ROTHAMSTED RESEARCH

The Cause and Control of Swarming in Bees

Full Table of Content


THE CAUSE AND CONTROL OF SWARMING IN BEES

SIR E. J. RUSSELL, D.Sc., F.R.S.

ROTHAMSTED EXPERIMENTAL STATION

Xx. The Cause and Control of Swarming in Bees

Sir E. J. Russell

Sir E. J. Russell (1935) *Xx. The Cause and Control of Swarming in Bees ;* The Cause And Control Of Swarming In Bees, pp 1 - 31 **- DOI: https://doi.org/10.23637/ERADOC-1-212**

20

THE CAUSE AND CONTROL OF SWARMING IN BEES

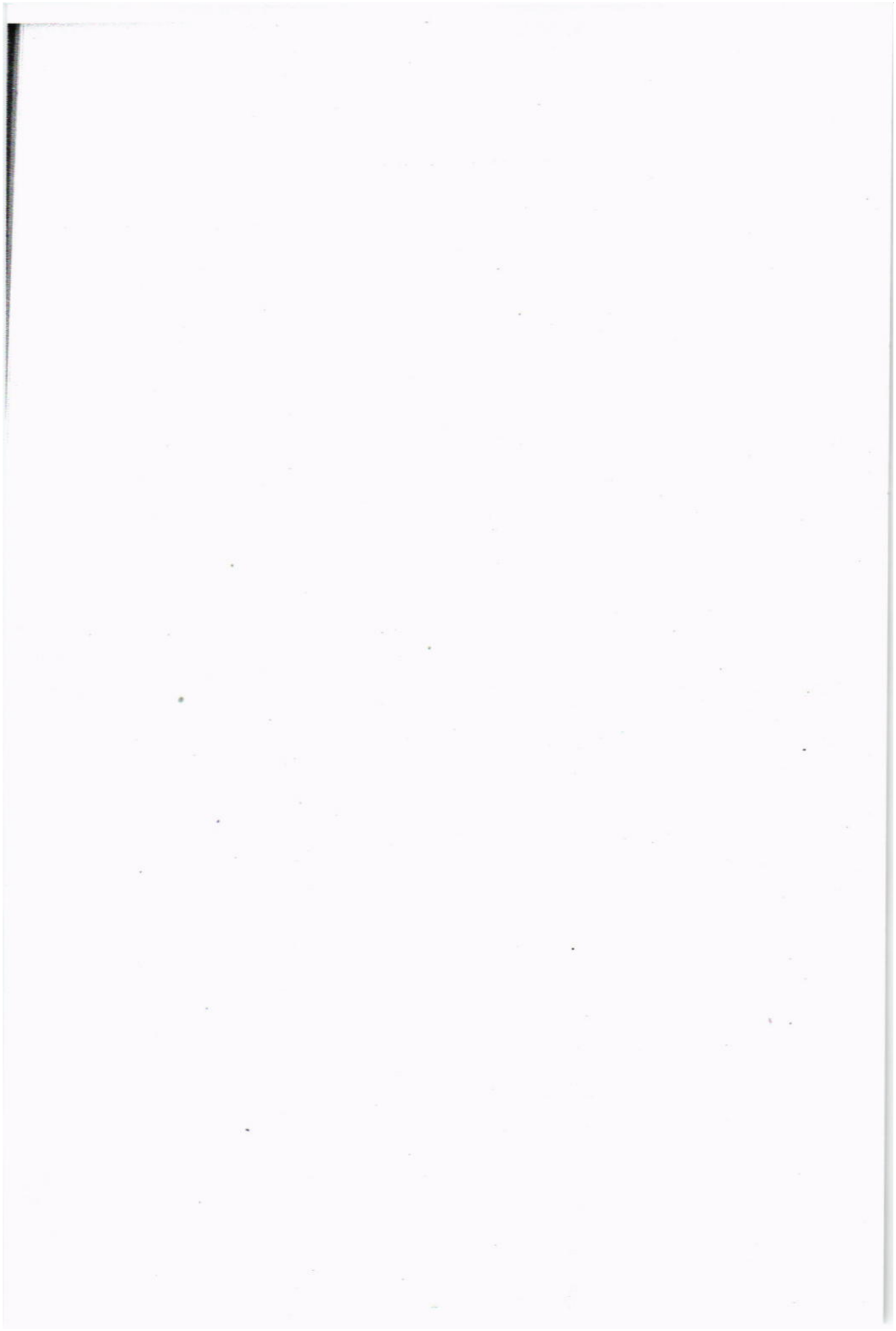
BEING THE REPORT OF A CONFERENCE HELD AT ROTHAMSTED ON APRIL 27th, 1935, UNDER THE CHAIRMANSHIP OF

SIR E. J. RUSSELL, D.Sc., F.R.S.
Director of Rothamsted Experimental Station

Contributions by

BROTHER ADAM, O.S.B.
Miss A. D. BETTS, B.Sc.
C. F. CLAY M.A.
W. HAMILTON
D. MORLAND, M.A.
W. H. J. PRIOR
L. E. SNELGROVE, M.A., M.Sc.

ROTHAMSTED EXPERIMENTAL STATION
HARPENDEN



ROTHAMSTED CONFERENCES

THE booklets in this series contain the papers and discussions at the conferences held from time to time at Rothamsted on present-day problems in crop production. The papers are written by well-known experts and discussed by some of the best practical farmers.

Obtainable from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

" THE MANURING OF POTATOES." 1/6.

(1)*THE GROWING OF LUCERNE." 1/6.

(2) " THE CULTURE AND MANURING OF FODDER CROPS." 1/6.

(3) " GREEN MANURING : ITS POSSIBILITIES AND LIMITATIONS IN PRACTICE." 2/-.

(4) " THE CULTURE AND MANURING OF SUGAR BEET." 2/6.

(5) " ART AND SCIENCE OF CULTIVATION." 2/-.

(6) " POWER FOR CULTIVATION AND HAULAGE ON THE FARM." 2/6.

(7) " MALTING BARLEY." 2/6.

(8) " RECENT CHANGES IN SYSTEMS OF HUSBANDRY IN ENGLAND." 2/6.

(9) " THE HERTFORDSHIRE AGRICULTURAL SITUATION : CAN IT BE IMPROVED ? " 2/-.

(10) " THE GROWTH OF CHEAPER WINTER FOOD FOR LIVE STOCK." 2/6.

(11) " THE MAKING OF NEW GRASSLAND : EXPERIENCES OF PRACTICAL FARMERS." 2/6.

(12) " THE PLACE AND MANAGEMENT OF SHEEP IN MODERN FARMING." 1/6.

(13) " THE TECHNIQUE OF FIELD EXPERIMENTS." 1/6.

(14) " MECHANIZATION AND BRITISH AGRICULTURE." 2/6.

(15) " RECENT DEVELOPMENTS IN MARKET GARDENING." 2/-.

(16) " PROBLEMS OF POTATO-GROWING." 2/-.

(17) " MODERN CHANGES IN THE TREATMENT OF LIGHT SOILS." 2/-.

(18) " BROOD DISEASES OF BEES." 1/6.

(19) " THE PRODUCTION OF PIGS FOR BACON." 1/6.

Numbers 1 to 15 inclusive are also published in book form : Vol. I (1-5), Vol. II (6-10), Vol. III (11-15), 10/- each ; postage extra.

*Out of print in separate copies.

https://doi.org/10.23637/ERADOC-1-212

CONTENTS

https://doi.org/10.23637/ERADOC-1-212

INTRODUCTION

WHEN, towards the end of last century, the straw skep was abandoned in favour of the moveable comb hive, the issue of a swarm ceased to be an occasion of rejoicing and has degenerated into a nuisance demanding vigilance lest the bees be lost. The modern beekeeper is able to increase the number of hives in his apiary by dividing his stocks at a time which suits his convenience and the necessities of the honey flow, rather than the whim of the bees and the weather.

Many systems have been put forward for the prevention and control of swarming. Some have proved successful in the hands of their advocates ; not all have shown themselves practical in respect of the time and labour involved ; while some appear to interfere with the gathering of the honey crop to a greater extent than even the issue of a swarm.

The object of this conference was to consider workable systems of management and the principles on which they are founded, and to put them on record for the convenience of beekeepers.

https://doi.org/10.23637/ERADOC-1-212

HISTORICAL NOTES ON THEORIES OF SWARM CONTROL

By ANNIE D. BETTS, B.Sc.
(Editor of *The Bee World*)

THE methods a beekeeper uses to manage his bees influence his ideas about the nature and organisation of the bee-colony much more than is sometimes realised. The Greeks and Romans did not try to control swarming, and so most of them were quite content to believe that a stock of bees was a city-state, like Athens or Rome, which had a king or general set over it, made war on its neighbours at intervals, and—when it grew very prosperous and the population increased—sent out some of its citizens to found a daughter-city or colony elsewhere. The only ancient writer who seems to have an inkling of another idea is that good practical bee man, Columella. He writes of the swarm as being composed of the younger bees, who have grown tired of living any longer under the rule of the old ones, and so leave home. Whether he learnt this from some Greek writer whose work is lost, or from beekeepers in Spain when he was a boy, or whether he thought of it himself, is not known. But he seems to be one of the first—if not the very first writer on bees to realise that the colony is like a family rather than an army or a city.

During the Middle Ages, as in ancient times, most practical bee-keepers could not read or write, and those who wrote bee-books generally copied the classical authors without adding much new material. No one wanted to control swarming, at any rate in England and most parts of Northern Europe; they wanted as many early swarms as possible, so as to have plenty of stocks to "take up" and sulphur in autumn. Only a few author-beekeepers seem to have practised any sort of swarm control. As an instance we may take our greatest bee man, Charles Butler. He copied the classics freely in his book; but he controlled swarming by a method which he did not learn from them. He used, not only the straw skeps general in Hampshire in his time and until recently, but also tall wicker skeps, shaped like a dunce's cap. When the stock in one of these prepared to swarm, he stood it on its head in a hole and put an empty skep on top of it, plastering the join between the two bottom edges with cow dung. This gave the bees plenty of room, and also killed most of the queen cells. I do not know, but am inclined to think that he learned this method in the Chilterns in his youth. The only place where it is now in use is in France—in the Gatinais district—so it must go back to the Ancient Britons at least, if not further—for we have no reason to think that Charles Butler was ever in France.

https://doi.org/10.23637/ERADOC-1-212 *pp 7*

It is almost certain that, if we knew more of the Britons and other prehistoric peoples, we should find that they had more accurate knowledge about bees than the Greeks and Romans. Having no writing or books, they have not been able to leave us any record of their knowledge, except in folklore and the survival of old skeps like the ones in the Gatinais.

In 1771, in Vienna, a Carinthian beekeeper, Anton Janscha, published a book on swarming. He, like Butler, was a poor man's son ; but unlike Butler, he had no education until he was over thirty ; and he died when only 39. His book is wonderful and most practical ; but he is a splendid instance that what a man believes about bees will govern his management of them. He says that swarming is due to two things—the bees' propagating instinct and their industry. When the stock grows crowded, these instincts cannot find satisfaction in the old home, and so a division of the colony takes place—the stock swarms. In exact accordance with this theory, Janscha says that to prevent swarming one should give more room, but adds that the surest way is to decapitate or cut out the drone brood and to remove the queen cells. He used those long shallow hives in which we still buy Carinthian bees, and no doubt it was fairly easy to find all the queen cells in such a hive, when the floor-board was removed.

Janscha anticipated a great many of Huber's discoveries ; but he died before he could answer the objections of the authorities of his day, who were opposed to his views ; and so his discoveries were forgotten.

Now we come to another continental beekeeper who did a great deal for the craft—the German cabinet-maker, Johann Mehring. In 1857 he invented foundation ; and in 1869 he wrote a book called, " The new One-Being-System as a Foundation for Beekeeping." In it he stated that the bee-colony must be regarded, not so much as a community of insects living together, but as a single organism. The book went out of print and was forgotten. But, a few years later, Rev. Schönfeld gave a copy of it to a young fellow-parson at Ossmannstedt in Thuringia. This man was Ferdinand Gerstung.

Gerstung himself had already hit upon this idea, that the bee-colony was a unit or single organism, and he was so delighted with Mehring's book that he brought out a new edition of it in 1901, in the preface to which he acknowledged his debt to Mehring for many of his own ideas.

Gerstung taught that a colony and its combs is one indivisible whole from the point of view of its life-processes. It consists of a number of layers or shells, one within the other. Imagine that the combs are transparent, so that you can look at the nest as a whole. You will see honey outside with the foraging bees on it, then a blanket of pollen all round the brood, and finally the brood itself in the middle with the nurse bees and queen. The queen, Gerstung

https://doi.org/10.23637/ERADOC-1-212

believed, follows a definite course, in spirals, returning every three weeks to the same place, as the cells again become vacant for her to lay in. Therefore the beekeeper must not disturb the order of the combs, or even take them apart needlessly ; for by so doing he will upset the orderly movements of the queen and throw out the life-processes of the colony-organism.

The young bee—Gerstung taught—follows what he called the centrifugal law. That is, she moves away from the centre of the colony as she grows older. When newly emerged, she stays near her cell, and, when the queen comes by on her rounds to lay in it and other newly-vacated cells near by, feeds her. She tends the eggs, and when the grubs hatch, is at the right stage to feed them. When they are ready to be sealed, she is a wax-maker, and seals their cells. Then, her work as a nurse being done, she leaves the centre of the colony and goes further outwards. She cleans the hive, stands guard at the door, learns to fly ; and, finally, as a forager, goes far away from home in search of food.

The separate organs of an animal's body are all nourished by the blood, and each takes from it what it requires for its functions. So too—said Gerstung—is it with the bee-colony. Its blood is the brood food, which he thinks of as a stream circulating in the colony. The queen and nurses need protein for eggs and brood-feeding, and take this out of the stream ; the wax-making bees need fat ; and the foragers need sugar to supply energy for flying and other hard work. If the colony is properly balanced, the food stream is used up evenly and nothing remains in excess when all are satisfied. But, if some class of bees is not able to use up enough of the particular foodstuff they should take out of the stream, that foodstuff will be in excess, and the normal life of the stock will be upset. Thus, if the queen's laying is checked, the nurses and wax-makers will soon not have enough grubs to feed or seal over, and protein and fat will be in excess. The bees then try to find outlets for the superfluity. They produce warmth ; they build drone combs and rear drones. This fails to relieve the situation sufficiently ; so they start queen cells, which absorb a great deal of brood food. This makes things better for a time, until the cells are sealed, and there is a reduced call for royal jelly. The bees would then feed it to the queen ; but she has ceased to lay, and will not take it. They cannot eat it themselves, so there is now no outlet for the excess brood food ; and the bees must seek a new home to find occupation for their superfluous materials and energies. The swarm inevitably results.

Thus, according to Gerstung, the bees do not rear drones and queens in preparation for a swarm, but in an instinctive attempt to avoid the necessity of swarming.

It is obvious how helpful Gerstung's theory is in suggesting what we should do and avoid if we want to prevent swarming. Any action on the beekeeper's part which results in idle nurses—such as putting

https://doi.org/10.23637/ERADOC-1-212

a sheet of foundation into the middle of the brood nest, or even pulling the nest about needlessly—may cause queen cells to be started. Again, cutting out unsealed queen cells might cause a swarm to come off instead of hindering it; for it would cause a sudden excess of royal jelly. One could think of other instances. Many modern methods of swarm control are based, directly or indirectly, on Gerstung's idea that the bee-colony is a unit—an organism. His work has had to be corrected in details; but his chief merit remains. He made beekeepers think of the colony as a unit, and thus gave them the first really solid basis for swarm control—and, I might add, for many other operations of practical beekeeping.

The idea that the colony is an organism also occurred—I believe independantly—to our countryman G. W. Bullamore, and was published by him in the *Beekeepers' Gazette*, 1911. This was, however, a good many years after Gerstung first published his ideas, and over forty years after Mehring's book. So I fear that we cannot claim any of the credit for this, one of the most important advances made in beekeeping theory. It is, however, pleasant to know that Britain is now taking quite a respectable part in developing the consequences of the theory for practical beekeeping, and also in extending the work of Rosch and others on the division of labour in the hive. It was this work which confirmed Gerstung's main idea, though it proved him wrong in many small details; and it is very regrettable that he did not live to see it. Gerstung died ten years ago, a few months before Dr. Rösch published his first paper.

https://doi.org/10.23637/ERADOC-1-212 *pp 10*

GERSTUNG'S BROOD FOOD THEORY

By Brother Adam, O.S.B.
(St. Mary's Abbey, Buckfast)

Dr. Gerstung endeavours to explain the mysterious phenomena of the life-cycle of a colony of bees by comparing it to a plant, rather than to a more highly organised animal. He maintains that just as a plant originates from one germ out of which the diversity of cells —roots, stalk or stem, bud, flower and fruit—develop, and as each group of cells performs its allotted task, and as the parts depend upon and derive life from the whole, so too in a similar way do the various members of a colony of bees originate and subsist. A branch cut from a tree is bound to wither, so likewise individual members, apart from the colony, cannot exist for any length of time. Queen, drone and worker each performs the duty it is designed for by Nature towards the upkeep and propagation of the species, and in turn each unit derives and relies on the existence of the whole.

A colony of bees therefore is, according to Gerstung's views, an organism the existence of which is dependent on the concordant co-operation of the various units, and existence of the units presupposes the whole as source and bearer of life.

Dr. Gerstung's organic conception has a direct relation to all aspects of colony-life. However, we are concerned with it only as it relates to swarming.

In English literature on beekeeping Gerstung's name is mainly associated with what is termed "the brood food theory." The brood food theory is a logical development of the aforementioned " organic conception."

Dr. Gerstung sees in brood food the primary source and stimulus of all the phenomena that take place in the life-cycle of a colony, and draws a parallel between brood food and the sap circulating in a tree. During the dormant season only enough sap is generated to sustain life, but when, in response to warmth, more of the life-giving element is produced than is demanded for subsistence, growth and all the diverse forms of seasonal development are, one by one, set in action ; leaves, buds, flowers and fruit succeed each other in due order. So too, Gerstung maintains, does brood food play a similar role in the life of a colony. A continuous flow and exchange of brood food takes place among nurse and field bees, and a flow from the former to queen and drones ; each caste, every section of the worker population draws from the brood food stream, " Futtersaftstrom," the particular sustenance it requires. The rising intensity of the brood food flow sets

https://doi.org/10.23637/ERADOC-1-212

one instinct after another into motion. In the first instance the reproductive, then the drone-raising instinct; the comb-building instinct; and, finally, when the greatest intensity of the flow is reached, the propagative instinct. The succeeding phases of development are only attained if the brood food flow exceeds the demand made on it at the time; conversely, the moment the flow declines, the propagative impulse, the drone-raising impulse, the building-impulse, and eventually the reproductive impulse recede into abeyance.

The actual conditions usually leading to swarming come about as follows. Until nectar is available a steady increase in nurse bees, and a corresponding extension of the brood nest takes place normally, provided no shortage of stores or prolonged cold spells check the development. But at the time when the first nectar is gathered a tremendous spurt of brood rearing generally occurs, and the queen is forced to lay to her maximum capacity. Indeed, at this period the area of brood is often doubled and trebled in the space of a few weeks. Now, according to Gerstung, the critical stage as regards swarming is reached the moment this horde of emerging bees assumes the duty of nurses. On the one hand the queen has attained the limit of her egg-laying capacity, and on the other hand the emerging bees are capable of providing brood food for at least twice the number of eggs the queen can produce. There is only one further outlet for an overproduction of chyle—royal larvae. Queen cells are accordingly constructed and the swarming impulse and the swarming fever aroused.

This, briefly summarised, is Gerstung's brood food theory. It is a hypothesis only, as the author himself affirmed; but a hypothesis possessing the greatest element of probability.

Speaking from my own observations and experience in handling almost every known variety of bees, I have been led to the conclusion that the brood food theory is the only satisfactory explanation of the cause of swarming so far put forward. Lack of room, insufficient ventilation, congestion of the brood chamber are merely secondary influences. Indeed, too much room and ventilation more often than not inhibit normal expansion of the brood nest, the ratio of nurse bees to brood becomes unbalanced, and swarming caused in consequence.

One vital aspect of Gerstung's theory is, I believe, often overlooked, namely, that the presence of a preponderance of bees of nursing age does not itself induce swarming; it only gives rise to the swarming impulse if the bees are excited to an overproduction of brood food. In other words, if by one influence or another the energies of young bees is diverted into other spheres of occupation than the elaboration of brood food, then no swarming will occur. It must be borne in mind that bees possess the ability of adapting their activities to the needs of the moment. Were it not for this fact

https://doi.org/10.23637/ERADOC-1-212

then swarming would be bound to develop in every colony the moment a queen reaches her maximum egg-laying capacity, or at the time breeding declines. If the attention of a section of the young bees of a colony is centred on other activities than nursing brood, they will pass then the nursing stage of their life without ever taking an active part in the preparation of brood food.

One obvious conclusion that may be inferred from Gerstung's hypothesis is that colonies which develop gradually from the time breeding commences until the height of the season is reached, and which are in no way and at no time checked in their development, are the ones least susceptible to swarming.

The Buckfast System of Swarm Control

Swarm preventitive measures possess an inherent element of uncertainty, unreliability on account of the manifold influences beyond our control to which bees are subject. Moreover, the various strains, and even individual colonies of the same strain, react often quite differently to identical treatment. We have therefore at Buckfast adopted a system of swarm control which I will now outline.

All honey producing stocks are re-queened annually. Queens two years old fail all too frequently at the height of the brood-rearing season, and thereby induce swarming. Every queen before being introduced into a stock has one of her wings clipped. Unrestricted breeding-space, and an abundance of stores is provided so that at no time is normal development of a colony checked.

Throughout the swarming season each colony is examined at intervals of ten days. On the first occasion a colony is found preparing to swarm we merely remove all queen cells. If, however, queen cells are again present on the subsequent visit, then this is taken as a definite indication that that colony is determined to swarm. The queen is therefore removed and every queen cell searched for and destroyed, and the colony thus left until the next visit. On the subsequent round all the queen cells possessed by the queenless stocks are once more removed, and then given a young fertile queen. Colonies thus re-queened, after being without a fertile queen for ten days, can be relied on not to swarm again for that season.

Were it not for the fact that all our stocks are taken on to Dartmoor in August for the heather harvest we would, regardless whether preparations for swarming are in progress or not, de-queen every colony about June 15th-20th, and re-queen them ten days after. The advantages derived from this form of swarm control are :—

(1) Swarming is prevented absolutely, with the least possible expenditure of time and labour per colony.

(2) Stocks are kept undivided.

(3) Colonies thus re-queened, just prior to the main honey flow, work well-nigh with as great energy as newly hived natural swarms.

(4) Breeding is suspended at a time when, in most districts, it

https://doi.org/10.23637/ERADOC-1-212

would be a disadvantage. (Bees which emerge after July 1st attain maturity too late to take an active share in gathering honey, and therefore subsist on stores laid up for winter.)

(5) A break in breeding at the height of the season is the most effective check and remedy to all milder forms of brood and adult bee diseases.

Unfortunately, where heather honey aimed at, the aforementioned periodical examination of colonies seems inevitable. A colony made queenless in June is quite useless for the production of a surplus in August.

There is one detail of management I would like to draw particular attention to, as it has an important bearing on swarming, namely, at no time during the swarming season do we alter the position of combs in the brood chamber, or disturb the ordered arrangement of the bees more than can possibly be helped. A disorganisation at this period beyond any doubt tends to induce swarming.

https://doi.org/10.23637/ERADOC-1-212

SWARMING AND THE DIVISION OF LABOUR IN THE HIVE

By D. MORLAND, M.A.
(Rothamsted Experimental Station)

IN a former paper the Brood Food Theory of Gerstung was examined in the light of the work of Rösch, Soudek and others (*Annals of Applied Biology*, vol. XVII, 1930, p. 137). Gerstung considered the colony rather than the individual bee as the unit, and maintained that swarming is due to an unbalanced state of the hive population resulting in a surplus of nurse bees and the preparation of brood food in excess of the requirements of the nurseling larvae. He held that it was this surplus which led to the raising of queen cells, since a single queen consumes royal jelly throughout her larval life, while worker larvae only receive it in their youngest and smallest stage. In my earlier paper I referred to the way in which Rösch's studies of the division of labour in the hive fit in with this theory. His method was to mark individual bees on emergence from their cells and to watch their activities in an observation hive.

During the past four seasons we have been making observations on similar lines in the experimental apiary at Rothamsted. Sealed brood without adhering bees is placed overnight in an incubator maintained at the hive temperature of 33 °C. The following morning the newly emerged bees found on the combs are marked with a quick drying cellulose enamel on the back of the thorax. A code of colours is used by which it is possible to tell the date of emergence of any marked bee. When the marked bees have recovered from the temporary stupor caused by the solvent in the paint, they are introduced to a large six-frame observation hive. If proper care is exercised, these bees are accepted by the following morning and thereafter behave as normal inhabitants of the hive. Observations made on such marked bees confirm the findings of Rösch as to the sequence of promotion from nurse to housekeeper and then to forager, but some cases have been noticed of bees flying, carrying pollen and even accompanying the swarm at a precociously early age.

The addition to the observation colony of some thousands of bees, all potential nurses, exaggerated that preponderance of nurses over brood, which according to the brood food theory leads a colony to swarm. At the same time the levy of sealed brood taken from the strongest stocks of the apiary, for hatching in the incubator, produced in them the opposite condition. Any surplus of young bees in the incubator, which was not required for marking, was also introduced into the colonies under experiment. As a result of this it frequently

https://doi.org/10.23637/ERADOC-1-212

happened that the only colonies in the apiary to swarm were those to which marked bees had been added. This would suggest that the equalisation of stocks, which some authorities have so heartily condemned, or the establishment of nuclei on lines consistent with this theory, may be a practical method of swarm control, in apiaries which are known to be free from brood disease, provided that the nuclei or subsidised weaker stocks are given queens reared from the more desirable colonies.

When swarms emerged from the observation colonies of marked bees, they were hived in the usual way on empty drawn comb and left overnight with a comb of unsealed brood to settle down in their new home. The following day the usual sloping board was placed in front of the hive, containing the swarm, and a number of glass jars fitted with wide necked funnels corresponding to the batches of marked bees present in the original colony was provided. Sometimes the fly sheet of a tent was pitched over the hive as a protection from sun and wind. The frames were removed one, by one and either the coloured bees were picked off the combs and sorted into their appropriate jars, or else the bees were shaken on to the sloping board, and the marked ones picked out as they ran into the hive. This was repeated, until no more coloured bees remained on the combs or in the brood box. The jars of bees were then taken to the field laboratory and the bees given a whiff of ether for convenience in counting. After they had recovered they were re-introduced to the swarm. This was a full day's work for two people. The following day the same procedure was repeated with the parent stock. The possibility that anaesthetised bees might become confused and return to the parent colony was not lost sight of, but a special watch was kept, and there is no evidence that this took place. In one instance the same process was repeated with a cast which emerged after the prime swarm, but unfortunately on another occasion a cast absconded and was lost. No report of a stray swarm with strangely marked bees was received from the neighbouring beekeepers.

Once it was reported that bees of curious aspect, " having green mould growing on their backs," had been observed prospecting round an unoccupied hive one mile from the apiary. After this had continued for a week, it suddenly ceased on the day when a swarm issued from the observation hive with a clipped queen and was successfully hived. The informant was shown bees marked with a green spot on a white background and declared that they were the same.

After the first year the number of bees marked on each occasion was noted and kept approximately uniform, and a very good idea of the rate of mortality of worker bees at that time of year was obtained by adding together the numbers of each batch recovered from stock and swarm respectively. It is admitted that the handling necessary in the process of marking, clumsy application of the colour, or careless introduction, may cause some casualties (in one case the

https://doi.org/10.23637/ERADOC-1-212

entire batch perished from one of these causes) but with practice, a very high percentage of acceptance has been achieved during the later seasons. Once, when a swarm emerged on the day following the introduction of a batch of bees, only a very small loss out of the total introduced was recorded.

It will be seen from the diagrams that in the height of the season, after about 21 days, 50 per cent. of any batch had disappeared, and that by between 40 and 50 days the marked bees of any given colour had become extinct. It may be objected that the colours might wear off and an old bee appear not to have been marked, but in the comparatively rare instances when this has occurred such bees are very easy to recognise from the fact that there is a black shiny patch on the thorax from which the hairs are entirely absent, having come away with the paint. It might also be thought that the presence of the paint would in some way shorten the life of the bee, but except where a slip has been made and paint has got on to the base of the wing or over the spiracle, there seems no reason to believe that this is so.

Various statements have been made as to the age of the bees which constitute the swarm. It is most frequently said that it is the young bees which go out. In the light of Rösch's work, it was expected that it would be the middle aged bees (the " control bees " of an American writer) which would be found in the greatest numbers in the swarm. In the experiments at Rothamsted this was found to be the case, though not in very striking preponderance. While very young batches were poorly represented, the falling off of the older categories was due to the high rate of mortality of the foragers at this time of year and was almost as great among bees of the same age remaining in the parent stock, so that the difference in distribution of the different aged bees in stock and swarm was not so great as had been expected. A well-known beekeeper suggested that the high rate of mortality might be due partly to the use of an observation hive only one comb thick ; in fact, we did not find it easy to winter bees properly in such a hive, in spite of heavy insulation. Since then, one or more control hives of the ordinary single walled type (now known as the " National " hive, see Ministry of Agriculture Marketing leaflet No. 79) was used. Results did not differ materially from those which had been obtained with the observation hive.

The use of marked bees has also afforded an opportunity to study the prevalence of drifting. Although the apiary is regularly arranged and contained only a few types of hive, the number of coloured bees found in other hives has been relatively small. This is remarkable when it is remembered that they are only adopted members of the colony. No attempt was made to mark drones, as they do not directly affect the Brood Food situation, but it is probable that more drifting might have been encountered in their case.

https://doi.org/10.23637/ERADOC-1-212

Although the mass marking of bees does not lend itself to such detailed study of the division of labour as the marking of individual bees, as practised by Rösch, it has given a good indication of the way in which a stock is divided at swarming. There seem to be no very striking variations in the proportion of marked bees in stock and swarm and it is felt that any further work that may be undertaken on this problem should take the form of a determination of the distribution of bees of different ages in the different parts of hives worked on the " Demaree," " Snelgrove," or other systems of swarm control.* Probably the information desired could be obtained by using fewer and smaller batches of bees than in the studies which have here been reported. This might make it possible to have a larger number of stocks than just one or two devoted to the experiment.

* The work of the 1935 season has been on these lines.

https://doi.org/10.23637/ERADOC-1-212

THE SNELGROVE METHOD OF SWARM PREVENTION

By L. E. Snelgrove, M.A., M.Sc.

It is impossible in the brief time allotted to me to deal fully with my method of swarm prevention and I shall therefore confine my descriptions to its application to a stock of bees which has not made preparations for swarming and which is housed in a "Simplicity" or "National Single-walled hive." As I proceed I shall illustrate my points by means of the hive placed at my disposal to-day by the officials of this station. For the important modifications necessary in the case of a stock which is building queen-cells preparatory to swarming, for the application of the method to other types of hives, for its use in queen-rearing, preparations for the heather season, and detailed working instructions, I must refer my listeners to the book I have recently published on the subject.*

A good method of swarm control should conform to the following conditions :—

(1) It should be applicable in all circumstances and certain in its result when properly carried out.

(2) It should require little time and labour.

(3) It should not involve the breaking down of queen-cells or (if not desired) searching for the queen.

(4) It should provide for annual re-queening, selection of stock, and increase or limitation of stocks as desired.

(5) It should ensure immediate occupation of supers and no interruption of honey-gathering or the laying of the queen.

(6) Above all it should not involve cruelty such as is occasioned by the forcible confinement of queen or drones by means of queen excluders.

The methods I have devised fulfil all these conditions. In particular the amount of time necessary to prevent a stock from swarming throughout the season should be considerably less than one hour.

The success of a stock of bees in respect of honey-gathering depends on the number of field bees it contains during the period of the main honey flow. Every effort must therefore be made to stimulate the queen to lay plentifully during the spring, and with this end in view the stock must be provided with additional brood boxes as necessary until the last week in May. It is easy to prevent swarming until this time by judicious increase of the brood nest and by supering in the ordinary way.

* "Swarming : its control and prevention." (Snelgrove) 1935.

https://doi.org/10.23637/ERADOC-1-212

When a new brood chamber is added some precautions are necessary. It is often useless merely to place it *under* the brood nest, for in unfavourable weather the bees will confine themselves to their original combs, prepare queen cells, and swarm. The new brood chamber should be placed *above* the original one, and to ensure that the bees will occupy it two frames of brood with bees should be lifted from the lower to the upper chamber and placed on either side of a central empty comb, their places below being filled by two empty combs or foundation. The same procedure should be followed if it becomes necessary to add further additional brood boxes.

A stock occupying fairly fully a double brood chamber, and possibly to some extent a super, at the beginning of the last week in May is in ideal condition for successful treatment. Better results will naturally be obtained from a stock which has needed a third brood box.

Let us now assume that towards the end of May our typical stock occupies twenty brood frames and that above these there is a shallow frame or section rack, the hive having been well ventilated below by a wide entrance and the queen not having been at any time restricted for room to lay.

On a convenient day the brood combs of the stock, with adhering bees are separated into two groups—those containing brood, which are placed in what we shall call Box A, and others which are brood-less, or nearly so, and which are placed in Box B. With the latter are placed the queen and one comb containing a little young brood.

Box B is then placed under the excluder and will become the future brood nest of the stock. Box A containing the brood is placed above the excluder and the super.

If it is desired to avoid the task of finding the queen it is only necessary to shake the bees gently off the combs of Box A and let them run into the hive at the main entrance. The queen will then be in Box B and under the excluder.

The bees in A, separated from the queen by an excluder and the super, begin to raise queen-cells. On the fourth day, when the feeding of the young queens is practically completed, Box A is separated from the rest of the stock by means of a screen-board. This is similar to a clearer-board, the clearer hole being covered by perforated zinc or wire gauze. Wedges are cut from the upper and lower rims of the board so as to provide small entrances or exits about $1\frac{1}{4}$ inches wide. They are cut on three sides of the board and serve to deprive the stock in A of flying bees and at the same time to re-inforce the stock in B which occupies the supers.

When the screen board is placed under Box A, one of the upper small entrances is opened and the flying bees from this box return to the hive by the main entrance, thus re-inforcing the stock in Box B. By suitable manipulation of the wedges the lower stock is still further re-inforced on two specific dates so that young queens

https://doi.org/10.23637/ERADOC-1-212

emerging in Box A cannot possibly lead off swarms because there are no flying bees to accompany them.

The whole force of field bees is concentrated in Box B and the supers. As this stock is deficient in nurse bees, which cannot increase to excess for four or five weeks, and as by that time the queen's laying power will have declined, there will be no tendency on the part of these bees to swarm.

The bees in both boxes retain the same odour because of the wire gauze between them. The stock in B establishes and maintains a column of bees reaching through the super to the gauze in the screen-board, and the super is therefore immediately occupied after the insertion of the board.

By simple modification of Box B it is possible to rear several young queens at one time. Selection of stock is made easy by the application of the method to the best stocks three or four days earlier than to the others.

It will be realised that by this method the full force of field bees is kept at work in the supers, which may be added at suitable intervals and that the young queens are reared under the best possible conditions.

The method should not be applied before the queen has reached the peak period of her laying—that is, usually about the end of May. If it be used earlier the stock may need some relief of its brood nest after three weeks in order that there be no late swarming. Such relief can be given by exchanging two combs of brood in Box B for two broodless ones in A.

At the end of the honey season the two stocks may be united, or they may be wintered separately.

https://doi.org/10.23637/ERADOC-1-212

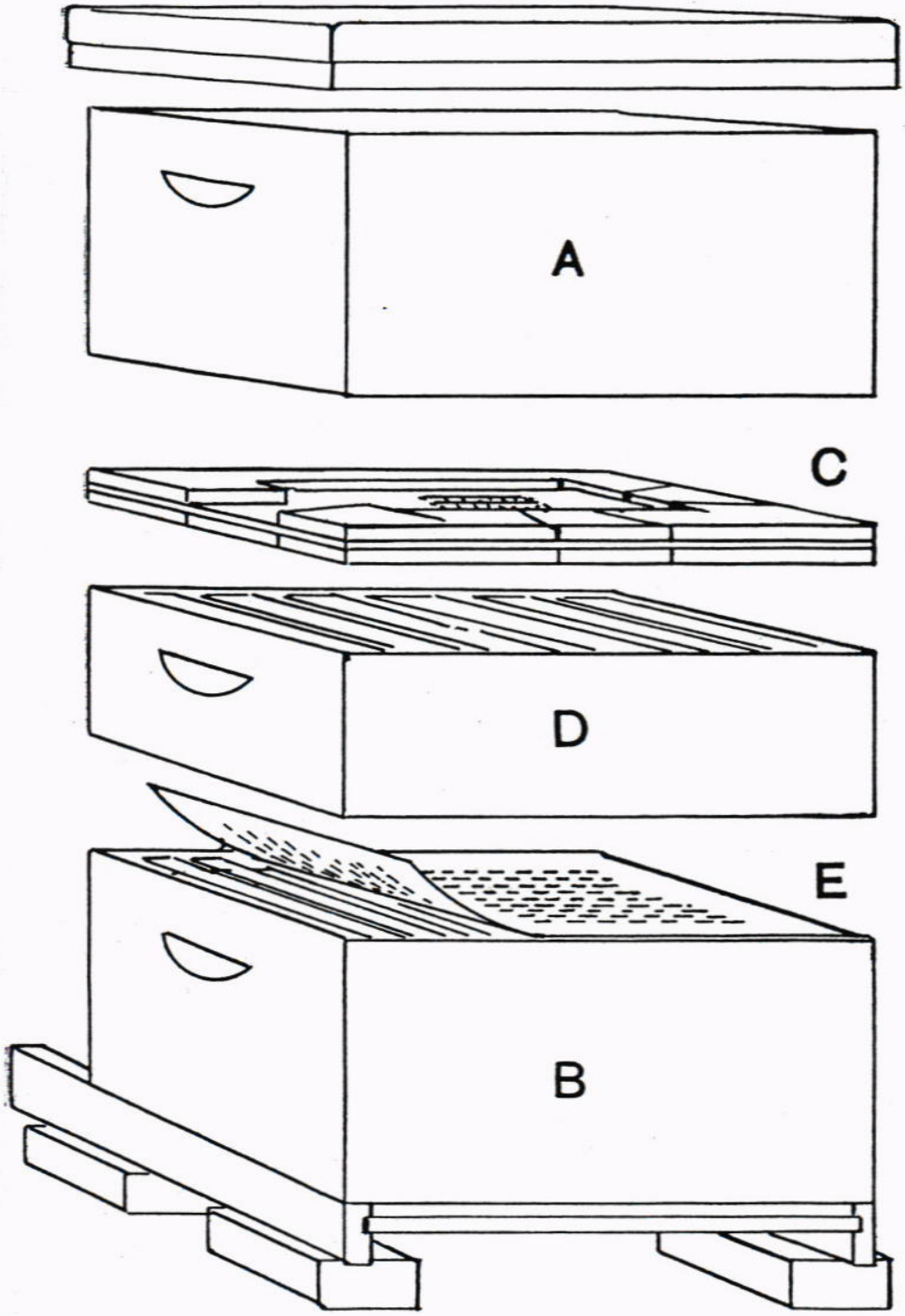


PLATE I. SNELGROVE METHOD.

A. "Box A" containing brood and young bees, in which queen cells are raised.

B. "Box B" containing broodless combs and laying queen on one comb of brood, to which the flying bees return.

C. The special screen boards having three pairs of removable entrance blocks and a ventilation hole in the centre covered with wire gauze.

D. The supers.

E. Queen excluder placed between queen chamber and super.

https://doi.org/10.23637/ERADOC-1-212

THE DEMAREE PLAN

As notes of Mr. Prior's lecture are not available, a short account of the Demaree plan is inserted below.

The term "Demaree method" is a general one and there are several variations of it. Originally it was a treatment for swarms which had issued in the ordinary way, but it has been taken to mean "any method for expanding the broodnest by transferring the brood or the queen from one broodnest to another—and then confining her activities to one particular broodchamber (usually the bottom one) by the use of a queen excluder, for the purpose of the prevention or control of swarming." (Root.)

It will be seen that the above comprehensive definition covers more than many people would describe as demareeing and would include the Peck and Snelgrove methods among others.

The following is a quotation from an article by G. W. Demaree (*American Bee Journal*, LXVII, p. 303, 1892):

"I begin with the strongest colonies and transfer the combs containing brood from the broodchamber to an upper story above the queen excluder. One comb containing some unsealed brood and eggs is left in the brood chamber with empty combs.

"The colony thus has all of its brood and the queen, but the queen has a new brood nest below the excluder, while the combs of brood are in the super. In twenty-one days all the brood will be hatched out of the combs above the excluder, so a continuous succession of young bees is sustained. Usually the combs above the excluder will be filled with honey by the time all the bees are hatched, and no system is as sure of giving one set of combs full of honey for the extractor in the very poorest seasons: and if the season is propitious the yield will be enormous under proper management."

Demaree himself modified the plan in 1894 and again in 1895. An extra entrance was provided in the upper brood chamber so that the drones hatched above the queen excluder could escape. Later he put the sealed brood above, leaving the unsealed below with the queen. The most favoured plan at the present time is to have the supers between the two brood chambers above the queen excluder, rather than on top of the upper brood chamber. This gives the bees in the upper brood chamber a feeling of queenlessness and queen cells are started, which may later either be destroyed or used for increase. A criticism which has been made against the Demaree system is that the honey, which is stored in the combs of the upper chamber, after the emergence of the brood, is alleged to be inferior to that from supers in which brood has never been raised. Mr. Prior contended that there was no evidence for this belief, and that he had gained prizes for such honey at shows at which those who condemned the practice were acting as judges.

https://doi.org/10.23637/ERADOC-1-212 *pp 23*

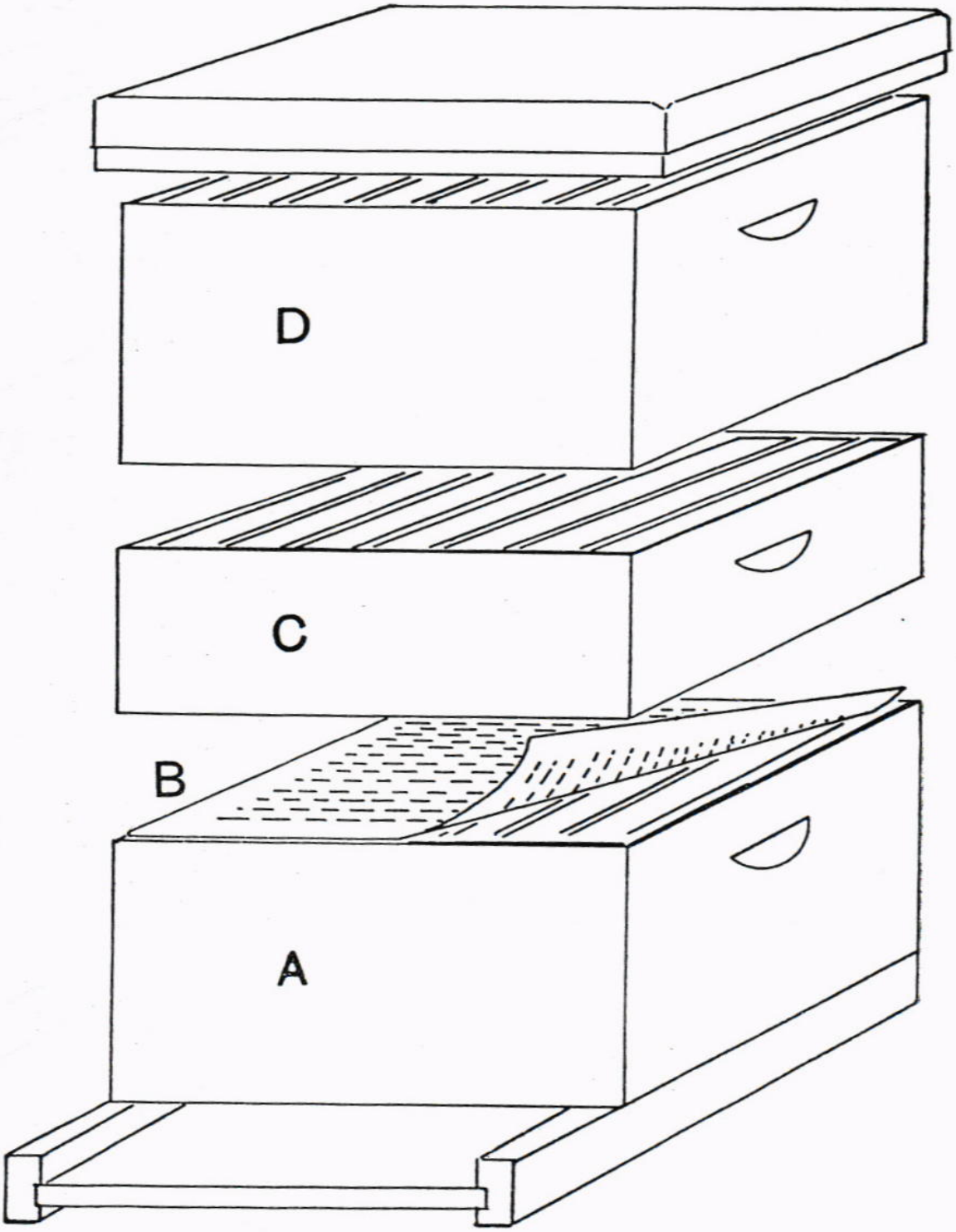


PLATE II. DEMAREE PLAN.

A. Laying chamber containing the queen.
B. Queen excluder.
C. Super or supers, which are added as the honeyflow progresses.
D. Chamber containing brood which has been put up. In this chamber queen cells are liable to be started.

https://doi.org/10.23637/ERADOC-1-212

THE PECK SYSTEM

By C. F. Clay, M.A.

Mr. S. Peck of Histon, Cambs., being unfortunately prevented by illness from being with us to-day, I am commissioned by him to give a description of his method of swarm-control. Mr. Peck, and his father before him, have been in charge of the apiaries of Messrs. Chivers of Histon, for more than thirty years. As these apiaries have for their main objective the pollination of the fruit trees, the hives are scattered among the orchards, and not arranged in the familiar symetrical rows of the commercial apiary.

Mr. Peck first states that in order to get good results from his method of swarm control, the hive should have a deep entrance, as it is not convenient to prop open the entrance during hot weather.

The method should be begun when the stock is strong enough to swarm and may be continued until the swarming season is past, or until the stock is re-queened with a young fertile queen.

The queen is first confined to the brood chamber (A), which is done by placing a queen excluder dummy (C) down the centre of the brood box from front to back, and a queen excluder slide (F) is placed half across the entrance to the hive, thus enclosing the queen in a chamber from which she cannot escape. A stop (D) is placed close up against the queen excluder at the entrance, in order that the queen cannot pass round the end. Alternately the queen can be confined by using a hive with combs which run parallel to the entrance, by placing the queen excluder across the hive dividing it in half. Whilst this method gives much greater freedom to the bees at the entrance, it leads to some trouble with the drones which become pent up behind the excluder.

When the supers (G) are put on, the top of the queen chamber is covered with half a sheet of excluder. (E) This is to the advantage of the bees who can enter the supers more easily without having to pass through a queen excluder.

The queen is given five combs which are nearly empty, or filled with hatching brood. It is essential that one comb should contain a few eggs or hatching brood, as otherwise the workers are liable to kill the queen.

After ten days, a very prolific queen will have filled the five combs with eggs, but probably a queen of average capabilities will have failed to fill all five completely. These combs are then exchanged with those on the other side of the queen excluder dummy. The combs taken from the queen chamber are shaken, allowing the bees and queen to remain where they were, and the combs from the other side (B) of the excluder to replace those full of brood, and these

https://doi.org/10.23637/ERADOC-1-212

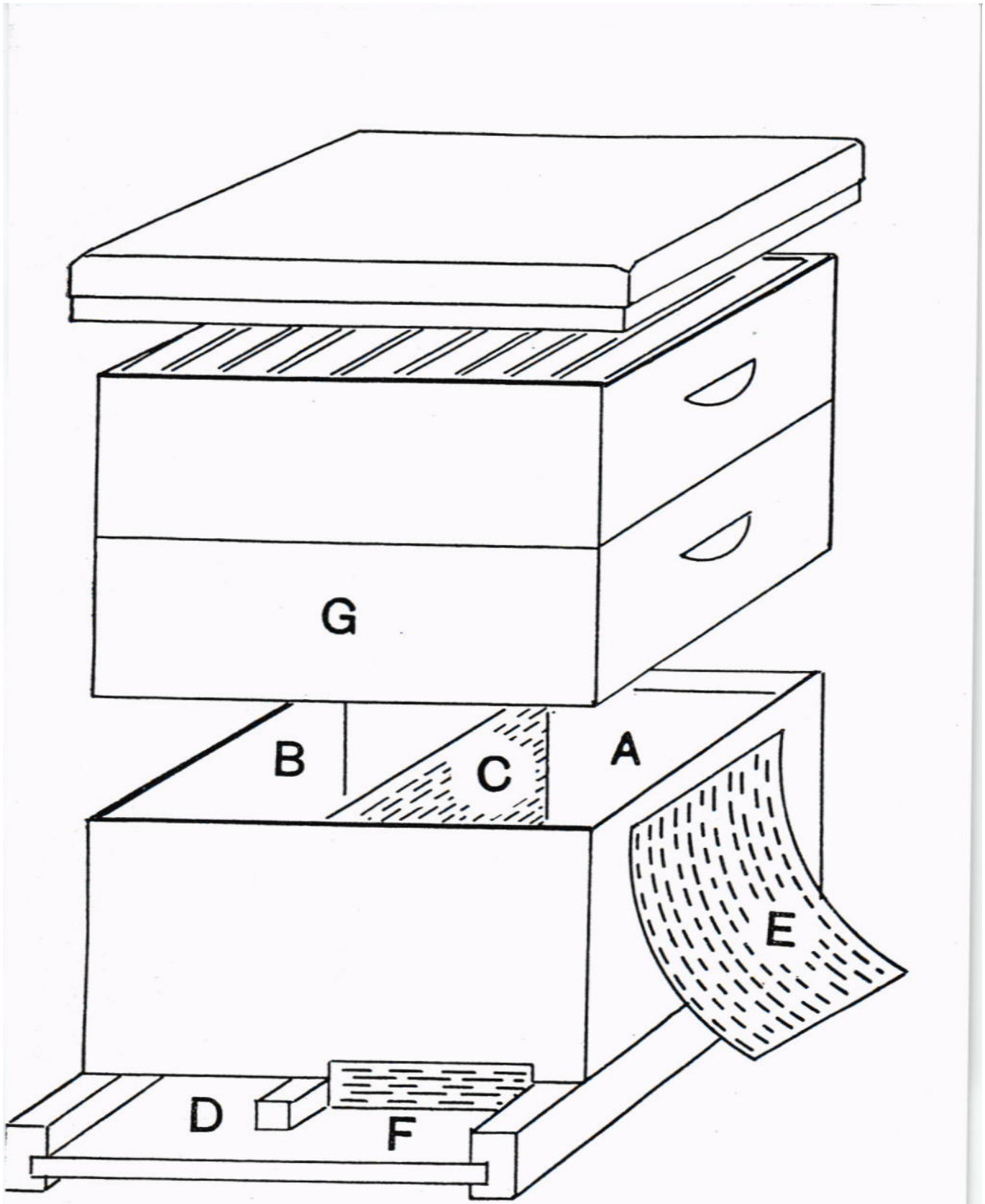


PLATE III. PECK SYSTEM.

A. Laying chamber containing the queen.
B. Chamber to which brood is to be transferred every tenth day.
C. Hanging queen excluder.
D. Stop to prevent queen passing round end of queen excluder.
E. Half sheet of excluder, which covers laying chamber (A) when supers are on.
F. Queen excluder slide over entrance of laying chamber.
G. Supers.

https://doi.org/10.23637/ERADOC-1-212

are put in their place. Shaking should not be attempted during the honey flow, and the queen should be found at the beginning of operations and kept in her proper chamber.

This process is repeated every ten days throughout the swarming season or until the stock has accepted a young fertile queen.

It must be pointed out that the work of the queen is not interfered with nor retarded by this method, as, if she had the run of all ten combs at once she could only fill them with eggs once in twenty-one days, as it takes three weeks for the brood to emerge.

Bees treated in this way do sometimes attempt to swarm, but they return to the hive almost at once. On their return they usually destroy any advanced cells in the queen chamber, leaving the less mature cells until they become a danger to the queen. These cells are removed by the manipulator on his next visit.

If a queen is overlooked in the side of the hive to which the queen has no access, the young queen generally gets mated and returns to the hive, but if two or more cells are missed, the bees will swarm. Only a few bees—about 1½ lbs. perhaps—will go with the virgin queen, as long as the old queen is still confined to the hive.

It is important that frames containing new foundation should not be placed in the queen chamber, as the bees will not draw out combs if these frames are placed between those containing capped brood. Such frames of new foundation should be placed between combs containing eggs which have been freshly removed from the queen chamber.

During the height of the season when queen cells are being formed it is often advisable to make a nucleus, and a comb with a queen cell attached can be removed, and later on united to the parent stock when the young queen is fertile.

It is preferable to use a hive with twelve brood combs which thus allows extra room for honey and pollen near the brood nest. Using this system it is found that bees occupy sections more promptly than usual, and there is no fear of losing swarms through over-crowding. The system is suitable for a large commercial apiary, and given suitable weather conditions, eighty stocks can be manipulated in one day by an experienced beekeeper and one assistant to work the smoker.

In conclusion, I must add that Mr. Peck manages to manipulate so large a number of hives in one day by a methodical visit at which he works with an assistant, opens the hives, shakes the bees back into the queen chamber, puts the frames into a frame box and just lifts over the other frames into their place leaving his assistant to close the hive whilst he goes on to the next. Thus each hive takes only a very few minutes.

https://doi.org/10.23637/ERADOC-1-212

SWARMING : WHAT IS THE CAUSE ?

By Wm. Hamilton

Swarming of the honey-bee is a natural phenomenon. It is Nature's method of propagating the species.

Swarming causes work to the beekeeper, reduces the possible crop of surplus honey, and often results in the loss of the swarm.

But every colony of bees does not swarm every year, and therefore it is obvious that under certain conditions existent in the colony bees have no inclination to swarm. If a few colonies have no desire to swarm would it not be possible to subdue or eradicate the desire to swarm in all colonies, provided the condition which induces swarming were known ?

Theories have been advanced at different times as to the cause, among which are the Gerstung theory or brood food theory ; the unbalanced condition of the colony theory ; and the congested brood-nest theory. Gerstung's theory, which is explained by other speakers, was at one time widely accepted by theorists, but in my opinion and, I believe, in the opinion of most of the professional beekeepers in Britain and America, the theory is unsound.

If the brood-food theory be correct why does not every colony swarm every year ? Of course, the nurse bee need not do much, if any, nursing of the brood. There appears to be a general impression among beekeepers that bees under certain ages cannot perform other than certain duties which the experiments of Rösch and others have shown they are best fitted for. Further, I believe there is also a general impression that bees under ten days old make brood food automatically. Neither of these impressions are correct.

The giving of brood either sealed or unsealed often checks the preparations to swarm. Giving sealed brood should accentuate the desire to swarm if Gerstung be right.

The successful entry of a virgin queen accidental or otherwise to a colony preparing to swarm usually has the effect of stopping swarming for the season.

A period of bad weather has the tendency to make the bees destroy the queen cells that have been built, and in some cases to cease making further attempts to swarm.

How do these cases square with Gerstung's theory ?

It can easily be proved that young bees by themselves have no more inclination to build queen-cells than have old bees by themselves.

https://doi.org/10.23637/ERADOC-1-212

The congested brood-nest theory is widely accepted as a probable cause of swarming but in my opinion it is only a contributory cause.

Many other contributory causes have been advanced, such as old or failing queens, drones, lack of ventilation, and strain or race of bee. There is little doubt that these factors have a bearing on swarming.

I propose to examine the problem as briefly as possible.

The first thing to find out is whether we can make bees swarm at will. That is not difficult, for all we have to do is to take the queen out of a good colony in the summer and twelve to fourteen days later a swarm will issue headed by a virgin queen.

From this experiment it is easy to see that the presence of more than one queen cell caused swarming. If all had been destroyed but one, no swarm would have issued. And in natural swarming the same thing applies. Bees never swarm normally unless young queens are being reared in the hive.

Sealed queen-cells, then, are definitely the indirect cause of swarming and I submit that the urge to rear young queens when made queenless is precisely the same urge as when queen right. It is only a question of degree.

What then is the urge which causes the bees to rear young queens at the time they have a fertile queen present. I do not believe it is the surplus of brood food, for as has been shown, when a colony that has been making no obvious preparations to swarm, is dequeened cells are started, although the effects on the amount of brood food needed cannot be felt for about three days. Further I am of opinion that the manufacture of brood food is automatically reduced as the need for it lessens. As I see it, the association between the brood and the queen is inseparable. The urge to rear brood is dominant in the bee colony for a period, and is always a powerful instinct in the working season. Bees associate the queen with brood, and feed her with pap. If the instinct to rear brood is stronger than the capacity of the queen to produce it ; if her stamina is not sufficient to stand the strain of high egg production ; and if she refuses the food provided, the bees instinctively associate the food she refuses with the brood, and lavish it on a few selected larvae. It may be that the odour of a failing queen is akin to the odour of the brood. If so, the bees may be instinctively impelled to feed the pap to selected larvae in the hope that it will re-create the odour which the queen, by her inability to take the food, is losing.

I think it is generally agreed that the queen has a distinctive odour. To prove that all sound queens have the same odour I have succeeded in publicly demonstrating the transference of queens from colony to colony without mishap. If however we try to introduce a virgin queen to a colony that has recently had a fertile queen taken out, the bees refuse her unless special precautions are taken. On the other hand if a virgin queen is taken away from a colony, the bees

https://doi.org/10.23637/ERADOC-1-212

miss her in a few minutes, but will take a fertile queen without demure. If the brood and queen be taken away the bees become almost frantic in their excitement. If we return the brood they become quieter and in a day or two become normal.

Which goes to prove that there is an association between the brood and queen.

To make the proposition clear I submit that when the brood-rearing instinct is dominant the failure of a queen for any reason whatsoever, such as old age, poor breeding, congested brood nest, physical defect, or racial characteristics, causes the bees to rear queens.

It is necessary now to glance at the preparations bees make for normal swarming. The first sign is the rearing of drones. The second is the construction of embryo queen-cell cups. I am of the opinion that when a queen begins to lay drone eggs she literally begins to die. It is a sign of weakness and nature directs that precautions be taken, and just in case of accidents the male element in the colony must be provided. Of course the queen may live for a year or two longer but Nature takes no chances. To say that the bees know that they will need drones or that the queen feels that she is failing is nonsense. Bees have no intelligence as we understand the word and are merely creatures of instinct and habit.

Regarding queen cups I do not believe that they necessarily mean the rearing of queens and believe that initially they merely signify an excrescence of wax within the cluster.

Have we found the cause of swarming yet? No! I have only dealt with the first phase. The second phase I propose to deal with now.

Bees don't always swarm when the queen is failing. They build cells sometimes and then destroy them. Sometimes they rear only one young queen and thus supersede the old one. In the first case, bad weather may be the cause of the destruction of cells; in the second case, it is usually after the brood-rearing urge has subsided that supersedure takes place.

There are three powerful instincts inherent in bee-life, namely, brood-rearing, honey-storing, and swarming. The first two instincts are primarily concerned with the preservation of the colony and the third is probably more concerned with the preservation of the race.

If we examine the methods of swarm control and prevention we shall find that most of them are based on the instincts which demand the preservation of the colony before that of race.

Take the Demaree system; the brood is separated from the old bees and the queen. The advocates of the brood food theory claim that this proves their theory, but nothing could be farther from the truth. The fact is that the instinctive desire to rear brood for the preservation of the colony is at once aroused and checks swarming. The same applies to the Snelgrove system and many others. Take

https://doi.org/10.23637/ERADOC-1-212

the " shook " system where the colony is deprived of all its brood. Here again the fear for the existence of the colony is aroused.

Take the method of giving the bees a big hive or unlimited room. Again the instincts aroused are the brood rearing and storing instincts for the preservation of the colony. The larger brood nest requires more food to keep it going and the queen is less apt to be checked. Furthermore the tendency is strong to develop the storing instinct.

I now suggest that the ultimate cause of swarming is instinctive fear, which develops an excitement and results in swarming. There are many conditions which might cause this excitement. One instance, which most beekeepers see often, is the effect of smoke on a colony. The bees become frightened and fill themselves with honey, and in that condition are similar to the bees in a swarm. They do not leave as a swarm, however, but that is probably because the smoke has, in addition, a demoralising effect.

The best example for our purpose, however, is the condition in a colony when queens are being reared. The bees recognise that there is a potential queen in each queen cell, and they group themselves into bands in the vicinity of each cell. They do so because they are unable to determine which queen is the right one. The well ordered colony which by its very nature is a unit is divided into a number of units. One queen is needed ; a fully developed and prolific queen ; and the existence of the colony is at stake. The excitement grows, and the queen herself, fertile or unfertile as the case may be raises the excitement to " boiling " point, when she instinctively tries to destroy the rivals present. The groups of bees refuse to surrender the unborn queens to her fury. Something happens. The swarm has issued.

Bad weather for a few days at the time of sealing the queen cells may prevent the swarm. Dull damp weather subdues the excitement and lowers the temperature in the colony.

High temperature has always a powerful effect on fostering excitement, and a hot sun, masses of clustering bees secreting wax, and a congested hive, are factors which by themselves raise the temperature to danger point without any other excitement such as queen cells. It is well known how difficult it is to get rid of the swarming fever when the weather is very hot.

Many other examples might be given such as the effect of drones but it is time to sum up.

(1) The indirect cause of swarming is queen-cells.

(2) The direct cause of queen-cells is the failure of the queen.

(3) The cause of swarming is excitement engendered by a fear for the existence of the colony.

This fear makes, firstly, the bees build queen-cells and then again this fear makes them divide themselves, through excitement.

https://doi.org/10.23637/ERADOC-1-212

But paradoxically as it may seem fear can be used to prevent them from swarming.

Take away the brood. Take away the queen. Take away the honey from proximity to the brood. Give them a lot of work to do that excites them to the storing or breeding instincts rather than the swarming instinct. In short make the colony feel that its existence is at stake. These are the chief points in the modern methods of swarm control. Let us endeavour to dispense with these methods as far as possible.

Remove the cause of the excitement and you remove swarming. What is the cause of the excitement ? The queen ! What then is the remedy ? The only possible remedy as far as I can see is to breed better bees. It is as natural for a colony to supersede its queen as it is to swarm. Some strains of bees are given to superseding their queens rather than swarming. I have seen these bees. Why should not all bees have this characteristic developed ? Some races of bees are inveterate swarmers for reasons I have not had time to go into.

But there are strains of Italians, Caucasians and French Blacks that with good management seldom attempt to swarm. Some people think that it is not possible to breed a selected strain of bee, because of the risk of unwanted drones spoiling the effort. Believe me there is no danger. The person who tells you that after years of selective breeding, he has been unable to make any improvement, obviously lacks knowledge of the subject. Few beekeepers give this matter even a tithe of the study it deserves. My advice is keep a pure strain of bee and avoid mongrels. Keep a record of the non-swarmers and nine times out of ten these will be found to produce most honey. Of course it is obvious that if the Demaree or Snelgrove methods are practised, no true guide can ever be obtained of the qualities of the bee. Select the best and rear queens from it. Introduce these queens to *all* colonies. These queens may mate with strange drones but that is of little matter. Next year all the drones in the apiary will be directly related to the workers of the best colony of the year before.

If a good colony is again selected and queens reared from it these queens will mate, almost without exception with the drones in the apiary, in every hive of which the drones have the same blood. If a strange drone or two comes in and mates a queen, it doesn't matter because no blood other than the beekeeper desires can ever contaminate his or her bees. Never breed from bad tempered bees however good they are and never keep two kinds of bees in the apiary.

In conclusion, I claim nothing very original in this paper on swarming except that I have divided swarming into two phases. Even if the brood food theory were correct as to the building of cells it could never explain the phenomenon of the swarm. I trust I have given at least a feasible explanation of that phenomenon.

https://doi.org/10.23637/ERADOC-1-212 *pp 32*