Beekeeping in the IPP Peltier-cooled incubator

Under the direction of biologist Jürgen Tautz the Würzburg BEEgroup is carrying out basic research on bee health.

His **mentor**, Martin Lindauer, who is, along with Nobel Prize winner and behavioural scientist Karl von Frisch, one of the most famous ambassadors of bee research, one day presented him with a beehive. He must have known **Jürgen Tautz** well, because the present had the desired effect. From studying **neurobiology**, Tautz switched his main research field to these wonderful insects whose secrets still fascinate people of all ages. Today the **biology** professor is renowned amongst those scientists, setting the pace in bee research around the world. AtmoSAFE visited him and the students of the **BEEgroup** in their idyllic retreat on the edge of the Würzburg University campus.

Professor and best friend of the bees **Jürgen Tautz** with staff member Hartmut Vierle in the **laboratory**

Zoology's little patient: the honey bee is ill

Acacia, wild flowers, clover, lime-tree blossom, buckwheat, heather, rapeseed, fir, cherry, lemon, apple. From this list of fruit trees and flowers that form the basis of different types of honey, it can be seen how important the **honey bee** is for the preservation of our biosphere. Some 80% of indigenous cultivated plants are dependent on pollination by bees for reproduction and, in particular, to produce good yields. This is true for fruit and berries just as much as for oil plants such as sunflower or rapeseed (mainly pollinated by wind), and many types of vegetables. Our supply of vitamins, plant oils, fibre, trace elements and minerals would no longer be guaranteed in these parts, without the third most important domestic animal, after cattle and pigs.

Health research is an essential part of biology

So what is it that is threatening this small insect, which has been living in symbiosis with man for thousands of years? Apart from environmental toxins, used as pesticides in agriculture, the dangers lie in the impoverishment of our landscapes, in agricultural monocultures and in the risks of a one-sided breeding of these immensely important insects. **Honey bees** are no longer as robust as their wild-living relatives, are less adaptable and more susceptible to disease. The **BEEgroup** at the University of Würzburg dedicates a significant part of its work to **basic research**, especially **bee health research**. Many bees who are involved in this project started their lives in

one of four Memmert IPP Pelt**ier-cooled incubators** in the bee station.

Repeatable conditions in the laboratory: Reproduction of the social uterus in the cooled incubator

In the beehive, pupae are tended and fed in a complex social system until they are finally ready for the tasks assigned to them as young bees. To achieve valid research results, the bees, who are part of the health research, must be raised under constant conditions in the **laboratory** and above all in vitro in a sterile environment, without coming into contact with other bees. It took three years for the researchers of the **BEEgroup** to develop a concept to create a replica of the social uterus in which bee pupae are raised. The greatest problem was food. After numerous series of experiments, the special design food was finally found that could replace the natural "sister milk". Like mammals, the bees feed their brood with special glands.

Marvellous temperature control technology by nature

Magical zoology: photograph of a **heater bee**

It has long been known that bees climatise their nests through their own body heat. Through a variety of studies the Würzburg scientists were able to substantiate these findings. Temperatures fluctuate between 33 °C and 36 °C. From 38 °C and below 28 °C, the larvae die or present serious developmental flaws. The realisation that bees can be “baked” by their sisters in a controlled manner is also relatively new. The breeding temperature has an influence on the learning and communication ability, on how long the bees live, and also on their fitness. **Honey Bees** can regulate the temperature in the hive, and even in specific brood cells, down to a **precision** of 0.1 °C – a masterly performance in **temperature control technology**. Every honey bee can heat its body up to 44 °C, and thus individually climatise the nest, even though there are specialists in the beehive for this very purpose. **Jürgen Tautz** likes to use a striking image for this physiological phenomenon. The bee disengages its wings and floors it, so to speak, by beating its wing muscles rapidly, while moving them imperceptibly outwards. Because of its special anatomy, its rear part remains cool and the warmth emanates only through the chest area, which is used to heat the brood cells.

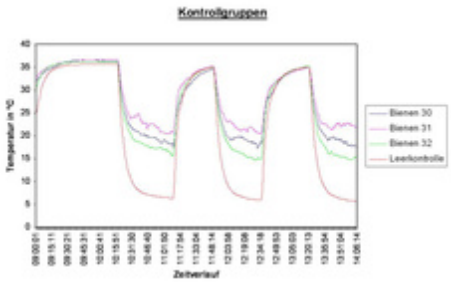
Basic research: fitness test provides

clues as to the causes of disease

Jede mit einem Chip versehene Biene der BEEgroup beginnt ihr Leben in einem Memmert Peltier-Kühlbrutschrank IPP

Let us take a look at one of the numerous experiments in **basic research**, with which insight can be gained into the evolutionary defence mechanisms of bees against parasites and other pathogens. The breeding of test bees in the **cooled incubator** takes place under various precisely defined conditions. Food, breeding temperature, but also selectively chosen bacterial, fungal or viral infections, are some of the most important parameters. In order to research the various effects, the animals are subject to a fitness test in the Memmert Peltier-cooled incubator, which is heated and cooled with extremely smooth-running **Peltier elements** . The advantages of the user-friendly ramp programming of the IPP come fully into their own here. “We lose no time at all in programming or documenting our temperature curves. A further important aspect in choosing our Memmert appliances was the **precise temperature control**. If even the temperature sensors, special sensory cells in the antennae of our bees, measure with a **precision** down to 0.02 °C, and the heater bees regulate the nest temperature down to a **precision** of 0.1 °C, then our uterus that is replicating nature of course needs to keep up with this“, explains professor Tautz. “The **Peltier technology** provides another essential advantage for our bees”, adds Hartmut Vierle. “They are not disturbed by the vibrations of a compressor.”

Evaluating bee health by heating capacity



Temperaturkurven des Fitnesstests im **Kühlbrutschrank**

Over a period of several hours, the animals are continually subject to changes in temperature, in order to stimulate their heating capacity. This heating capacity of the bees is one of the reactions that can be most reliably triggered, and is therefore used as a decisive criterion in being able to assess health and fitness. **Jürgen Tautz**, and his colleagues and students in the **laboratory**, continue to be amazed by the evolutionary masterly work of bee colonies, who have now been around for over 30 million years, and how they manage, in a complex interaction of behavioural changes, innate immune system defences, hygiene measures and

selective climate control of the nest, to cope with ever new dangers, especially ones caused in modern times by man. This last issue gives reason to worry. The **BEEgroup** in Würzburg has not tired of generating publicity for its protégés. Because ultimately the beauty of our planet and the existence of man are closely linked to these wonderful creatures.

Homepage of the **BEEgroup**: www.beegroup.de

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