

## The Influence of Mendel's Beehive Improvements on the Development of Beekeeping in Czech and Slovak Republics

### Vplyv Mendelových ulepšení oulu na rozvoj češského i slovačského pčelarstva

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**Abstract:** Apart from laying down the foundations of genetics, Johann Gregor Mendel was an active beekeeper. In the past, a number of Mendel's experiments with bees have been studied in detail. However, relatively little is known about new beehives Mendel developed. This study investigates Mendel's efforts in improving beehives of the time and how these improvements influenced the later development of apiculture in the former Czechoslovakia. For this purpose, the history of hive construction in Central Europe is briefly reviewed. It is concluded that Mendel rationalized the construction of the Moravian association's hive. His improvements probably inspired other development of association hives in the Czech and Slovak Republics. Some elements of Mendel's hive designs can be seen in later beehives constructed in Czech Republic and Slovakia. It is possible that these hive designs were directly inspired by Mendel's publications. In addition, Mendel was among the first beekeepers in Moravia to construct top opening movable frame hives with shallow boxes. It was not until 1980s that shallow boxes became widely established. Although, the authors of the later shallow box hives were probably not aware of Mendel's work, it is evident that Mendel was well ahead of his time. It is clear that Mendel's influence on modern living is not limited only to the study of genetics.

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**Abstrakcijny:** Krom položení zakladu genetiky, Johann Gergor Mendel byl aktivny pčelovod. V minulosti bylo raziskavano mnoho Mendelovych pčelich experimentu. Medžutym je znany jediny malo o oulech ktore Mendel izmyslil a razvinul. Tuta paper razsleduje Mendelovy usilje při ulepšovani oulu a ich vplyv na razvoj pčelarstva vo byly Československo. Zatom je kratce dany pregled o istorii projektovanje oulu ve srednji Evrope. Nakonec Mendel racionalizoval konstrukciji Moravisjkyho družstevního oulu. Jego praca nadohnutila razvoj inych družstevnich oulu v Čehija i Slovackija. Nekoliko prvok Mendeloveho ouloveho projektovanje jest možno byt videno v pozdnejších oulech v Čehija a Slovackija. Jest možno že tuta konstrukcije byly nadohnutiny bezposrednjo Mendelovymi publikacemi. Dodavanje, Mendl byl medzi prvymi pčelovody v Moravě kto postavili vrhem pristupne oulu s melkimi nastavki. Až v 80. letech 20. stoletje sa široce ustanovili melke nastavki. Hot' pozdnejši avtori pravdapodobno neznali Mendelovu usilje, jest samorazumny že Mendel predstih jeho vreme. Jest takože samorazumny že Mendlov vplyv na naš moderny živjy presahuje studium genetiky.

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## 1 INTRODUCTION

Johann Gregor Mendel is best known for his experiments on the heredity of morphological charaterers in plants. Mendel shared information about his experiments in 1865 and subsequently published them in 1866. His so-called “Mendel's Laws” laid down the foundations of genetics<sup>1</sup>. Mendel's work on heredity facilitated an explosion of animal breeding efforts, including bee breeding<sup>2</sup>.

Beekeeping, or the rearing of honey bees (*Apis mellifera* L. 1758) is an economically important activity that assures pollination of agricultural and horticultural crops as well as of wild plants. Bees also produce a wide range of products such as honey, wax, royal jelly or bee venom that find wide use in food sciences, medicine, manufacturing and cosmetics<sup>3</sup>. As of 2015, more than 54 000 people were engaged in beekeeping in the Czech Republic<sup>4</sup>. Mendel himself kept bees in Brno<sup>5,6,7,8</sup>. In 1870 he became a member of the Moravian Apicultural Society. In 1872 he was elected its vice-president and in 1877 a honorary member<sup>9</sup>.

In the past, Mendel's beekeeping practices and experiments with bees were studied extensively. Mendel attempted controlled mating of honey bee queens, evaluated new honey bee genotypes and studied honey bee forage just to mention a few of his activities<sup>6,9</sup>. For two years he was experimentally rearing *Trigona lineata*, a tropical stingless bee<sup>10,11,12</sup>. Mendel's apiary is functioning up until today<sup>13,14,15,16,17,18</sup>. To commemorate Mendel's beekeeping achievements, the Mendel Bee Research Association (MBRA) was founded in 2011 as a society concentrating on bee research, beekeeping education, publishing and bee breeding<sup>19</sup>.

In addition, Johann Gregor Mendel constructed several hives of his own. Since the advent of beekeeping in Central Europe, beekeepers continue to search for an ideal beehive. This search has produced hundreds of hive designs throughout the course of centuries. Mendel's hive improvements were very advanced for his time<sup>9</sup>. It is interesting to note, that the most important hive developments in the Czechoslovak history originate from Moravia<sup>20</sup>. Given this promising fact, this study examines the historic development of beehive designs in the former Czechoslovakia in relation to Mendel's own hive improvements.

## 2 PRE-MENDEL HIVE DESIGNS IN CZECHIA AND SLOVAKIA

The association of man and honey bees is very old<sup>21,22,23,24</sup> but it was not until the 1840s that various Czech beekeepers attempted to construct practical movable frame box hives<sup>25</sup>. The first successful movable comb frame hive was developed by Jan Dzierzon (Poland) and Lorenzo L. Langstroth (USA) independently in the 1850s. Both hives work on the same principle and show remarkable similarities. The main difference between the two is that Dzierzon's hive opens from the side, while Langstroth's hive opens from the top. This was for a good reason. Dzierzon's hive gained high popularity in German-speaking Europe where apiaries (enclosed buildings with beehives) were traditionally used. Since space is limited in apiaries, it is more practical to open the hives from the side. In America, where beehives were often located in open space, it was more time-efficient to open the

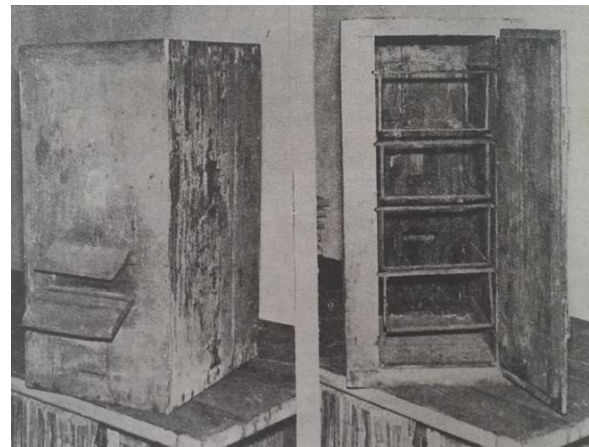
hives from above<sup>26</sup>. Because of limited exchange of information and language differences, top-opening hives did not become established in Central Europe for a very long time.

During this time, hive designs started to diversify. Bee colonies develop differently and give different honey yields in various hives and so beekeepers started to search for an ideal hive. This hive would assure optimal colony development throughout the year and would also be practical for beekeeper to handle<sup>27</sup>. This search known as the “hive question” (úlová otázka in Czech), continues until the present day. Beekeepers often claim that their own hive design is the best but often do not provide experimental evidence to support their claims<sup>29</sup>.

### 3 MENDEL'S HIVE IMPROVEMENTS

During the late 19<sup>th</sup> Century, it was common that each beekeeping association had its own joinery and manufactured hives for their members<sup>28</sup>. This resulted into each association using a different hive<sup>29</sup>. The hive manufactured and promoted by the Moravian Apicultural Association is often referred to as the “Moravian association hive”. Mendel himself initially kept bees in the Moravian association hive<sup>16</sup>.

The Moravian association hive evolved from the Wunder back-opening hives. At the time, the Moravian association hive was considered one of the most advanced hive technologies in the whole of Central Europe<sup>16</sup>. The hive consisted of four chambers each with 10 frames. Each frame had the dimensions of 25x13cm, thus giving a total surface area of 260dm<sup>2</sup>. The bottom three chambers were used as the brood nest, bees stored honey supplies in the uppermost chamber. The brood nest and the honey chamber were separated by a simple wooden queen excluder. A 7.2cm high area known as the “under-ceiling” above the uppermost honey chamber was kept free of bees. This empty space was used by the beekeeper to reach for the frames. The walls of the hive were made of two 1.9cm wide planks, the hollow between the two was filled with sawdust, probably to provide insulation<sup>9</sup>. A photograph of a Moravian association hive Mendel used can be seen in Fig. 1.

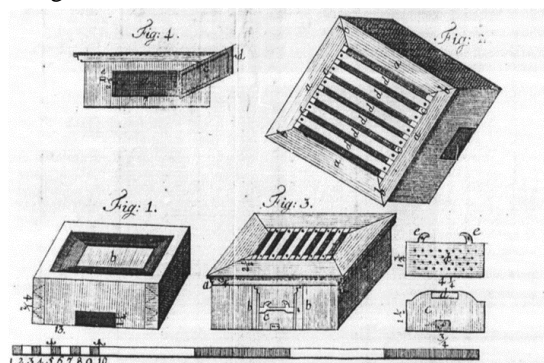


**Fig. 1:** A Moravian association hive Mendel used in his apiary. The hive was reconstructed in 1965 for the G. Mendel memorial symposium<sup>9</sup>.

**Obr. 1:** Moravijsky družstevni úl užívany Mendelem. Tuta úl byl rekonstruován v rok 1965 dlja G. Mendel pametni symposium<sup>9</sup>.

Mendel made several improvements to the design of the Moravian association hive. His improved hive had only two chambers instead of the original four. He increased the size of the frames used. He also removed the under-ceiling and used specially made tongs to move the frames. This resulted into a more space for bees<sup>9</sup>.

In addition to improving the Moravian association hive, Mendel also improved the Christ magazine hive. The Christ's magazine hive was originally constructed by J. L. Christ who published details on it in his book *Anweisung zur nützlichen und angenehmen Bienezucht für alle Gegenden* in 1779. The hive consisted of up to 8 hive boxes with fixed frames. Each hive box had an entrance for the bees and was 12.2x35.2cm. The hive would be placed at a right angle to the beehouse so that the beekeeper could check on the status of his bees by looking through a glass screen at the hive bottom<sup>24,30</sup>. The original design of Christ's magazine hive can be seen in Fig. 2.



**Fig. 2:** A drawing of Christ's magazine hive<sup>30</sup>.

**Obr. 2:** Črtanje Chrsitova oulu<sup>30</sup>.

In 1875, Mendel made himself 4 hive boxes and adapted their dimensions to suit the size of the Moravian association hive. Mendel did not attach the frames to the hive boxes thus creating a movable frame hive. Each hive box contained 10 frames. He made additional measures to prevent the bees from rearing excessive amounts of drone brood. Mendel transferred weak bee colonies into the hives. The colonies gained on strength quickly and continued to develop rapidly<sup>5,9</sup>.

#### 4 POST-MENDEL HIVE DESIGNS IN CZECHIA AND SLOVAKIA

For decades after Mendel's death, back opening hives remained popular. In Moravia, the Moravian association hive was frequently used and in Bohemia, the hive was adapted to make the Bohemian normal hive<sup>30</sup>. Most of these latter designs followed Mendel's hive improvements by abandoning the use of the "under-ceiling" and split the hive into just two chambers. While there is no direct link between Mendel's work and the later evolution of the Moravian association hive and the Bohemian normal hive, it remains possible that Mendel played a significant part in inspiring development of these side opening hives.

Another popular hive invented in the late 1890s and the 1900s that remains very popular among Czech beekeepers until the present day is the Budečák hive. A literature survey of different hive designs of the early 20<sup>th</sup> Century<sup>31,32,33,34,35,36,37,38,39,40,41,42</sup> revealed that the Budečák hive reassembled the closest the Mendel's improved Moravian association hive. It consisted of two chambers - a brood chamber and a honey chamber. A detailed drawing of the Budečák hive can be seen in Fig. 3. An account on the development of the Budečák hive is given in the book Rational Beekeeping in Word and Picture (Pokrokové včelařství slovem i obrazem) published by the Koleč beekeeping company<sup>32</sup>. It reads:

*“When building these hives, we went to school to the greatest masters of practical beekeeping, and since the invention occurred in Koleč by the famous Budeč mountain, we baptised them with the name 'Budečák hives’”*

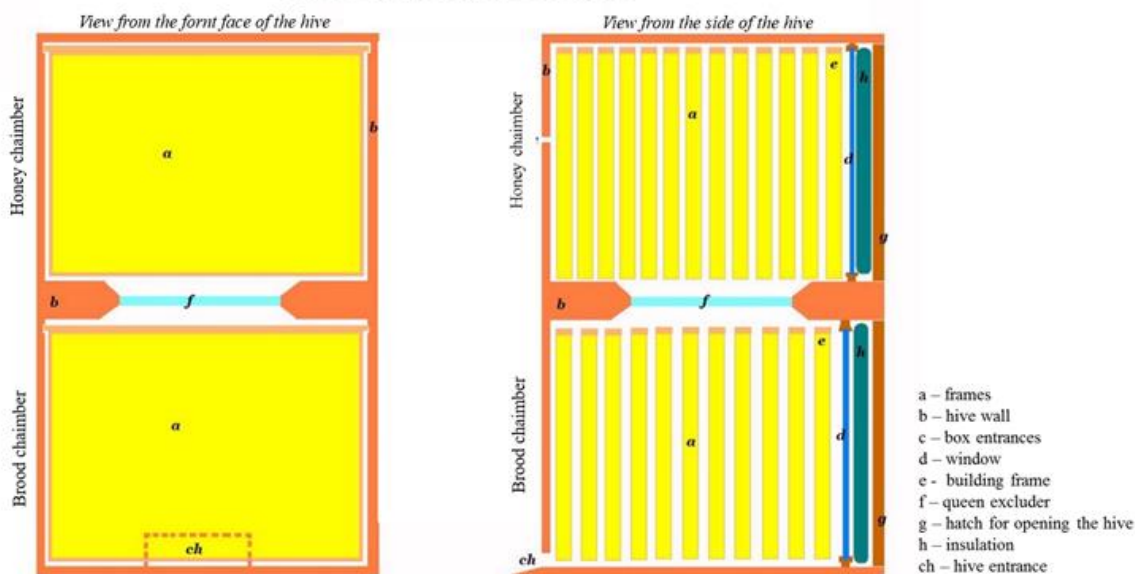
The quote makes it clear that the hive was inspired by several “masters of practical beekeeping”, and that the development of the hive was not influenced solely by the Koleč beekeeping company. Although there is no direct link, it is possible that the development of the Budečák hive was influenced by Mendel's improvements of the Moravian association hive. Mendel's obituary published in the journal *Včela moravská* states that he was considered an outstanding beekeeper<sup>5</sup>. Since there may be a link between Mendel's hive developments and the Koleč beekeeping company, it is possible that Mendel also affected the development of other hives produced by the company such as the Side-opening Czechoslovak hive<sup>32</sup>.

A brief look at the list of exhibited items at the Brno beekeeping exhibition in 1904 reveals the diversity of hive designs available at the time. Most of these hives were back-opening. The 1904 beekeeping exhibition in Brno was an important milestone in beehive construction in the Czech lands. Because of the diversity of beehives that were used at the time, beekeeping associations started to try to unify the frame sizes used in beehives. At the time, three frame dimensions were popular among Czech beekeepers (39x24cm, 48x26cm and 44.8x23.2cm). A vote among the beekeepers showed that the 39x24cm frame size was the most popular and this frame size was from then on promoted by the beekeeping associations<sup>20</sup>.

Back opening hives of the time had a number of disadvantages. Bee overwintering was considered poor, the colonies developed slowly in spring, the hives were expensive and hard to manage. Some beekeepers in Bohemia and Moravia promoted hives that open from the top, these hives were referred to as “American hives” during the beginning of the 20<sup>th</sup> Century<sup>36</sup>. During this time, the hive *Hospodář* was one of the first (if not the first) serially made top opening box hive in Central Europe. By 1904, the many adaptations of the hive were manufactured by at least two companies. This was at least 15 years after Mendel constructed his top opening movable frame box hive. However, the *Hospodář* hive gained little popularity and the production was soon stopped<sup>20,32</sup>. Interest in box hives opening from the top remained minimal during the next decades, as of 1946 only 6.4% of Czech hives followed the *Hospodář* design<sup>39</sup>. Budečák hives were much more popular, they made up 14.7% of the 109 hive systems used in Bohemia at the time<sup>41</sup>. The upcoming decades have been marked with an escalating diversity of beehive types<sup>37</sup>. During the next 50 years, back opening hives such as the Budečák hive grew in popularity. This was because beekeeping in enclosed apiaries and enclosed mobile wagons remained popular<sup>20</sup>. The Budečák hive was also preferred by beekeepers since it was the cheapest of all the hives offered<sup>42</sup>.

In Slovakia, the development of hives started much later than in Czech lands. Beekeeping in log hives or skeps remained popular until about 1885. The first modern beehives that gained wide use in Slovakia were side opening. However, under Slovakian conditions, beekeeping in side opening hives was considered impractical. Beekeepers therefore soon abandoned side opening hives and tried to introduce a standard hive that would then be used by all Slovakian beekeepers. The first wave of hive design unification started in 1935. Three standard hive types were established (Hive A, Hive B and Hive C). These top opening box hives differed only in the frame sizes. Hive A was preferred in areas with scarce nectar flows, Hive C was preferred in lowlands and Hive B was a compromise of the two. The upcoming waves of hive normalisation in 1955 and 1960 largely unified the hive designs in Slovakia and this situation persists until the present day<sup>39</sup>.

### The Budečák Beehive



**Fig. 3:** A schematic drawing of the Budečák hive. Adapted from wikicommons.

**Obr. 3:** Schematičný izkazanje Budečskyho oulu. Po wikicommons.

In Czech Lands, bee hive design was far from unified. Although beekeeping organisations attempted to introduce a standard hive, these were never widely accepted<sup>40,42</sup>. The 1950s showed renewed interest in top opening hives. However, conservative beekeepers did not want to give up their back opening hives. Therefore, a compromise was reached, a hive that could be opened both from the top and the side (universal hives). Although universal hives were already known since the early 20<sup>th</sup> Century<sup>31</sup>, it was not until now that they have been rediscovered<sup>33</sup>. These hive designs included the Moravian universal hive and the Bohemian universal hive. The mid-20<sup>th</sup> century has also seen further endeavour to unify the hive designs used in Czechoslovakia. The Czechoslovak hive was designed for this purpose; however, it was not adapted by all the beekeepers in the republic<sup>39</sup>. Quite in contrary, new box hive designs began to be manufactured during the 1950s (Tachov hive, Třeboň hive, K39 hive). The Tachov hive, Třeboň hive and the K39 hive were heavily insulated<sup>20</sup>.

The 1980s showed further diversification in hive designs. A group of Moravian beekeepers led by doc. RNDr. Vladimír Ptáček, CSc. constructed a new box hive known as the Optimal hive. This hive consists of very shallow boxes, the frames are only 17cm high<sup>43</sup>. The Optimal hive became a pioneer of shallow box hive technologies in Czechoslovakia and became widely established. It was followed by similar shallow box technologies such as the Slezánek hive. In order to further promote shallow hive technologies, the Optimal Club was founded. The development of shallow box hives inspired the construction of combined hives (i.e. hives that use both shallow and deep boxes). A contemporary example of such a hive is the Sedláček hive<sup>44</sup>.

In 2000, the Czech Beekeeper's Association (PSNV CZ) was founded to promote the Langstroth hive. Although at the time the Langstroth hive was more than 150 years old and used around the whole world, its establishment in Czechia and Slovakia was prevented by language differences and different political ideology. In 2004, the *Moderní včelař* magazine was founded to promote box hive technologies<sup>45</sup>. Today, the hive designs in Czech and Slovak republics remain diverse, but are dominated by movable top opening box hives. A number of back opening hives still remain in operation<sup>20</sup>.



## 5 CONCLUSION

As was seen above, we know of two beehives Mendel constructed: i) he improved the Moravian association hive and ii) improved the Christ magazine hive. Mendel informed other beekeepers about his experiments with the new hives during the meetings of the Moravian Apicultural Society. His contributions were also published in the association's bilingual journal *Včela brněnská (Die Honigbiene von Brünn)*<sup>51</sup>. It however remains questionable if Mendel's hives were used by beekeepers at the time he published his records.

An extensive literature survey of many Czechoslovak beekeeping books and catalogues<sup>31,32,33,34,35,36,37,38,39,40,41,42</sup> revealed, that some later hive systems show some similarity to hives Mendel devised. A hive that shows remarkable similarity to Mendel's improved Moravian association hive is the Budečák hive. It was used from the late 19<sup>th</sup> Century, its popularity peaked before the 1950s and remains in use today. Just like Mendel's improved Moravian association hive, it uses only two chambers, has a similarly installed queen excluder and lacks the under-ceiling. It remains to be elucidated if the two hives developed independently of each other or if the Budečák hive was influenced directly by Mendel's publications. The latter is very likely, since the journal *Včela brněnská* was read throughout Central Europe and was very popular among beekeepers at the time. The inventors of the Budečák hive also acknowledge that the development of the hive was influenced by a number of "masters of practical beekeeping"<sup>31</sup>. It is likely that Mendel's work inspired other beekeepers to improve their association's hives<sup>5</sup>.

Mendel also constructed his own adaptation of Christ's magazine hive. He probably based his construction on the original German book published by J. L. Christ<sup>29</sup> but he improved the hive significantly. Like this, Mendel became one of the first beekeepers using movable frame box hives in the Czech Lands. He was probably one of the earliest shallow box beekeepers in the former Czechoslovakia. The serially made box hive *Hospodář* was manufactured for a brief period during the 1900s. It was not until the 1980s, when the shallow box hive *Optimál* became popular in Czechoslovakia<sup>46</sup>. This was some 100 years after Mendel's first experiments with the improved Christ's magazine hive. The earliest developers of the *Optimál* hive<sup>43,47,49,50</sup> were probably not aware of Mendel's shallow box hives, they were mainly inspired by American and Slovak beekeepers of the 1960s<sup>36,48,50</sup>. It therefore seems that Mendel did not directly influence the development of shallow box hives in the Czech and Slovak Republics, but he was certainly one of the first beekeepers to experiment with this new technology.

In conclusion, apart from laying down the foundations of genetics<sup>1</sup>, Johann Gregor Mendel was a respected beekeeper<sup>5,6,7,8,9,10,11,12,13,14,15,16,17,18,51</sup>. He originally kept bees in the Moravian association hive<sup>16</sup>. He later made several improvements to the Moravian association hive. It is likely that his experiments inspired other beekeepers to also improve their association's hives<sup>5</sup>. Some back opening hives constructed later such as the Budečák hive show similarities with Mendel's improved Moravian association hive. It is possible that Mendel's experiments with back opening hives influenced other hive designs. Back opening hives remain popular up until the present day. In addition to this, Mendel improved the Christ magazine hive<sup>29</sup>. Like this, he became one of the first shallow box beekeepers in the Czech lands. It was not until the 1980s shallow box beekeeping was rediscovered<sup>33,43,44</sup>. Although it seems unlikely that later beekeepers were aware of Mendel's shallow box hive, Mendel was certainly ahead of his time. It is therefore evident that Mendel's influence is not limited to the establishment of genetics.

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