An Attempt to rear the Japanese Bee in a Framed Hive (Studies on the Japanese Honeybee, *Apis cerana cerana* Fabr., IV)[1)]

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(With 4 Text-figures)

The native honeybee of Japan, *Apis cerana cerana* Fabricius, has been continuously reared in this country since far before the introduction of modern apiculture using the European bee, *A. mellifera* L. Even before the opening of Japan to the Western civilization, a relatively developed apicultural technique had existed. But, most of the colonies have been reared in primitive hives such as wooden boxes, log or barrel ones (Akahira & Sakagami 1958). Removable frames were never employed and the honey was simply extracted by separating some combs from the hives and by pressing or boiling them, which caused naturally a considerable damage of colonies. In South Asian countries, the use of framed hives for *A. cerana indica* has been repeatedly attempted and is now well established (Franssen 1931, Presswalla 1934, Muttoo 1956). Nevertheless, such a tentative was practically not established in Japan, in spite of sporadic attempts by certain enthusiastic keepers. This is mainly due to the rapid extension of *A. mellifera* in this country and the consequent alteration of economic values between two species. However, the Japanese bee possesses various favourable characters in comparison with the European sister. The comparative study of these closest relatives is, therefore, important from both the scientific and practical points of view. And this can be only sufficiently made by rearing *A. cerana cerana* in a framed hive. For this purpose, in the present paper, a system for the rearing of this species in a framed hive will be briefly described. This was chiefly developed by Kouta, in close collaboration with Sakagami. Before going further, the writers should like to express their cordial thanks to Dr. Y. Tokuda for his kind technical advices, and to Prof. Tohru Uchida, for his constant encouragement to the writers' studies.

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1. Frame and hive employed

Apis c. cerana can be successfully reared in a standard hive, as far as several precautions are observed. Various biological observations made by Sakagami (in press) were mostly based upon the colonies forced to live in Langstroth hives. But, tnis hive seems to be too large and less suited for the appropriate management of colonies than the type described herewith.

Dimensions and general appearance of frame and hive-parts are illusrated

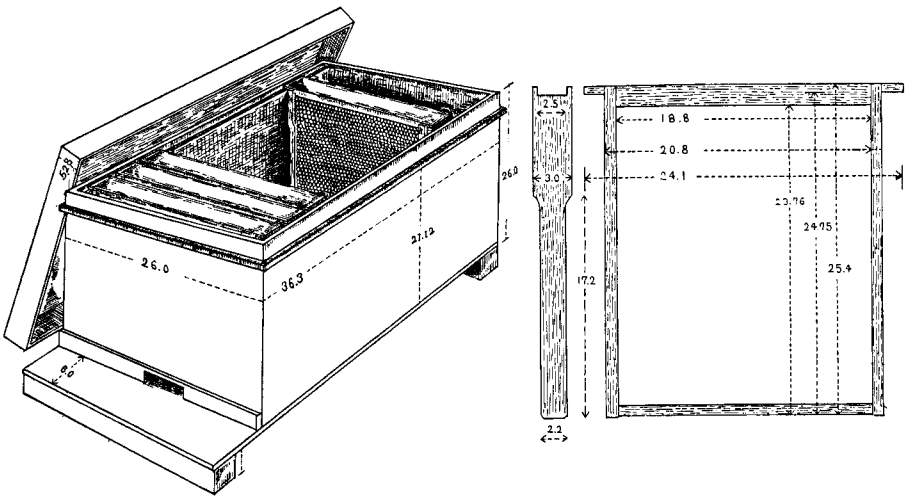

Fig. 1. Dimensions of hiva and frame used for *cerana* colonies.

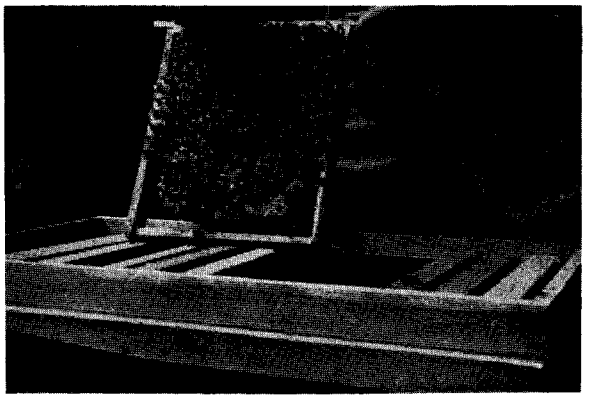

Fig. 2. Hive and frame for *cerana* colonies.

in Figs. 1 & 2. The width of top bar (2.5 cm) approximately corresponds to the doubled mean depth of *cerana* comb cells. Frames of much larger sizes can be accepted by colonies, but, for the honey production, they are often less profitable because of the fragile nature of *cerana* combs. The height of Hoffman style side bars was determined by the width of extractor baskets used for Langstroth combs, although well developed natural combs often reach 30 to 40 cm in height. Dimensions of hive body were naturally determined by those of frames. Fig. 2 (left) illustrates a hive containing 10 frames such as described above. The bottom piece is separable; this is essential in order to render possible the removal of wax moth-nests, which accumulate in *cerana* hives much more than in *mellifera* ones. The entrance can be situated either in parallel with, as seen in the figure, or in indirect alignment to the row of frames.

2. Transferring colonies into framed hives

As most of the colonies of *cerana* are reared in frameless hives, some precautions must be mentioned here to be observed when one is transferring them into the hive described above. At first, the received framless hive must be firmly fixed or hung at the top. The bottom piece, then, one of the side pieces which is relatively free from the nest body, are carefully removed. After inspecting the comb arrangement, other side pieces are also removed, with the minimal damage to combs. Nextly, each comb is separated one by one in the beginning from the two outermost ones, after the bees attached to them are driven away by mears of mild blowing, spraying or stimulation with a fine stick. As *cerana* workers are far more sensitive to such stimuli than *mellifera* ones (Sakagami, in press), they readily abandon the treated comb and escape into the central ones. The separation is done by means of a heated knife, the separated combs are fixed to the frames by melted wax. In the case of central larger combs, they are fixed not only to the frames but also to a wire stretched between the side bars.

When several combs were thus separated and fixed to the frames, the bees are driven away into the new frames, by inserting the latters into the original hive. It is naturally desirable to transfer the queen into the new hive as soon as she is discovered. After all the combs are fixed to the frames and the bees are transferred, the bees remaining inside the old hive are shaken into the new home.

If a comb contains a considerable stored area, the latter must be cut off and only the remaining half is attached to the frame, because the stored area is difficult to be fixed firmly to the frame, due to its weight and fragile nature. The stored honey is readily transferred by the workers into the new hive. When a fairly large colony is transferred into the new hive, special attention must be paid in order not to damage the combs. It is advisable, therefore, that the removed combs should be propped up by an obliquely held plate when transferred, to prevent any breaks down caused by the treatment.

During several days after transferring, the new hive must be daily inspected

to repair the torn off combs. It is essential to feed abundantly the new hive, for the sake of recovery from the inevitable shock caused by the transferring.

3. Miscellaneous remarks on routine management

As far as surplus storage exists in the hive, *cerana* colonies require little care. As is well known (Tokuda, 1924, Sakagami, in press), *cerana* are excellent comb builders; they build new combs even in the seasons out of honey flow. They show a distinct preference to newly built combs (Sakagami, in press; Tokuda 1924) and often abandon the older ones. This tendency is particularly clear in oviposition. The eggs are often laid in half-built cells less than 1 mm in depth.

They show also a distinct avoidance of *mellifera* combs and comb foundations. These are, if inserted, either simply neglected or gnawed down. It is advisable to give them not a foundation plate of full size but a piece of it cut about 2–2.5 cm in height, as the basis of first orientation in comb bulding (Sakagami, in press).

They are so sensitive to mechanical shocks that a special caution must be taken at hive inspection, especially when the hive is opened. As mentioned above, it is relatively easy to drive away the bees attached to the combs. In the case of old, firm combs, the attached bees can be removed by a violent shake of the comb as in *mellifera*. But the combs are often so fragile that it is better to remove them by means of a mild blow or continuous striking with a fine stick. As *cerana* workers have no consistency to remain in the combs, all the bees stream out by these mild stimulations into the other combs, in following a few bees which initiated the movement.

4. Honey extraction

When the colony has become sufficiently strong, another hive body is inserted under the original one. Three to four brood combs are, together with the queen, transferred into the lower story. The empty spaces in both bodies are filled with wired frames. When the combs in the lower story were filled with honey, they are transferred into the upper story. Using the excluder inserted between the two stories, the queen is confined to the lower one, and the honey is extracted only from the upper story. The excluder is made of bamboo sticks, 3 mm in diameter and 4 mm apart in distance.

Each honeyed comb is, by means of a strong wire bent rectangularly at the tip, inserted into the extractor baskets. As the new combs are very fragile, it is better to extract only from combs in which the bees have reared their broods at least more than once. After having been extracted, the combs are returned to the hive, the arrangement is adjusted a few days later. The extraction must be stopped before the end of honey flow. Thereafter, the hive must not be disturbed too frequently. Occurrence of surplus storage and removal of wax moth nests are two essentials to maintain the healthy conditions of after flow colonies.

5. Swarming

It is often said that the Japanese bee is apt to swarm. But, this seems to be partly due to the confusion of true and absconding swarms, the latter being a characteristic of all the bees belonging to the Asiatic honeybees. In the normal colonies without laying workers, the drones are relatively rare in the non-swarm seasons. Their appearance, together with the filling up of combs by stores and broods, indicates the commencement of swarm heat.

The queen cells are built in the lower margin of the central combs as in *mellifera*. The subsequent processes show, however, a peculiarity of this species (Fig. 3). First, the queen cells are distinct (a), but they became gradually less conspicuous because of an intensive building of worker cells around them. Often the space between the queen cell and the surrounding worker cells is filled with wax. Consequently, the queen cells are occasionally overlooked unless there is careful examination (b). However, after cocoon spinning of the queen larvae is finished, the cells became again conspicuous by the removal of outer waxy cover by workers (c).

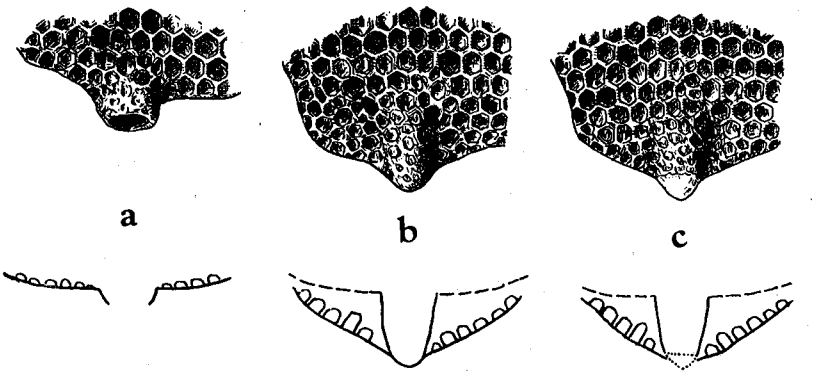

Fig. 3. Development of a queen cell (from a to c).

As already mentioned previously, the swarm of *cerana* chooses, in contrast to that of *mellifera*, a rather broad substratum when forming the initial cluster (Akahira & Sakagami, 1958, Sakagmi, in press). The swarm clusters are transferred into new hives as in *mellifera* ones. However, to multiply the number of colonies, it is naturally better to prevent the swarm issue and to divide the mother colony into daughter ones of which the number is determined by the breeder's plan, based upon the number of queen cells and strength of mother colony. In order to let the about equal amount of homing bees be absorbed in the new dnaghter colonies, the hives must be arranged side by side at the site where the mother colony had

been previously located. The latter must be placed in a quite remote site, to prevent the drifting in of virgin queens, which may kill their mother.

In all seasons, the orphan colonies must be united to queenright ones as soon as discovered, because it is difficult to obtain the emergency queen cells from the orphan colonies of *cerana*. When dequeened, the workers of this species rapidly transform the laying workers (Akahira & Sakagami 1958, Sakagami, 1958, in press). Later, the emergency queen cells are constructed but they usually contain drone broods. Colony uniting is relatively easier than in *mellifera*, but it is preferable to feed both colonies to be combined before or at the time of uniting.

6. Robbery

As far as surplus storage occurs, there is no danger of the development of robber bees. If both *cerana* and *mellifera* colonies are reared in the same apiary, however, usually it is the former species to initiate this malignant behaviour, and also to succumb for the same cause at a time of honey dearth. The *cerana* robbers are less aggressive but extradordinarily pertinacious in comparison with *mellifera* ones. When a robber bee just attempting to intrude the victim hive is prevented by the finger tip, *mellifera* robbers usually retreat and do not try to override this barrier. On the other hand, *cerana* robbers are often completely indifferent to such disturbance and attempt persistently to intrude into the hive. To exterminate this detrimental activity, it is essential to find the colony from which the robbers issue. This is detected by a peculiar wing noise of robbers and abnormally active in- and outflying at the hive entrance. The robber activities are inhibited by the installation of an excluder acting unilaterally in front of the robber colony. Thereafter, such a colony is translocated to a remote place at least more than 2 km apart, which seems to be the limit of effective flight range of *cerana* colonies. The colony must be returned to the original site only after the extermination of the robbing tendency by means of surplus feeding.

On the other hand, the setting of the colonies of two species side by side in the honey dearth seasons must be avoided, because it is, in all probability, catastrophic to the *cerana* colonies once *mellifera* develop the robbing tendency, because of the more powerful and aggressive nature of the latter species (Sakagami, in press).

7. Enemies

Wax-moths, both large and lesser species, European honeybees and the giant hornets are three major enemies of *cerana* colonies (Akahira & Sakagami 1958, Sakagami, in press). Moreover, spiders and ants may occasionally cause a considerable damage to them. As *cerana* is far less resistant to the wax-moths than *mellifera*, it is important to clean repeatedly the bottom piece of the hive and to destroy the mothnests by smoke flame.

8. Absconding

From the standpoint of apiculture, one of the most troublesome characters of *cerana* is surely its tendency to develop the absconding swarm. This is caused by 1) Food shortage either due to honey dearth or being robbed, 2) Absence of broods or abnormality in queen reproductivity, 3) Unsuitable nest site, and often 4) Various still undetectable reasons. Occasionally, the absconding is predicted by the abnormal confusion of workers at hive inspection, or by the persistent attempts to intrude into the human habitations. In these cases, it is desirable to detect the existence of causes mentioned above, although often this cannot sufficiently prevent the escape once attempted.

It is a curious fact that in either true or absconding swarms, *cerana* often chooses a definite site for the formation of the first cluster. For example, one escaped colony attached three times in one and the same place, underneath the trans-case of an electric pole, about 5 m above the earth surface and about 30 m from the nest site. In another case, the root slit of a pine tree was preferred twice by one and the same colony, of which the nest was situated about 20 m distant from the tree.

9. Hibernation

At least under the temperate climate, the hibernation of *cerana* coloinies

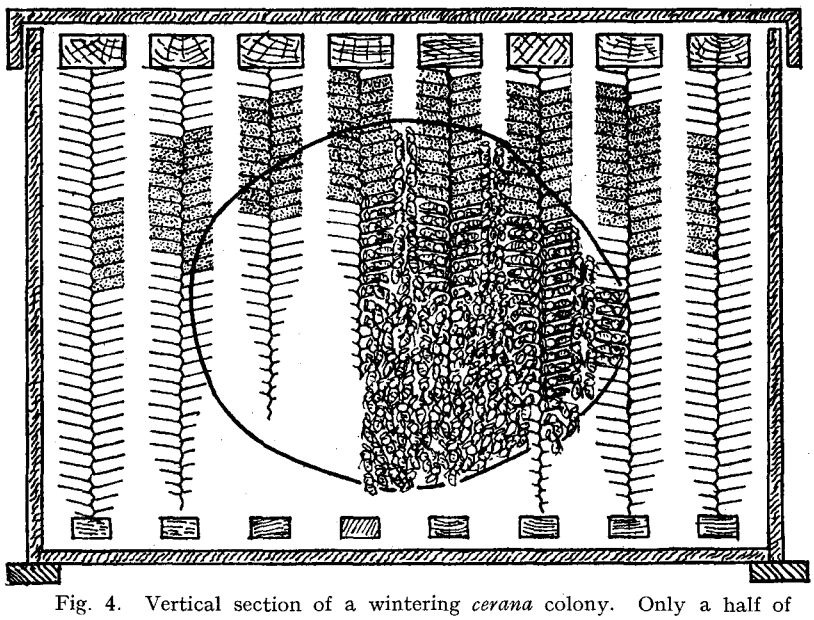

Fig. 4. Vertical section of a wintering *cerana* colony. Only a half of winter cluster is schematically represented.

requires little cautions. Only a simple package by strawmatting and constriction of entrance is sufficient for the healthy wintering, although surplus storage is naturally indispensable. They seem to be much more resistant to cold conditions, as often active in- and outflying are observed at the entrance in such cold days that *mellifera* colonies do not show any outer activities. Inspecting the wintering colonies, there is found, not always but often, a peculiar habit of this species. Especially in strong colonies, the lower half of each central comb is gnawed down as seen in Fig. 4. Consequently, the winter cluster is, in this case, not separated by combs as in *mellifera* one, but form a compact worker mass at least in the lower half. It is well known that *cerana* workers constantly gnaw down the comb surface.—At a glance, this habit seems to be an unnecessary, in connection with the multiplication of wax-moths, rather harmful character, although it is compensated by their excellent wax-producing ability. However, it is conceivable that this habit is favorable in the wintering from the standpoint of heat economy.

Summary

In the present paper, a system for rearing of the Japanese honeybee, *Apis cerana cerana* Fabricius, using a framed hive was briefly described, together with some additional notes on the biological peculiarities of this species.

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