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South African "Fertile" Worker-Bees.

By G. W. ONIONS.

IN the May, 1912, issue of this *Journal* I gave a clear and concise statement of collected facts to show that worker-bees laid eggs which developed females. This phenomenon of reproductive activity in fertile workers may be observed by any experienced apiarist who will investigate it along practical lines and with an open mind. In my own experience the conclusions arrived at, some years before I had the courage of my convictions to publish them, have been fully sustained. As stated, however, in the first announcement of my discovery in the *Agricultural Journal* of October, 1909, and also clearly indicated in the account above referred to, my observations in this connection were confined to the bees of the Cape Peninsula. Since my coming to Rhodesia, and particularly during the past twelve months, the results obtained by me from systematic experiment upon Cape laying workers have included many unmistakable examples of the natural tendency in these bees to propagate females instead of males.

With reference to these results I have found in Rhodesia a vantage-ground for observing the capabilities of Cape bees, for in general appearance the bees of this country differ so greatly from those of the Cape Province, that they are readily distinguished. Furthermore, each of these varieties has a distinct mark which the other has not. I refer to the bright yellow scutellum displayed by Rhodesian workers; and in Cape bees to a projection of the middle veinure of the back wing, not by any means a striking mark, but to the careful observer an infallible distinction.*

Thus a favourable opportunity is afforded for determining the chief points at issue, which could not otherwise be secured than by complete isolation of the bees under consideration; the conditions obtaining being parallel with those brought about in the time of Dzierzon by the introduction of the Italian bee into his country, thereby enabling him to establish his theory of parthenogenesis. Hence, with only one colony of Cape bees, and that queenless, amongst many of Rhodesians producing large numbers of worker-bees from worker-bee's eggs, having all the characteristics of the Cape bee and none of the Rhodesian, it could not reasonably be inferred that the eggs from which this brood proceeded had been purloined from Rhodesian beehives. And, again, if several Rhodesian colonies, all of which having been brought to a condition of hopeless queenlessness at the same time, are found a little later to contain egg-laying workers of the Cape variety and brood hatching Cape worker-bees, there is obviously

* Mr. W. F. L. Sladen in his "Queen Rearing in England" describes a continuation of the middle vein of the hind wing in some of the bees of India, particularly *Apis dorsata* and *Apis indica*. Mr. Sladen's book came into my hands soon after its publication, and on seeing this note I promptly examined specimens of the English, Italian, and native bees in my apiary, to find this feature clearly produced in the latter variety but not in the others. It is remarkable that it is not also found in Rhodesian bees. I believe these South African bees are here recorded for the first time.

only one way to account for such an occurrence, namely, that these Cape laying workers had proceeded from the Cape beehive, and there being no Cape Queen present to account for the eggs which evolved Cape worker-bees, the Cape laying workers themselves must have been responsible for them. These are not imaginary cases, but actual occurrences in my apiary carefully watched and noted. An important circumstance in connection with these examples of the Rhodesian colonies was that no laying workers of their own were produced while the female productiveness of the Cape laying workers lasted. In one instance the Cape bees eventually outnumbered and survived the Rhodesians, and in some others Rhodesian drone-producing laying workers finally occurred. Here let me state that on testing Rhodesian bees for further examples of female parthenogenesis they have been in every instance found to react in accordance with the well-known habit of European races.

I had been led to expect this negative result on the ground that my first acquaintance with the indigenous bees of this country brought to my notice a resemblance to European bees on the one hand and a difference between them and Cape bees on the other. I refer in the first place to their general conduct under certain practical manipulations of bees. For instance, I have found in the case of field bees returning to an empty hive, as often happens after transferring from natural hives and removal to a distance, that it would depend on the numerical strength of the remaining bees, and probably also the nectar resources at the time whether these bees would build drone or worker comb. A small cluster would probably build worker cells, but a goodly number of bees would be sure to construct drone cells; and after a lapse of several days, or probably weeks, one or more laying workers would appear. This is also true of European bees, but does not apply to Cape queenless bees however weak or strong in number, for under similar conditions they would invariably build worker comb, and egg-laying workers would be in evidence as a rule within two or three days. Secondly, anatomical study of Rhodesian bees had revealed to me points of structural difference between them and bees of the Cape Province, in respect of which they are identical with Europeans.

Another advantage of the Rhodesian point of view is that opportunity afforded for testing and answering the interesting question whether the worker-producing worker is to be accounted for as having mated with a drone. The possibility of such an explanation occurred to me when I first became convinced that laying workers were responsible for the production of female brood in queenless hives, and anatomical examinations were carried out by me with the object of elucidating this point. I was by that time familiar with the appearance under the microscope of living spermatozoa as obtained from the seminal receptacles of fecundated queens. The bare signs of the presence or absence of the fertilizing element in the queen may easily be seen with ordinary eyesight, as is well known to the advanced bee-keeper. I had also ascertained the existence of a well-developed sperm sac in Cape worker-bees (which existence I believe has not hitherto been reported), which also the most up-to-date textbooks declare to be entirely absent in both ordinary and egg-laying worker-bees. This is undoubtedly true of European bees, and I may add of Rhodesians as well. So conspicuous is the spermatheca in the bees

I am describing that it may be readily seen with the naked eye. Though small compared with the same organ in a queen its appearance is exactly similar, having the same silvery covering of interlacing nerves which makes it in either case easy of detection. After all that I had previously learned from textbooks on the anatomy of bees the discovery of what I naturally regarded as an abnormality caused me to direct my attention particularly upon this point, but although my dissecting work frequently revealed well-developed ovaries and the presence of eggs, yet the sperm sac in laying workers has never been found to contain anything but a clear fluid like that found in unmated queens. Notwithstanding the existence of this essential organ, the otherwise restricted anatomy of these, like all other worker-bees, forbids the idea of concourse with drones as a possible explanation of their fecundity. In view of this circumstance, my repeated failures to discover sperm cells and the following facts: (1) That I had obtained laying sperm workers at times when queens failed to mate owing to drones being out of season; (2) that all the female offspring of worker-bees that I had seen was of the Cape bee type, even though pure Italian drones had been plentiful in my apiary. I had discarded the theory of drone agency for that of parthenogenesis before writing of my first report on this matter, as that report also clearly implies. Therefore, to return to my narrative, I was not surprised to find Cape fertile workers producing worker progeny that were true to type, although in this instance surrounded by pure Italian and Rhodesian drones, but with no Cape drones in the country.

Having resumed my pen on this subject as an indication that its investigation is still in progress as well as to draw attention to the additional facts here presented, it is not my object at present to reinforce my previous account by a narration of similar experiences (though they have been repeated often enough to furnish material for another article), for my statements, incredible though they may appear to be, have first to be brought by other competent observers to the test of experiments such as have already been sufficiently described. The question of the correctness of my assertions have to be settled in this way and the issue cannot be avoided. The case, as I have briefly put it, is based not upon hypothetical argument but upon facts that are susceptible of immediate proof by those having the inclination as well as the necessary skill and patience for the task. On the first public intimation of this matter it was promptly taken up by Mr. W. Tirrell, of Retreat, Cape Province, and determined for himself in his own apiary. No other bee enthusiast, so far as I am aware, has come forward to corroborate my statements, nor has any one attempted to disprove them by practical demonstration.

In conclusion, I may point out that this claim in respect of the ability to produce female progeny in laying worker-bees is in no way opposed to previous knowledge of facts connected with the intricate and elusive subject of parthenogenesis. The refusal of Cape bees to conform to the preconceived ideas of laying-worker idiosyncracies may merely provide an instance in which the exception to the rule does not oppose but may even reinforce it.