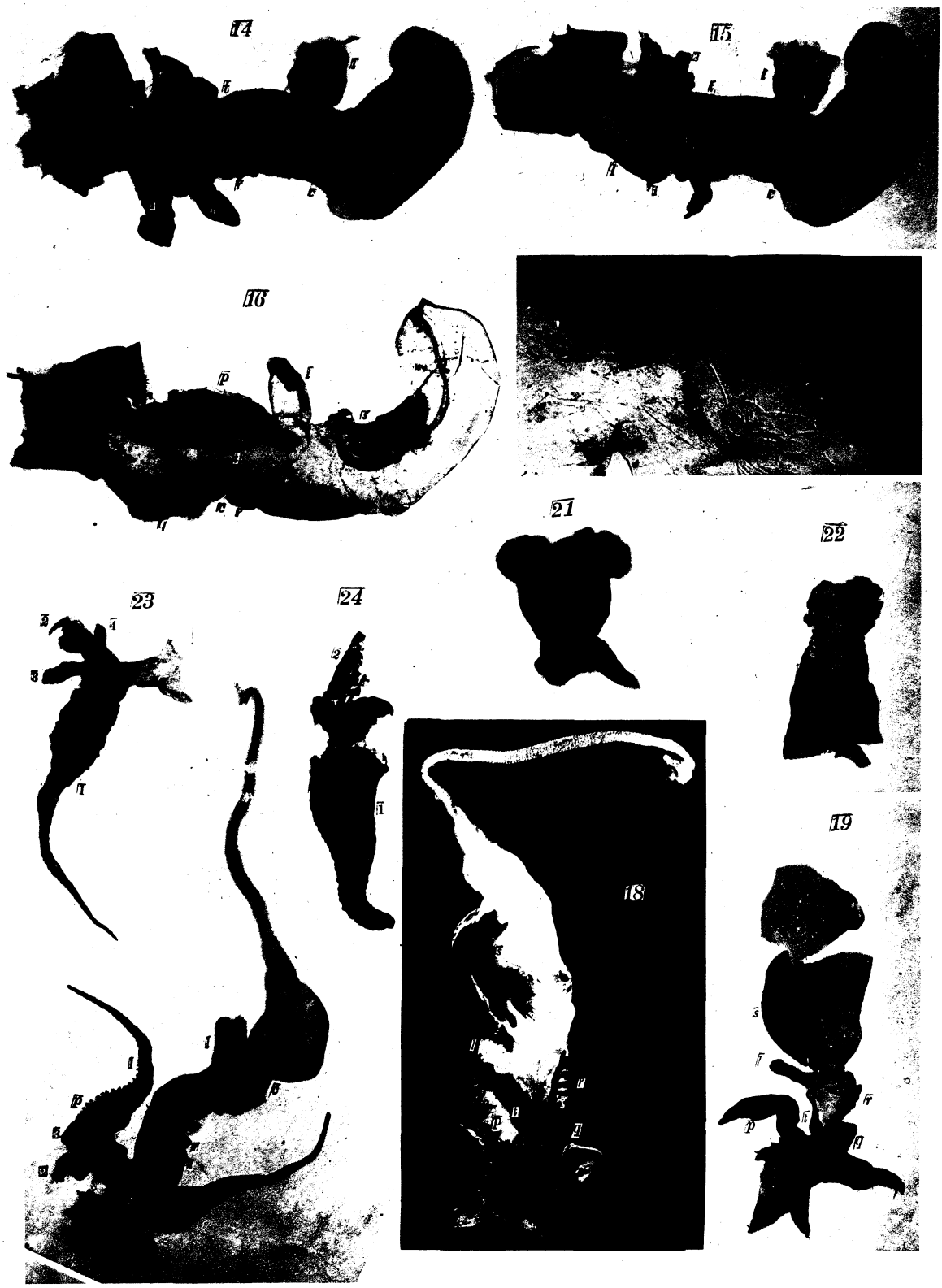
生態學的特徵トシテ數フヘキモノ多々アルモ、就中日本蜂ハヨク逃去スル如キ、或ハ巢門ニ於テ mellifica ト反對方面ノ体位ヲ持シテ煽風スルカ如キ事實ノ外、ナホ日本蜂ハ無王トナルトキ働蜂卵蛆ヨリ王蜂ヲ養成スルコトヲナサスシテ自ラ產卵スルニ至リ、而モ往々ニシテ此無精卵ヨリ生セル蛆ノ上ニ一時的王臺ヲ設クルカ如キ、又王蜂ノ翅ヲ一部剪ルトキハ久シカラスシテ其ノ亡失ヲ見ルカ如キ、又王蜂ノ產メル卵ハ初メヨリ橫臥セルカ如キ事實アリ。日本蜂ハ又性怯懦ニシテ刺戟ニ應シテヨリ一齊ニ短キ翅音ヲ發シ、刺戟强キトキハ巢面ヲ去リテ一方ニ集合シ、又害敵ニ對シ突進スルヨリモ寧ロ之ヲ避クル傾キアリ、螫サヾルニハ非ルモ又幾分嚙ム性アリ、mellifica ノ侵入ニ對シテハ强ク防禦セス既ニ內部ニ入リタルモノニ對シ殆ト關知セサルノ態度ヲトリ貯蜜ヲ奪ハレテ遂ニ全滅スルニ至ル。つゞりむしノ害ヲ受クルコト甚シク、

すゞめばちノ攻擊ニ對シ隱匿シテ其ノ危難ヲ免ルヽノ點ハ mellifica ノ擧措ニ比シテ有利ナルコト既ニ知ラルヽ所ナリ。又日本蜂ハヨク巢脾ヲ嚙ミ破リ、或ハ房壁ヲ削レルモノヲ殘存ス。容易ニ蠟ヲ分泌スルノ性ハ一ノ長所ニシテ、其ノ腹板下ニハ屢ヽ 1mm 以上ノ厚キ蠟鱗ヲ見受ケラル。蜂膠 (propolis) ヲ用ヒス。又房壁甚タ薄ク僅ニ 32μ ニ過キス。巢房小ニシテ働蜂房ハ直徑(邊ヨリ邊ニ至ル)、4.65 mm、雄蜂房ハ 6.36 mm mナリ、即チ雄蜂房ノ大サハ mellifica ノ働蜂房ノソレト相近シ、又日本蜂ノ蠟ハ mellifica ノモノト其ノ化學的及物理學的性狀ニ於テ差異アリ。殊ニ面白キハ日本蜂ノ雄蜂蛆カ成熟シテ結繭スルトキハ其ノ繭ノ房口部ノ中央ニ小孔ヲ設クルコトナリ。雄蜂出房スルトキハ此ノ孔ヲ有スル繭ノ一部ハ小圓板狀ヲナシテ落ツ。該孔ヲ貫キタル繭ノ斷面ヲ見ルニ孔邊ニ近キ所ハ絹層凡ソ十層アリ、漸次周邊ニ向ヒテ其ノ層ヲ減ス。內口緣ニ暗褐色ノ物質ヲ堆積シ、此物質ハ絹層間ニ滲入シテ之ヲ堅緻ナラシム。孔ハ深サ約 0.4 mm、外口直徑、0.4–0.6 mm、內口直徑 0.25 mm ノ漏斗狀ヲナセルモノニシテ、內外空氣ノ流通ニ資セルモノヽ如シ。mellifica ノ繭ニハカヽル小孔ヲ認メサルノミナラス繭層モ亦日本蜂ノソレノ如ク厚カラス、弛緩シテ氣通容易ナルモノヽ如シ。

之ヲ要スルニ日本蜂ノ此等ノ特徵ハ明カニ mellifica ト區別セラルヘキコトヲ證スルモノニシテ、日本蜂ハ朝鮮、支那等ノ產ト相一致シ、又諸家ノ指摘セル indica ノ特徵ヲ有ス。即チ日本蜂ハ indica ノ中ニ編入セラルヘク、又 indica ハ mellifica ト對立スル獨立ノ種タルコトヲ斷定スルヲ得ヘシ。亞非利加產 unicolor ハ屢ヽ indica ト近緣ノ如ク考ヘラレシモ今ヤ此ノ兩者ノ間ニハ截然タル解剖學的區別ヲ存シ、mellifica ト unicolor トノ關係ハ mellifica ト indica トノ關係ノ如ク相隔リタルモノニ非ス。



Y. Tokuta photo.



Y. Tokuta photo.