History of secondary minerals discovered in Jáchymov (Joachimsthal)

Historie objevů sekundárních minerálů z Jáchymova (Czech summary)

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Jáchymov is type locality for 22 minerals, including 17 secondary minerals. Data on history of discovery and description of new minerals was extracted by search in old literature. Minerals are arranged in the chronological sequence of discovery.
Explanation of names of discredited or re-defined minerals and some historical names is included at the end of this paper.

Key words: secondary minerals, history description, old mineral names, Jáchymov

Introduction

Mining in Jáchymov experienced episodes of boom as well as periods of severe decline. Its prosperity was dependent of mineral wealth and during ages the main interest moved from silver to uranium ores. Mineralogy, mining and ore dressing proved to be often mutually interdependent. The beginnings of mineralogy in Jáchymov date to mining development in early 16th century. The first mineralogical notes appear in texts by Agricola [86], Mathesius, Ercker, and others.

The first scientific information on minerals and rocks from Jáchymov was presented in 1772, 1775, and 1790 by Born [181], [197] who described 207 specimens. Born used traditional mineralogical terminology by Linné and Cronstedt but in his third monograph he used chemical system introduced by Lavoisier and crystallographic terminology of Romé de l'Isle. Kratochvíl [118] transferred descriptions by Born in terms of modern mineralogy and concluded that Born described secondary minerals, which were later introduced as uranopilite and cuprosklodowskite. Haubelt [182] undertook a similar interpretation but concluded that Born did not describe the two mentioned uranium minerals. He suggested that Born [181] described gypsum and earthy Ag_2S, Haubelt [182] also suggested that annabergite, arsenolite, bismite, erythrite, pyrolusite, and zippeite can be recognised among the minerals described by Born [197].

Similar to Born, other old descriptions of Jáchymov specimens deal mainly with primary ore minerals.

During the period 1842 to 1856, mainly J. F. Vogl described over 30 mineral species from Jáchymov. By that time the Jáchymov minerals were studied by Haidinger, including seven new minerals, which are at present considered as valid species. Tschermak published a number of papers on Jáchymov minerals in the years 1860-1870.

This work was continued a decade later by Schrauf. Larsen extensively studied the optical properties of Jáchymov minerals at the beginning of the twentieth century.R. Nováček (1935-1941) studied in detail mainly secondary minerals from Jáchymov. X-ray diffraction, widely introduced after 1945, provided a new powerful method of mineral identification. Frondel and Peacock continued study of Jáchymov minerals. But only museum specimens were available by that time.

The secrecy surrounding uranium mining in the period 1945-1960 resulted in absence of detailed mineralogical study of material mined at that time and in absence of study material. The mining district was declared as exhausted by 1960 and all the mines were closed in 1964. Owing to shortage of funding and time, a systematic study of secondary minerals was never undertaken.

Following table shows how the numbers of Jáchymov minerals recognised were increasing during the last two centuries:

	minerals			
	secondary	primary and gangue	rock forming	total
beginning of the 19th century [189]	2	15	1	18
1842 Zippe [189]	11	23	1	35
1856 Vogl [189]	40	33	10	83
1927 Ježek [189]	53	43	11	107
1950 Kratochvíl [118]	64	58	28	150
1965 Tuček [141]	65	62	29	157
1997 this study	207	73	44	310*

** plus 30 unnamed phases (see another paper)*

Despite of all the adverse developments, the Jáchymov mining district is of world-wide renowned. The following table lists 22 minerals for which Jáchymov is the type locality.

Minerals for which Jáchymov is the type locality

mineral		chemical formula	author
Uraninite		UO_2	Brückmann (1727)
Torbernite	*	$Cu(UO_2)_2(PO_4)_2$. 8 - 12 H_2O	Werner (1793)
Sternbergite		$AgFe_2S_3$	Haidinger (1827)
Haidingerite	*	$CaH(AsO_4)$. H_2O	Turner (1827)
Johannite	*	$Cu(UO_2)_2(SO_4)_2(OH)_2$. $8H_2O$	Haidinger (1830)
Bornite		Cu_5FeS_4	Haidinger (1845)
Zippeite	*	$K_4(UO_2)_6(SO_4)_3(OH)_{10}$. $4H_2O$	Haidinger (1845)
Voglite	*	$Ca_2Cu(UO_2)(CO_3)_4$. $6H_2O$	Haidinger (1853)
Lindackerite	*	$H_2Cu_5(AsO_4)_4$. 8-$9H_2O$	Vogl (1853)
Uranopilite	*	$(UO_2)_6(SO_4)(OH)_{10}$. $12H_2O$	Dauber (1854)
Akanthite	*	Ag_2S	Kenngott (1855)
Argentopyrite		$AgFe_2S_3$	Waltershausen (1866)
Isoklasite	*	$Ca_2(PO_4)(OH)$. $2H_2O$	Sandberger (1870)
Schröckingerite	*	$NaCa_3(UO_2)(CO_3)_3(SO_4)F$. $10H_2O$	Schrauf (1873)
Mixite	*	$BiCu_6(AsO_4)_3(OH)_6$. $3H_2O$	Schrauf (1879)
Uranophane-beta	*	$Ca(UO_2)SiO_3(OH)_2$. $5H_2O$	Nováček (1935)
Metauranopilite	*	$(UO_2)_6(SO_4)(OH)_{10}$. $5H_2O$	Nováček (1935)
Brassite	*	$MgHAsO_4$. $4H_2O$	Fontan et al. (1973)
Nickel-zippeite	*	$Ni_2(UO_2)_6(SO_4)_3(OH)_{10}$ .16 H_2O	Frondel et al. (1976)
Krutovite		$NiAs_2$	Vinogradova et al. (1976)
Albrechtschraufite	*	$Ca_4Mg(UO_2)_2(CO_3)_6F_2$. $17H_2O$	Mereiter (1984)
Jáchymovite	*	$(UO_2)_8(SO_4)(OH)_{14}$. $13H_2O$	Čejka et al. (1996)

Seventeen phases among the 22 minerals listed, i.e., 77%, are secondary minerals, marked by an asterix ""*

The present study of old literature on secondary minerals from Jáchymov provided often fragmentary pieces of information which gradually evolved to an integrated picture of the history of individual type specimens and their description. This history includes various interesting aspects which gave impetus to writing this chapter.

The following text reviews the secondary minerals for which Jáchymov is the type locality. The mineralogist's name given next to mineral name is widely considered as the name of author of the original mineral description. However, more than a century ago, the practice of introducing new minerals was often different from the present procedures and somewhat complicated in some cases. On several instances, these mineralogists were rather authors of the name, than authors of the original mineral description. For example, Haidinger only described crystal morphology of a mineral, which he named johannite, while a qualitative chemical analysis of the mineral named *Uranvitriol* was published by John in 1821 and 1845. Websky is considered as author of uranophane (from Silesia), though he reported a qualitative analysis only in 1859, while a complete description of the mineral (from Wölsendorf) was provided by Bořický, who coined the name uranotile for this species. Nováček is considered as the author of uranophane-beta, though he described the phase under the name β-uranotile. An extreme case is represented by the mineral voglite. It was completely described by Vogl under the name *Uran-Kalk-Kupfer-Carbonat*; though Haidinger only introduced the name voglite for this mineral, he is considered as author of the mineral description.

Haidinger must be credited for introducing mineral names, which compare well with the present practice of mineral nomenclature. In the past century, many impractical and unsuitable names were in usage. When Werner introduced torbernite, he was opposed for naming a mineral after a person. In support of his suggestion, Werner quoted two examples from the history of mineralogy. Obsidian was introduced by Plinius to honour Obsidius who brought the specimen from Ethiopia; witherite was named after Dr. Withering, who discovered the mineral [216]. It was a second case only after prehnite (to honour Colonel von Prehne). The present authors do not want to diminish the Haidingers contributions to mineralogy - the aim was to point the complicated history of some minerals recognised in Jáchymov and the history of science.

Torbernite - Werner 1793

The first description of the green micaceous mineral was probably by I. Born in 1772, who coined the name *mica viridis crist.* [181]. It is not clear which mineral he named as green mica, but it is certain that the mineral originated from Jáchymov. In absence of green rock-forming micas in the district, it is very probable that it was a uranium mica.

Green micaceous mineral is again mentioned in the Werner's translation (1780) of the mineralogy textbook by Cronstedt. Werner described rare green mica from the mine Georg Wagsfort in Johanngeorgenstadt and from Eibenstock and classified it as a subspecies besides light mica (muscovite), dark mica (biotite) and common mica (zinnwaldite) [320]. Werner inferred that the green mica contains iron since it is associated with iron oxides. Later, on Werner's request, the green mica was analysed by Bergman who determined copper, alumina and chlorine. (UO_2 was isolated in 1789 and uranium as late as in 1841.) The analysis was done prior to 1784, since in this year Tornbern Olof Bergman died. According to Hofmann (1788, 1789), Werner introduced the name *Chalkolith* [113], [223] for the green mineral to express copper content. This happened before 1788, not in 1789 as given by Dana [98].

In 1789, Klaproth isolated from uraninite from the Georg Wagsfort mine supposed uranium which, however, was in fact UO_2. He found that the same compound is present in the green micaceous mineral and a yellow ochre from the same locality.

The names *Chalkolith* and *Torbernit* appear in the list of minerals by Estner [323], compiled in 1790. Karsten, a student with Werner, while defending Werner's methods of mineral descriptions against criticism by Estner in 1793 [323], characterises the history of the name in the following way [322]: Werner named the green micaceous mineral from the Georg Wagsfort mine *Torberit* in allusion to Bergman's christian name. After Bergman determined Cu, Cl and Al in the mineral, Werner changed the name to *Chalkolith*. After repeated analyses by Klaproth confirmed the presence of Ca and U, and Cu appeared only as a minor variable component, Werner returned back to the original name.

Obviously, in the text by Karsten, there is a spelling error in the name *Torberit*. It is understandable that Werner named the mineral after the analyst. Leaving aside the question if the explanation by Karsten is completely correct, it is certain that the original locality for the mineral named *Chalkolit* and *torbernit* is the mine Georg Wagsfort. The reason for the repeatedly published statement that the type localty is Jáchymov is possibly the original description of the green micaceous mineral by Born.

Haidingerite - Turner 1827

Haidinger [225] described morphology of two types of crystals on a specimen in Ferguson's collection in 1825, which he considered as a variety of pharmacolite. He inspected the collection in 1824 probably in Edinburgh. A locality of the specimen was unknown. The analyses of the crystals by Turner [226] showed that one type of crystals corresponds to pharmacolite, but the second type of crystals was of a new mineral. Haidinger did not name this mineral, probably because he was not convinced in validity of the data. In 1827, Turner named this new mineral haidingerite. (Description of yet another mineral on the same specimen indicates that it was brassite, a species described only 150 years later.)

Tschermak [224] described haidingerite in two specimens from Jáchymov in 1867, deposited in the Emperor's Museum in Vienna. He described crystal morphology of the mineral. Tschermak mentioned that after publication of the paper in 1825, Haidinger came to conclusion that the Ferguson's sample was from Jáchymov. Tschermak [224] gave also a complete description of a new mineral for which he introduced no name; consequently this mineral was described only 100 years later as brassite.

Johannite - Haidinger 1830

Johannite was first found in Jáchymov in 1819 during re-opening of an old adit on the Geister vein in the Eliáš mine. Specimens deposited in the collection of the mining official of F. Peška were inspected by Haidinger in spring 1826, when he visited Jáchymov in the company of Robert Allan from Edinburgh. Haidinger met R. Allen before, while staying with his father, banker Thomas Allan, during his travel to Edinburgh in 1823-1825. John obtained one specimen for his study some years ago, the remaining pieces were purchased by Kašpar Šternberk for the Museum of the Bohemian Kingdom in Prague. In 1829, Haidinger obtained specimens of johannite from this museum for his study. John [165] described johannite from Jáchymov as a new mineral under the name *Uranvitriol* in 1821; his analysis included only quantitative determination of SO_3 and uranium. Haidinger named the mineral johannite in honour of Austrian Archduke Johann [161] in 1830 [272].

The second find of johannite took place in 1850 and 1851 [59] during re-opening of an adit on the Fluther vein in the Barbora mine and another specimen was collected on the Fiedler vein in the Eliáš mine. No additional johannite was found until 1927 [189].

Lavendulane - Breithaupt 1837

The information on type locality given by Nickel and Nichols [228] is in error. According to Breithaupt [222], Annaberg is the type locality of lavendulane.

Zippeite - Haidinger 1845

Zippeite from Jáchymov was first studied by Franz Xaver Maxmillian Zippe [161], Austrian mineralogist and curator of the mineralogical collection of the count Kašpar Šternberk. This collection later formed the first major part of the mineral collection in the National Museum, Prague. In 1845, Haidinger [170] named this mineral zippeite. John [165] described this mineral as early as 1821 under the name basisches schwefelsäures Uranoxyd. Vogl [59] published first chemical analyses of zippeite by Lindacker in 1857.

In absence of a type specimen, Frondel [24] redefined zippeite using a specimen analysed by Nováček [24]; the specimen was donated from the mineral collection in the National Museum, Prague.

Voglite - Haidinger 1853

Voglite was described from Jáchymov in 1853 by Vogl [60] under the name Uran-Kalk-Kupfer-Carbonat. Haidinger named this mineral in honour of Josef Florian Vogl, mining officer and mineralogist, who published papers on uranium minerals from the Jáchymov mines [161].

"*Undoubtedly, mineral names based on chemical composition are not quite suitable... it appears appropriate now to coin a specific name for this mineral species. I believe that my suggestion of the name VOGLITE could be widely accepted in memory of the tireless, diligent and sharply observing researcher, who saved this finely crystallised independent species and dedicated it to min-*

eralogists and mineral collectors", W. Haidinger, 1853, [60].

The specimens were collected by Vogl in the Fluder vein, Eliáš mine, in a depth of 150 to 170 m. The present inspection of the rare specimens kept in museums in Vienna, Graz in Styria and Freiberg suggests that all the pieces preserved may originate from a single site.

A quantitative chemical analysis of the mineral was done by Josef Lindacker from Abertamy in 1853 [60]. No modern analysis of this mineral does exist.

Lindackerite - Vogl 1853

This rare mineral was described in 1853 by Vogl [125] in specimens from old workings on the Geister and Červená veins in the Eliáš mine. It overgrows complex Ni, Co, Bi, Pb, Cu, and Zn ore and associates with erythrite, annabergite, pitticite, and ganomatite.

The mineral was named by Haidinger [118] after pharmacist and chemist Josef Lindacker from Jáchymov and Abertamy, member of the Imperial Geological Institute in Vienna [95], who first analysed this mineral and number of other minerals from Jáchymov.

Uranopilite - Dauber 1854

Uranopilite was first described in 1854 in a specimen from Jáchymov by Dauber [171] under the name *basisches Uransulfat*. The name uranopilite was introduced later by Weisbach [172]; besides uranium, the name derives from the Greek word for felt, in allusion to the appearance and silky lustre of uranopilite aggregates.

Acanthite - Kenngott 1855

Acanthite was described by Kenngott [221] using two specimens collected in Jáchymov in the 18th century, deposited in the Emperor's collection in Vienna. One of these specimens in listed in Mohs's catalogue of this collection under No. 2592, the other specimen is listed in the catalogue of Stütz from 1806. The name derives from the Greek word *acantha* for the arrow-like shape of the crystals [221].

Schröckingerite - Schrauf 1873

This mineral was discovered by the Austrian geologist Julius Schröckinger von Neudenberg (1813-1882), who visited Jáchymov in the function of the vice-president of the *Land* Financial Directorate in 1873, after a major fire [227]. During mineral collecting in a drift through the Evangelista vein, he collected a rare *Uranoxyd-Karbonat*, which was studied by professor Schrauf. He identified this material as a new mineral, which he named schröckingerite. Another specimen was found by Schröckinger in collection of the Imperial Ministry of Agriculture in Vienna; this piece from the Geister vein was listed as *Urangrün*. He found yet another specimen in the collection of the Benedictine charitable institute of St. Peter in Salzburg [159].

Isoclasite - Sandberger 1875

This mineral was described by Sandberger in 1875 on a single specimen from Jáchymov, which was deposited in 1875 in a collection of University in Würzburg, Germany. According to Sandberger, there is no doubt on the origin of this specimen, because it was listed in the old catalogue of this collection by Blank.

Therefore, the history of isoclasite sample is closely connected with a history of the Blank's collection. This collection was founded by Joseph Bruno Anton Blank, former member of the Minorits order in the Würzburg monastery (serving under name Joseph Bonavita Blank), sometimes before 1796. The collection included besides natural objects also pieces of art, which Blank acquired during his prolonged stay abroad. In 1803, he gave this collection of 28 710 items to the Würzburg University for a life rent of 1500 gold coins paid anually. Blank published a catalogue of his collection in 1796 and of new additions in 1820. The scope of the collection is indicated by the fact that it included 104 glass window cases housing minerals. Blank, Doctor of Philosophy, Professor of Philosophy and Natural Science at the Würzburg University, died in 1827.

Professor Rau was then nominated as director of the collections. Since 1830 the mineral collection became independent from the other collections. In 1863, Fridolin Sandberger (known for formulating the lateral segregation concept of vein-type ore deposits) was appointed to the post of professor of mineralogy and geology and curator of the mineral collection. Sandberger reorganised the collection and prepared a new catalogue. In 1903, under instructions of the curator professor Beckenkamp, the collection was moved to new building. The collection was again transferred to provisional place in 1943, when the premises were turned to military hospital. During advance of allied armies in Würzburg the collection was significantly demaged, though the most valuable exhibits were secured in time. The U.S. Army was using the museum building till 1947 and the collection was moved temporarily to the Institute of Anatomy. Finally, on February 23, 1972, the collection was moved to the new building of the Institut für Mineralogie where it remains till present [309].

Isoclasite was described as transparent crystals, altered in part into milk-coloured material. The transparent phase should be hydrated Ca phosphate, the milky mineral hydrated Na-Mg phosphate. Density of the transparent mineral is 2.92 $g.cm^{-3}$.

The chemical composition reported by analyst Köllnitz is surprising in the context of Jáchymov mineralogy, since phosphates are of rare occurrence and there is a general tendency to prevalence of As over P. The analysis is probably not reliable, since the analysis of apatite from India by the same author, published in the same paper, gives atomic ratio Ca : P = 2.96, instead of the correct value 2.50. Density for the analysed apatite from India is given as 2.7 $g.cm^{-3}$ (correct value for apatite 3.1 $g.cm^{-3}$ [212]).

The isoclasite specimen was probably lost during some of the numerous movings of the collection, since it could not be located at present (written information by

Professor M. Okrusch); consequently, a restudy is not possible.

Larsen (1921) published refraction indices for isoclasite and stated that the specimen studied was from the Roebling collection, placed at present in the Museum of Natural History - Smithonian Institution in Washington. According to written information by P. Dunn (1996), there is no isoclasite specimen in this collection, as it was probably loaned for study and used up. The description of the mineral by Larsen differs from the Sandberger's description.

No other description or find of this mineral has been recorded.

Mixite - Schrauf 1879

Mixite was first found in Jáchymov at the sixth level of the Geister vein in Werner mine [137] in 1880 by mining counsellor Anton Mixa from Příbram [227]. The mineral was described by Schrauf [136] and named after A. Mixa.

He described yellow bismite and torbernite associated with mixite and was baffled by this assemblage of phosphates and arsenates, which he explained by different affinity of respective anions in relation to U and Bi. Schrauf determined in his analysis less Bi and surplus water compared to the ideal formula.

Uranophane-beta - Nováček 1935

This mineral was first described by Nováček [35], [36] under the name β-uranotile. The study by Nováček was based on specimens Nos. 8100 and 9761 in the collection of the Mineralogical Institute of the Charles University and specimen No. 21213 in the National Museum, Prague.

The name introduced in 1935 was changed to uranophane-beta as a consequence of priority of the name uranophane [206], [207] in relation to uranotile [124]. Though the description by Websky was imperfect, inaccurate, based on a qualitative chemical analysis of a mixture, determination of density and hardness. The name indicates that the species is a second polymorph of uranophane. Besides uranium, the name derives from the Greek word for *to contain, or exist*.

Meta-uranopilite - Nováček 1935

Meta-uranopilite was first described by Nováček [35] under the name β-uranopilite in 1935. The name meta-uranopilite was used by Nováček only in 1941 [196]. He mentioned this name as a more suitable one, however, compared to the formerly used name β-uranopilite, he believed that the change of name would result in confusion. The present name with the prefix *meta* was adopted following recommendation by Frondel [174].

Metauranopilite description is based on a single specimen No. 17365, Mineralogical collection, National Museum in Prague. During the present revision, we have found specimen carrying this number, but the specimen is labeled as *uranosphaerite* from Jáchymov and differs from the specimen described by Nováček. This indicates that some of the specimens were re-numbered. The present X-ray and chemical analyses identified vandendriesscheite, compreignacite and uranophane as the main minerals and no sulphur-bearing mineral is present. Specimen No. 24272 in the same collection is labelled as beta-uranopilite and carries yellow long acicular crystals containing U, Si and Ca. X-ray powder diffraction data indicate a mixture of uranophane and lesser amount of schoepite. Čejka et al. [6] also noted that they could not find the original specimen studied by Nováček. Uranopilite has never been examined by X-ray diffraction. Nováček [196] stated that after previous analyses there is not sufficient material for a new analysis.

Brassite - Fontan et al. 1973

The study by Fontan et al. [210], based on museum specimens from Jáchymov, is considered as the original description of brassite. Fontan recognised the mineral as new phase in 1958. This mineral formed by dehydration of rösslerite. The name is in honour of Réjane Brasse, who first synthesised a similar compound.

This mineral was described from Jáchymov by Tschermak [224] as early as 1867 as an unknown phase, for which he did not introduce new name, though he presented a quantitative chemical analysis (which compares well with that by Fontana et al.). He determined correctly the number of H_2O molecules in brassite and recognised that it forms by a spontaneous dehydration of rösslerite. The specimen studied by Tschermak was in the Emperor's mineralogical collection in Vienna for a long time; it contained haidingerite and pharmacolite in addition to brassite.

Fontan et al. did not note that the papers of Haidinger [225] and Turner [226] describing haidingerite contain rather detailed description of the mineral later named brassite, including the content of As_2O_5, H_2O, and determination of Mg. Turner considered this mineral for picropharmacolite, because at that time neither rösslerite nor any other arsenate of Mg was known. Haidinger saw the brassite-bearing specimen in the collection of Ferguson in spring 1824, without a locality name [225] and later concluded that the locality is Jáchymov [224].

Nickel-zippeite - Frondel et al. 1976

The name of the mineral derives from its chemical composition. Nickel-zippeite was described on specimens from Happy Jack mine (Utah) and from Jáchymov [24].

Albrechtschraufite - Mereiter 1984

Albrechtschraufite was presented to the Commission on New Minerals and Mineral Names (IMA) by Mereiter in 1983. The type specimen originated in Jáchymov, without further specific location. Data on albrechtschraufite remained unpublished. Mereiter probably solved the crystal structure of this mineral. An abstract on crystal structure [62] is the only published information.

Jáchymovite - Čejka et al. 1996

The name jáchymovite was used in 1935 by Nováček [35] for cuprosklodowskite from Jáchymov. Since Nováček [35] identified jáchymovite as cuprosklodowskite, the name was abandoned.

A new phase identified in 1979 in a single specimen from Jáchymov was described by Čejka et al. [18] and named jáchymovite. The specimen No. NM 68905 is in the collection of the National Museum, Prague.

In the opinion of the present authors, jáchymovite is identical with the mineral studied and described by Nováček in 1935 as meta-uranopilite. Unfortunately, neither type material, nor any other specimen of meta-uranopilite is available. Methods used in the study of jáchymovite differ from the methods used by Nováček, which hampers a closer comparison. Megascopic properties of both phases are comparable. Examination of additional specimens of jáchymovite shows parallel extinction as described for meta-uranopilite. Nováček gave refractive indices only with two digits to the right of the decimal point, instead of normal 3 or 4 digits in his papers. This indicates problems with more accurate measurement. Assuming that a standard deviation of 0.01 applies to the values given by Nováček, then indices of refraction of the two minerals are similar.

Chemical analyses could provide important comparison. However, the analysis given by Nováček is incomplete and based on impure material. With regard to rather broad limits thus imposed, the chemical analyses for jáchymovite and meta-uranopilite are similar.

Discredited or re-defined minerals and mineral names and historical names

Antimonoker
According to Ježek [189] corresponds to cervantite.

Arsenige Säure
According to Ježek [189] corresponds to arsenolite.

Basisches Uransulfat
Dauber's name from 1854 for uranopilite.

Bismutospherit (bismutosférit)
Bismutospherit was described in old literature as Bi-carbonate in prismatic crystals with curved and scaly faces, hollow inside. The crystals are grey green or brown green [118]. The description and name is probably the same as for *waltherite* (see *waltherite*).

β - uranopilite
The name originally introduced by Nováček [35] for meta-uranopilite (see also meta-uranopilite).

β - uranotile
The name originally introduced by Nováček [35] for uranophane-beta.

Eisenvitriol
According to Ježek [189] corresponds to melanterite.

Eliasite
Synonym for gummite. The mineral is red brown in colour and hyacinth-red on edges, with orange to waxy yellow streak. Transparent in thin splinters. Lustre waxy to vitreous. Fracture conchoidal to uneven. Hardness 3.5. Density (average from three determinations) = 4.129 $g.cm^{-3}$ (measured by V. von Zepharovich).

Chemical analysis was done by F. Ragsky in the laboratory of the Austrian Imperial Geological Institute, Vienna: UO_2 (?-Uranoxyd) 61.33, CaO 3.09, Fe_2O_3 6.53, FeO 1.09, PbO 4.62, Al_2O_3 1.17, MgO 2.20, SiO_2 5.13, CO_2 2.52, P_2O_5 0.84, H_2O 10.58, As - traces, Total 99.10 wt. %

Eliasite is soluble in hydrochloric acid; it shows effervescence in acids. To 100 °C it looses 5.81 wt. %, to 300 °C additional 4.77 wt. % of water. According to Vogl, examination with blowpipe shows reaction indicating presence of uranium and iron, and corresponds to the behaviour of gummite.

Eliasite differs from gummite in its chemical composition, in particular the content of lead and by different appearance, as it is darker. Eliasite is amorphous and occurs as tabular remains of the former ore vein. According to Vogl, it was found in the Fluther vein, which intersects the Eliáš vein in western section of the Eliáš mine and trends h. 22 to 23. An additional find of eliasite lense 15 by 30 cm in size took place in the Barbora adit, 160 to 170 below surface.

(A packet containing pieces of the new mineral similar to gummite, sent by J.F. Vogl, mining officer in Jáchymov, was delivered to the Imperial Geological Institute, Vienna, on 23 rd November 1852. The specimens were examined by W. Haidinger and named on the proposal of the finder as eliasite.)

Flutherite
Weisbach's name for liebigite

Ganomatite
It was described as green or yellow brown to greyish, transparent to translucent coating in old workings, on weathered veins and ores, with erythrite, annabergite, lavendulan, gypsum, skutterudite, native bismuth, pyrite, and chalcopyrite. It is probably a mixture of minerals. Ulrich [195] stated that ganomatite differs from pitticite (an adsorption mixture of colloid arsenate and sulphate of iron) by containing Sb_2O_3 and Ag.

Gänseköttig Erz
A synonym for *ganomatite*

Hornsilber
Chlorargyrite

Hypochlorite
The name was introduced by Kenngot for an unidentified mineral accompanying bismutite. It occurs as yellow green to brown transparent prismatic crystals with a vitreous lustre. According to Lindacker, it contains Bi, SiO_2, CO_2, H_2O [118].

Chalcolithe
According to Ježek [189], a synonym for torbernite.

Kieselkupfer-Uranoxyd
Name introduced by John in 1845 for the mineral later named cuprosklodowskite.

Kobaltblau
According to Ježek [189], a synonym for lavendulan.

Kobaltblüthe
According to Ježek [189], a synonym for erythrite.

Kobaltvitriol
According to Ježek [189], a synonym for bieberite.

Kupfervitriol
According to Ježek [189], a synonym for chalcanthite.

Medjidite
Medjidite was described as a sulphate of U and Ca, but also as a basic sulphate and oxide of uranium. It is lemon yellow to orange yellow, forms translucent crystals, scales and tetragonal prisms in radiating aggregates, associated with uranium ochre in veins and wallrock fractures. It occurred in the Fluther vein in the upper Barbora adit [118]. Kašpar [106] considered *medjidite*, in its chemical composition a calcium-bearing uranopilite, as a mixture of uranopilite and gypsum.

Natürliches schwefelsäures Uranoxydul
A name introduced in 1821 by John [165] for mineral later described as johannite (Nováček [35]).

Nickelblüthe
According to Ježek [189], a synonym for annabergite.

Nickelvitriol
A name introduced by Vogl for lindackerite.

Pateraite
Pateraite was described as an amorphous, soft, opaque black mineral. It was found in 1856 in old workings on the Geister vein with erythrite, ganomatite, tetrahedrite, skutterudite, pyrite, galena, native Bi, gypsum, and bieberite. The name was introduced by Haidinger to honour Adolf Patera [118], chemist-metallurgist, in 1852 assistant at the Mining Academy in Příbram [209] and later a member of the Imperial Geological Institute in Vienna.

Pateraite was analyzed by G. Laube, Vienna. The mineral gives water, SO_3, and a sublimate of Mo oxide. *Pateraite* contains S 12.0, Bi_2O_3 2.0, CoO 27.0, Fe_2O_3? (or FeO ?) 16.0, MoO_3 30.0, H_2O 8.6, insoluble residue 3.8, Total 100 wt. %. The black mineral is mixed with pyrite, which can not be removed. Sulphur, Bi, and Fe can be deducted as bismuthinite and pyrite, and the remaining pure *pateraite* can be considered as cobalt molybdate.

Pateraite specimens from the collection of the National Museum in Prague were examined in the course of the present restudy. The specimens are of a black, fine-grained shale with a dolomite-pyrite vein carrying grains of galena. The vein is fractured by weathering of pyrite and the fractures are covered by a black material. X-ray powder diffraction of this black material resulted in identification of arsenolite, skutterudite, chalcopyrite, and tennantite.

Rothspiesglanzerz
According to Ježek [189], a synonym for kermesite.

Rotheisenstein
According to Ježek [189], a synonym for hematite.

Schwarzer Erdkobalt
According to Ježek [189], a synonym for asbolan.

Uraconite
According to Nováček [35] correspondence in optical properties of this mineral from Gilpina Co., USA, and zippeite shows that *uraconite* is identical to zippeite. Ježek [189] considered it as identical to uranopilite.

Uranblüthe
According to Ježek [189], a synonym for zippeite; following Nováček [35] a synonym for uranopilite.

Uranglimmer
According to Ježek [189], a synonym for autunite.

Urangrün
Breithaupt's name for mineral later discribed as cuprosklodowskite (Nováček [35]).

Uran-Kalk-Kupfer-Karbonat
Name used by Vogl for mineral later named voglite.

Uranochalcite
Nováček [35] presented chemical analysis and optical data of this mineral from Jáchymov and considered it as identical to cuprosklodowskite.

Uranoker
According to Nováček [35] it corresponds to uranopilite and zippeite; a synonym of *uraconite*.

Uranotil
Name introduced by Bořický for a new mineral [124]. For priority reason, the name uranophane (Websky [207]) is used.

Uranothallit
According to Ježek [189], a synonym for liebigite.

Uranvitriol
Name introduced in 1821 by John for mineral later named johannite (Nováček [35]).

Voglianit
Nováček [35] presented chemical analysis and optical data of this mineral and considered it as identical to cuprosklodowskite.

Voltzin
Voltzin was described from Jáchymov by Vogl [60]. It forms hemispheric aggregates and botryoidal stalactitic coating. It is straw yellow, brown red or greenish white in colour, translucent, with a greasy to vitreous lustre. It

has a conchiodal fracture. Density 3.5 to 3.8 $g.cm^{-3}$, hardness 3.5. The mineral is often coated by pyrite.

The chemical analysis done by J. Lindacker in Abertamy. Repeated analyses gave Zn 69.08, S 27.47, Total 96.55 wt. %. After recalculation to ZnS, 13.80 wt. % Zn remain. Calculation of this amount of Zn to ZnO requires 3.45 wt. % ogygen, i.e., the same amount which is missing to 100 % of the analysis.

The mineral was found in the Geister vein, Eliáš mine, at the level of the Barbora adit, 270 m below surface. This section shows an upgraded mineralization, including argentite, proustite, native silver and bismuth, galena, sphalerite, black secondary minerals of Ag, pyrite and native arsenic. *Voltzin* occured in drusy cavities in the upper part of the vein deposited in porphyry.

The present restudy of specimens Nos. NM 12913 and NM 12914 from the collection of the National Museum in Prague proved that sphalerite of a poor crystallinity is the only crystalline phase.

Waltherite

Waltherite was described in 1857 by Vogl. An anonymous author [213] one year later proposed the name *waltherite* to honour the director of the mining office in Jáchymov. The character of this publication, including morphological crystallography and proposal of the mineral name, suggests that Hidinger was a probable author, because Vogel never included the latter topics in his publications [60[, [125].

The mineral was described as Bi-carbonate in prismatic crystals as well as massive pieces, brittle, with an adamantine lustre and yellow streak. *Waltherite* also formed brown to green radiating crystal aggregates with a waxy lustre. It was found with torbernite in 1855 in the Dušní vein, intergrown in chrysocolla or chalcopyrite. According to Bertrand [118] it is a mixture of two minerals, a green and a brown mineral.

The present restudy of the sample No. NM 4877 from the collection of the National Museum in Prague shows correspondence with the above sample description and proves its identity with walpurgite.

Wapplerite

The problematic mineral *wapplerite*, closely associated with rösslerite, was described in 1873 by A. Frenzel [109]. It is characterised as crystalline crusts similar to hyalite and as small grape-like or indented aggregates with a rough surface. It is white and translucent but crystals are perfectly transparent.

Wapplerite was restudied by E. Fischer [107] and all the *wapplerite* specimens were identified as a mixture of rösslerite and pharmacolite. One of the specimens was accompanied by a label with inscription: "dr. Frenzel, 1875". This particular specimen was apparently donated at the time when Frenzel published his description and could be therefore considered as a type specimen of *wapplerite*.

Wismuth-Karbonat

Name used by Vogl for *waltherite* (= walpurgite).

Wismuthoker

According to Ježek [189], a synonym for bismite.

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Historie objevů sekundárních minerálů z Jáchymova

Jáchymov is type locality for 22 minerals, including 17 secondary minerals. Data on history of discovery and description of new minerals was extracted by search in old literature. Minerals are arranged in the chronological sequence of discovery.
Explanation of names of discredited or re-defined minerals and some historical names is included at the end of this paper.