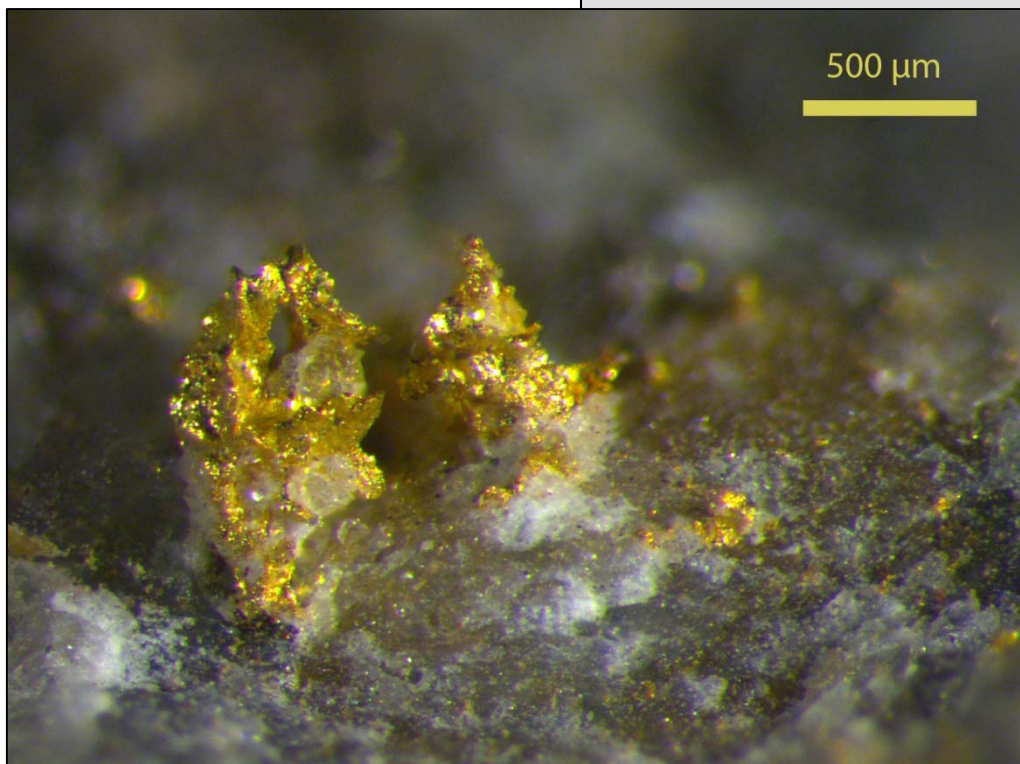


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Special issue commemorating
the 50th anniversary of the MKA:
The mineralogy of Belgium





1. Brookite associated with anatase. Old quarry, La Haie forest, Bertrix, Luxembourg, BE. Image width 5 mm. Collection and photo © Harjo Neutkens.
2. Anatase crystals. Les Rochettes quarry, Bertrix, Luxembourg, BE. Image width 6 mm. Collection and photo © Harjo Neutkens.
3. Bastnäsite-(Ce). La Flèche quarry, Bertrix, Luxembourg, BE. Image width 5 mm. Collection and photo © Richard De Nul.
4. Rutilated Xenotime-(Y) crystal associated with acicular rutile crystals. Old quarry, La Haie forest, Bertrix, Luxembourg, BE. Image width 3 mm. Collection and photo © Harjo Neutkens.
5. Bastnäsite-(Ce). La Flèche quarry, Bertrix, Luxembourg, BE. Image width 1.8 mm. Collection and photo © Dario Cericola.

Cover photo

Nothing suits a Belgian golden jubilee better than Belgian gold: native gold on matrix.

Sur les Roches quarry, Bastogne, Luxembourg, BE. Image width 3 mm. Michel Houssa collection, photo © Roger Warin.

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The "Mineralogische Kring Antwerpen" (MKA) v.z.w. ("Mineralogical Society of Antwerp"), Belgium, was founded in 1963. Since 1975, our club issues the monthly journal "Geonieuws".

For more information check our [website](http://www.minerant.org/about.html)
www.minerant.org/about.html.

This special issue of Geonieuws on "THE MINERALOGY OF BELGIUM" was realised to commemorate the 50th anniversary of the MKA.

Originally published in Dutch, we have deliberately omitted most administrative, organisational and club-related information in this English version, in order not to bother our non-Dutch readers. We hope the mineral collecting community will benefit from this initiative and the interested reader will learn more about the mineralogy of Belgium.

We do not provide a printed version of this PDF-file, which is freely available for everyone.

People interested in a printed Dutch version can contact our secretary at secretariaat@minerant.org.

We hope you will enjoy this English version. All reactions and/or comments are welcome at rik.dillen@skynet.be (editor).

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Cronstedt's column



Nothing left to find?

In a jubilee issue - such as the one you are reading right now - we are in fact somewhat morally obliged to take a little time to trace the evolution of our hobby. Was everything *really* that

much better in 'the good old days'? Did aesthetic mineral specimens *really* 'grow on trees', so to speak? Was it *really* that easy to gain access to quarries without getting in trouble (and without having to ask for permission)?

The answers to these questions are rather obvious. Yes, there were a lot less buildings and a lot more infrastructure works and quarries back then, and yes, a whole bunch of localities have meanwhile disappeared completely. However, private property was, is and always will be *private*. Landowners have always had the right to deny other people access, and some still exert that right today. Many quarries are a thing of the past, but some are still highly topical. The fact that interesting specimens can be found in Belgium even today, was recently revealed in an article... by a *Dutchman* in a *German* mineralogical magazine!

In 2007, Harjo Neutkens and Mario Orinx already described the beautiful calcites and fluorites they had found in Wellin (Luxembourg province, Belgium) in *Lapis* magazine. With those of you who regularly consult the Mindat website, Harjo's name should definitely ring a few bells. Aside from being a passionate collector, Harjo is also an excellent photographer of (Belgian) minerals. His pictures cannot only be found on the Mindat website, some of them have also previously been published in *Geonieuws*, and some are even in this very issue.

The aforementioned article had already made most collectors' (of Belgian minerals) hearts skip a few beats, but it was nothing compared to the masterpiece which Harjo published in *Mineralien-Welt* this year: current finds of quartz from Belgium, dating from 2010 to 2012. Oh, man... I have never seen such exquisite Belgian rock crystal specimens. I never would have imagined that 'them rolling hills of Belgium' would be harbouring such whoppers! To those of you who have not read the article yet: the issue in question is available in our library!

Even more recently, there have been rumours of magnificent hand-size specimens of baryte crystals of up to a few centimetres tall from 'a certain Belgian quarry'. The kinds of specimens that make you go "Really? These are from *Belgium*?!" To anyone lucky

enough to find any of these: we hope for your sake that these rumours are true, and that we will be able (and allowed) to admire these specimens at the exhibit which will be opening during the MKA conference. Anyway, should the lucky finder(s) like to have his/her/their find(s) described in a future issue of *Geonieuws*, please do not hesitate to contact us (see below).

Moreover, the input of hobbyist mineral collectors to the science of descriptive mineralogy becomes ever more important, even in our own country. For example, *graulichite*-(Ce) and *pumpellyite*-(Al), two of the three newest minerals found in Belgium (the third being *stavelotite*-(La)) were found by fellow collectors. Much of the new data which were reported in the second edition of *Les Minéraux de Belgique* comes from finds made by "amateur collectors". In the world of modern mineralogy, the negative connotation of the word *amateur* is - thankfully - finally being pushed into the background.

From the aforementioned we can thus deduce that even today beautiful and new things can still be found in Belgium (and obviously abroad as well), as long as you are willing to put in the necessary amount of enthusiasm, knowledge, patience... and of course a large dose of luck. We wish all members of the MKA a healthy amount of all of these requirements, and we hope that many of their finds will be described in *Geonieuws* in the next 50 years!

Glück auf!

Axel

*Axel Cronstedt
Upsala 28 14 Mart. 1741*

*Neutkens and Orinx (2007). Neu und schön: Calcit und Fluorit aus Belgien. Lapis Jg. 32 nr. 2, 13-18.
Neutkens (2013). Quarz aus Belgien – die aktuellen Funde von 2010 bis 2012. Mineralien-Welt Jg. 24 nr. 3, 14-23.*

P.S. You can reach me (nearly) always at axel.cronstedt@mineralogie.be

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'Belgian' mineralogy under 'Dutch' rule, 1815-1830

Ernst A.J. Burke

Based on the Eight Articles of London of 1814, the Congress of Vienna decided on the formation of the United Kingdom of the Netherlands in 1815. The Prince-Bishopric of Liège, the Principality of Stavelot-Malmedy, the Duchy of Bouillon and a number of other small autonomous regions (e.g. the Duchy of Limburg), which had never been a part of the Austrian Netherlands, were united - together with the Austrian Netherlands - with the former Republic of the Seven United Netherlands. Under French rule, the resulting republic consecutively became the Batavian Republic, the Batavian Commonwealth and the Kingdom of Holland. The Sovereign Principality of the United Netherlands came into being after Napoleon's defeat in the Battle of Leipzig (also known as the Battle of the Nations) in 1813. On 1 December 1813, William I (fig. 1) was proclaimed Sovereign of the State (the inauguration took place on 30 March 1814). Later, on 16 March 1815, he proclaimed himself king of the United Netherlands and Duke of Luxembourg.

The Congress of Vienna's decision did not exactly yield the desired result and only lasted for about 15 years. When on 25 August 1830 - after several years of conflict between the north and the south pertaining to different subjects - a nationalist opera (*La Muette de Portici*) was staged in Brussels, the Belgian Revolution erupted, which - because of strong military support from France - ultimately resulted in an independent Kingdom of Belgium. Despite the short amount of time that the union between both Netherlands was in effect, during this time many remarkable initiatives were taken which still exist today. For example, William I was - among other things - the founder and shareholder of the later *Société Générale de Belgique*, he introduced the metric system and ordered the construction of several canals (e.g. the Brussels-Charleroi Canal). William I was not just the "King-Merchant", in 1817 he also founded three universities in the southern provinces: Ghent, Leuven (whose catholic university had closed in 1797; the new state university would continue to exist until 1835) and Liège. Decisions on where to establish them, whether they should be 'state universities' or 'free universities' and aspirations of a single university would last until 1835 (Dhondt, 2006).

However, William I did not simply condone the Belgian Revolution and the subsequent partitioning of property between the Northern and the Southern Netherlands. He flatly repudiated the 1814 "Treaty of XVIII Articles" - which had been specifically drafted for this partitioning - and undertook the Ten Days' Campaign.



Fig. 1. William I, King of the United Netherlands.



Fig. 2. Jean Baptiste Julien d'Omalius d'Halloy.

Later that year, a new "Treaty of XIV Articles" was negotiated - although William I did not agree to it until 1838 - which was officially signed in 1839 as the Treaty of London.

Aside from several other agreements (e.g. Belgium had to deal with a rather unfavourable division of national debt), Belgium would lose the eastern part of the province of Limburg - which William I had named after the old Duchy of Limburg - to the Netherlands. In return, Belgium would acquire the right to construct the Iron Rhine, a railroad passing through the newly created province of Dutch Limburg. This particular railroad remains controversial even to this day.

Against this backdrop of drastic historic developments, remarkable things were also happening in science, including in those that would later be called the earth sciences. Groessens & Groessens-Van Dyck in Halleux *et al.* (2001, p. 269) quoted geologist Michel Félix Murlon (1880) writing: "One can say in all honour that at the exact same time when science accomplished one of its greatest achievements, Belgium was one of the first nations where geology took a rational and truly scientific road thanks to the works of d'Omalius d'Halloy, memorable works in Belgian science."

Jean Baptiste Julien d'Omalius d'Halloy (Liège, 16 February 1783 - Brussels, 15 January 1875) was a Belgian geologist, palaeontologist, stratigrapher, ethnologist and politician. D'Omalius d'Halloy (fig. 2) was one of the pioneers in the field of modern geology. He researched the stratigraphy and geology of Belgium and France and defined a number of important stratigraphic concepts, including the Cretaceous period. After his studies in Paris, d'Omalius travelled ca. 25,000 km on foot throughout the French Empire in approximately a decade, from 1804 until 1813. In 1808, he published his *Essai sur la géologie du nord de la France* in the *Journal des Mines*, which immediately gave him a good reputation.

The year before, he had already written his note *Sur la disposition des couches du coteau de Durbuy* in the same journal, in which the well-known anticline appears which dominates the small town of Durbuy and which is since then known as the 'Anticlinal d'Omalius'. D'Omalius completed the design for his geologic map in 1813, and submitted it to the *Conseil des Mines*. Its publication was postponed because of the aforementioned events between 1813 and 1815. In 1815, William I appointed d'Omalius governor of the province of Namur. It was not until 1822 that his *Carte Géologique de la France, des Pays-Bas et de quelques Contrées Voisines* was published in the *Annales des Mines*. It was a skilful masterpiece which, according to Edouard Dupont (1876), quoted by Groessens & Groessens-Van Dyck in Halleux *et al.* (2001, p. 270) "created the longitudinal and transverse grid of Western Europe, which made the author one of the most prominent founders of geology on the continent". His contemporaries already appreciated this work (and its author): French mineralogist Pierre Berthier (1826) named a mineral which d'Omalius had discovered in Angleur (province of Liège) halloysite in his honour.



Fig. 3. Jacob Gijsbertus Samuël van Breda.

D'Omalius d'Halloy was not the only one producing geologic or mineralogical maps of contemporary Belgium at the time.

By Royal Decree of 20 March 1825, the government commissioned the fabrication of a mineralogical map of the area south of Ghent and east of Kortrijk on a scale of 1:100,000. The final scale at publication was 1:200,000, but at least the map was completed within the foreseen period of five years. Because an uprising had broken out in the southern part of the kingdom, the surveyors – Colonel J.E. van Gorkum (Reconnaissance Officer) and geologist J.G.S. van Breda, professor at the University of Ghent – took the material with them to Leiden, where Van Gorkum published the map in seven pages (1833 – 1840). However, these pages have never been placed at Belgium's disposal, most likely because at that time, the country was at a "state of war" and because later (after peace was restored), Belgium began its own geologic surveys.

As mentioned earlier, one of the surveyors was Jacob Gijsbertus Samuël van Breda (Delft, 24 October 1788 - Haarlem, 2 September 1867), a Dutch botanist, palaeontologist and zoologist. In 1822, Van Breda (fig. 3) became professor of botany, zoology and comparative anatomy at the University of Ghent. Here he was also the director of the botanic garden, and in 1830/1831 even the principal of the University. He also researched (together with Van Gorkum) the geology of what would later become Belgium. Because of the Belgian Revolution, he had to abandon his work in Ghent.

Subsequently he first became 'extraordinary professor' and in 1835 professor of zoology and geology at the University of Leiden. In 1839, Van Breda moved to Haarlem, where – as successor to Martinus van Marum – he led the palaeontology, mineralogy and natural science departments at the Teylers Museum and became secretary of the Royal Holland Society of Sciences and Humanities.

In 1816, King William I ordered the reassembly of the Academy for Science and the Arts of Brussels. The French had abolished the academy - which Maria Theresa of Austria had founded in 1772 - in 1792-1793 and later in 1794. The academy held several competitions to describe the geology of the Belgian provinces: Hainaut was published by Drapiez (1823), Namur by Cauchy (1825), Luxembourg by Steininger (1828) and Engelspach-Larivière (1828), Liège by Dumont (1832) and Davreux (1833) and Brabant by Galeotti (1837). Groessens & Groessens-Van Dyck have commented on these descriptions of the francophone provinces in detail in Halleux *et al.* (2001, p. 272-274.)

After the geologic and/or mineralogical maps, it is now time to turn our attention to the minerals themselves. Even the more recent reference books on the minerals of present-day Belgium (Hatert *et al.*, 2002; Van Der Meersche *et al.*, 2010) maintain that hopeite is the oldest new mineral from Belgium. The first mention of the new mineral from the Altenberg was very brief, with a name that Haüy had previously used and even with an incorrect locality (Brewster, 1822). During a lecture on 17 June 1823, the mineral was more comprehensively described, albeit with an uncertain chemical composition, but including the new name and the correct locality; the text of this lecture was published with some delay (Brewster, 1826). By the way, the true nature of the mineral, a hydrous zinc phosphate, was not established until much later (Damour & Des Cloizeaux, 1879). So the name hopeite was not published in print until 1826 (the year 1824 stated in some works is incorrect). In that case, it would battle with halloysite (Berthier, 1826) for the honour to be the first Belgian mineral.

However, Pelckmans (2010) has shown that this honour had already been given when it was due - i.e. quite some time ago that is - namely to otrérite in a description by Nöggerath (1812) of what he called *Karstin (sogenannten Otrérite)*. Dethier had previously called that mineral *diallage métalloïde d'Otré* (1809, repeated in 1814), and according to Davreux (1833) Dethier had also previously used the name *ottrérite*, and the French mineralogist Louis-Nicolas Vauquelin had already analysed the mineral in 1812. By the way, Nöggerath does not mention Dethier, but J.L. Wolff, a painter from Spa, as the person who had initially discovered the mineral. Nöggerath's work has apparently eluded many people, and in this way Davreux (1833) is usually referred to as the source of the first thorough description of otrérite. However, the complete description of otrérite, including its chemical composition, was not published until 1842 (Damour & Des Cloizeaux, 1842). Remarkably, Schull was already using the Dutch name 'otreliet' for the mineral in 1827 and the mineral had already been classified as *Dutch*, since the Netherlands were still united at the time!

Now let us return to the locality of hopeite, the Altenberg, which - because of its special place in the history of Belgium - deserves at least some attention. The Altenberg is (or better, was) a hill of ca. 400-500 metres long and 100-150 metres wide. As demonstrated by a painting (fig. 4), this particular hill had already been largely levelled in 1843. The hill mainly consisted of calamine, a mixture of a number of zinc minerals including smithsonite, hemimorphite, hydrozincite and especially willemite. Calamine had already been mined here since the 13th/14th century (and possibly even earlier) because it was an important base material for the fabrication of brass. The Altenberg is located in Kelmis (the name is derived from calamine), now a German-speaking municipality of around 10,000 inhabitants in the province of Liège. Altenberg is also known, or probably even more so, by its French name of *Vieille-Montagne*, which was first used in 1455. The history of mining near Moresnet is very long and complicated (Engelen, 1976). Eventually the *Société des Mines et Fonderies de Zinc de la Vieille-Montagne* exploited the zinc mine from 1837 until it was shut down in 1885. Until the abolition of the old Duchy of Limburg, a state in the Holy Roman Empire, Kelmis belonged to the legal district of Montzen.

Just like the rest of the duchy at the time when the French Republic annexed the Southern Netherlands in 1795, Kelmis was incorporated in the then formed department of Ourthe and later, in 1815, in the United Netherlands. Moresnet is very close to Kelmis, and is now a part of the municipality of Plombières (Dutch: Blieberg, German: Bleyberg or Bleiberg). Moresnet came into being because - during the Congress of Vienna in 1815 after Napoleon's demise - Prussia and the United Kingdom of the Netherlands could not agree on each other's borders. The subject of this controversy was the valuable zinc mine in the small town of Kelmis. It was not until 1816 that they reached a compromise: in accordance with the Treaty of the Borders (*Aachener Grenzvertrag*)



Fig. 4. The Altenberg calamine mine in 1843. Painting by Jean-Baptiste Bastiné.

Moresnet became part of the United Kingdom of the Netherlands, New Moresnet (today part of the municipality of Kelmis) became part of Prussia and the area in between, including the town of Kelmis, became a condominium under the name of *Neutral Moresnet* with the mayor of Kelmis as its head of state. Both a Prussian and a Dutch (after 1830 Belgian) commissioner governed Neutral Moresnet, an area of around 250 inhabitants at the time.

The end of Neutral Moresnet came with the arrival of the First World War. In 1914, Germany - in which Prussia had been incorporated - occupied the area. Germany lost the war, and at the Treaty of Versailles in 1919, it was decided that Neutral Moresnet was to be awarded to Belgium. Article 32 of the Treaty of Versailles reads: "Germany recognises the full sovereignty of Belgium over the whole of the contested territory of Moresnet". On 10 January 1920, Belgium definitively annexed Neutral Moresnet. The area was added to the East Cantons, which in that year were separated from the German Empire and subsequently attached to Belgium as compensation for war damages.

The Altenberg zinc mine is known by several different names: Altenberg, Audenbergh, Kelmis, La Calamine, Moresnet, Grande Montagne and Vieille-Montagne. The extracted calamine ore produced approximately 750,000 tons of zinc. The calamine contained up to 40% of the zinc silicate willemite, Zn_2SiO_4 . Coppola *et al.* (2008) and others have mainly described the ore genesis of the Kelmis mine and similar deposits in Belgium. In present-day Belgium, willemite can/could be found in Angleur, Plombières, Engis, Fossey, Le Rocheux, Pandour and Theux (Hatert *et al.*, 2002), and also in Welkenraedt (Boni *et al.*, 2005).

The French mineralogist Serve-Dieu Abailard Lévy (1795-1841), who called himself Armand, discovered the mineral willemite. After his mathematics studies in Paris, it was difficult for him to obtain a university position in France because he was of Jewish descent. In 1818, he arrived in England by chance (because the vessel he was travelling on at the time was shipwrecked). Here he worked from 1820 onwards on a catalogue of famous mineral dealer Henry Heuland's very large collection (Lévy had also taken Haüy's mineralogy courses in Paris). During his work on this collection, Lévy discovered the new mineral species forsterite, babingtonite, brochantite, roselite, herschelite (renamed chabazite-Na in 1997), phillipsite and beudantite, which he published between 1822 and 1827. In 1824, he also redefined a previously known mineral as fluellite. Because printing was cheaper in the United Netherlands, Lévy moved to Brussels to finish the catalogue. However, in November 1828 King William I appointed him professor of mechanics, astronomy, crystallography, geology and mineralogy at the University of Liège, and Lévy abandoned the catalogue. After the Belgian Revolution, he returned to France where people had since become a little more tolerant towards Jews. In 1841 Lévy died of a ruptured aneurysm at the age of 45 (Le Cleac'h, 1995).

During his time as a professor at the University of Liège, Lévy studied the Altenberg ores and discovered a zinc silicate, which he named willemite after King William I, in recognition of his appointment in Liège. The mineral's publication and description involved a few remarkable facts. Lévy first mentions willemite in a letter (in German!) dated 14 September 1829 (Lévy, 1830): "*Bei einer Excursion, welche ich neulich gemacht, glaube ich ein neues Mineral entdeckt zu haben; es soll Willemite heissen, nach S.M. dem König der Niederlande.*" [Translation: "During a recent excursion, I believe to have found a new mineral; I will name it willemite, after His Majesty the King of the Netherlands."]. A French mineralogist at a (later) Belgian university writing in German about a mineral from *Neutral Moresnet*, which he had named after a Dutch king: a mineral involving probably not just four, but five different countries! Lévy did not edit the mineralogical data he had been working on in 1828-1830 - including the data on willemite - until 1840, and sent them to the *Académie des Sciences* for publication. The academy rejected the manuscript and returned it after some time to Lévy, who had meanwhile sadly passed away. It was only because his student Des Cloizeaux took action that the text was published posthumously (Lévy, 1843).

However, Lévy was not the first to discover the zinc silicate as a mineral. Vanuxem & Keating (1824) described a new mineral from Franklin (N.J., USA) which they called "Siliceous oxide or silicate of zinc (*Calamine*)". Their accurate analysis matches the formula of willemite, Zn_2SiO_4 .

However, they did not name the mineral in their description, most likely because they were in doubt. Was it really a single mineral? Could it be a mixture of two zinc silicates, one hydrous and another anhydrous? In 1828, chemist Th. Thomson incorrectly claimed that the mineral from Franklin was a manganese silicate, and his reputation as a chemist caused this blatant error to be attributed to Vanuxem & Keating. The confusion was complete when in 1832 C.U. Shephard named this incorrectly analysed material 'troostite'. Meanwhile Lévy had already introduced the name willemite, which later remained in use because of priority.

The series of strange events regarding willemite ended on an even stranger note. In 1916, the Italian mineralogist Ruggero Panebianco (1848-1930) proposed not to use the name willemite any longer because he was of the opinion that a new mineral should not have to be named after a king. Therefore, he suggested the name 'belgite' after the country where the mineral had been found (Panebianco, 1916). However, even at that time the Altenberg was still not Belgian; that only happened in 1920! Panebianco nevertheless had to be privy to the situation in Neutral Moresnet, because his publication was *nota bene* in Esperanto; in 1908, Dr. Wilhelm Molly had started an attempt to turn the tiny area into the Esperanto state of 'Amikejo'.

Collections of minerals and rocks must be stored for future reference. The first collections pertaining to natural history in what would later become the Kingdom of Belgium date from the Austrian period and were assembled by Prince Charles of Lorraine from 1741 to 1780. In 1811, the remainder of these collections, which were stored in the Nassau Palace on the Koudenberg, came into possession of the city of Brussels. In the 19th century, especially under the United Netherlands, these collections were regularly expanded thanks to the acquisition of specimens from overseas. In 1841, a few years after the country's independence, the city of Brussels sold the natural history cabinet to the Belgian government, which was the foundation of the Natural History Museum in 1846. However, there is no trace left of the minerals in Prince Charles of Lorraine's original collection of artefacts. The oldest pieces in the museum's current collection are from Russia (e.g. malachite, fig. 5) and are the result of a donation in 1828 by Crown Prince William of Orange, son of King William I. The crown prince was married to Anna Pavlovna, a sister of Tsar Alexander I. The couple usually stayed in Brussels, in what is now the Academy Palace. During a trip to Russia in 1823, the prince and princess had received an interesting collection of local rocks and minerals, which they subsequently donated to their city's museum (Van Tassel, 1982; Deliens, 2006).

By Royal Decree of 2 October 1817 a national central mineralogical and geological depot - associated with the Ministry of Water Management and Public Works - was established to gather and house "all artefacts of mineralogical, geological or historical importance which could be discovered during excavations or works within the realm" (Groessens & Groessens-Van Dyck in Halleux *et al.*, 2001, p. 271). For didactic reasons it was foreseen that analogue collections of the universities of Ghent, Leuven and Liège – which had been founded in the same year – would be replenished.



Fig. 5. Malachite from Turjinsk (Urals, Russia). Donated to the Museum of the City of Brussels by Crown Prince William of Orange in 1828. Presently in the collection of the Royal Belgian Institute of Natural Sciences. Photo credit: S. Pardon.


By Royal Decree of 10 February 1818, they received a credit of 15,000 guilders to acquire artefacts of mineralogical and geologic importance. The central depot's first curator was botanist Adrien Dekin, who previously, since 1803, had already been curator of the aforementioned natural history collections belonging to the city of Brussels. Dekin was also the *de facto* director of the first Botanic Garden in Brussels located near the Hofberg (officially his brother Josse held this position). A Royal Decree of 25 January 1841 would transfer the depot to the *Ecole spéciale des Mines*, which had been founded at the University of Liège in 1838. What eventually happened to the collections stored in this depot is unclear. Dekin died on 13 August 1823, a few hours after a fire had broken out in the room he had been using as his living quarters in the old finance building, where the mineralogical depot had been established. According to Groessens & Groessens-Van Dyck in Halleux *et al.* (2001, p. 271) Xavier Stainier reported in 1903 that the transfer had already taken place after the dissolution of the depot by William I in 1825, and that "the fossils had been handed over to the Museum in Leiden, where they undoubtedly still are". Stainier pointed out that the building where the depot had been established had burned down completely shortly after its dissolution, and he wondered about "what could have been transferred again in 1841". Alternatively, had the fire in question already happened in 1823 (i.e. *before* the dissolution of the depot in 1825), as described above?

Finally, for the sake of symmetry in this story, we return to one of the events after the Belgian Revolution of August 1830. The Provisional Government of the Southern Netherlands declared independence on 4 October 1830. The resistance against and hate towards King William I - who was justifiably seen as the personification of all 'Dutch' evil (he was indisputably an absolute monarch) - had by then apparently grown to extremes. So much so, that on 24 November 1830 the Provisional Government decided in its Decree No. 5 that "*all members of the House of Orange-Nassau be forever excluded from all power or authority in Belgium*". However, since 2001 a proposition has been repeatedly presented (most recently on 23 December 2010) to the Belgian parliament to declare this decree suitable for revision or even suspension. Surprisingly, the party striving to achieve this is at the same time devoted to an independent Flanders. The proposition's annex lists several reasons for the suspension of the exclusion of the Orange-Nassau family. The one that sticks out like a sore thumb is that (former) "King Albert II of Belgium is even - through his mother, Astrid of Sweden - a direct descendant of King William I." It admittedly sounds somewhat farfetched, but Astrid of Sweden - through her mother, princess Ingeborg of Denmark - actually *was* a descendant of Dutch king William I. Ingeborg of Denmark was the daughter of Louise of Sweden (later queen of Denmark). Louise of Sweden was the daughter of Louise of Orange-Nassau (later queen of Sweden and Norway through marriage). Louise of Orange-Nassau was a daughter of Frederick of Orange-Nassau, second son of King William I of the Netherlands. In short, six generations between Albert II and William I would surely have diluted the blood of the Orange-Nassau dynasty running through Albert II's veins!

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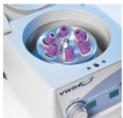

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Minerals with Belgian type localities

Erik Vercammen and Rik Dillen

Recognition of new minerals

Until 1959, any mineralogist could name and publish a new mineral on his (or her) own account. In that year, the IMA (the International Mineralogical Association, consisting of mineralogists from all over the world) established the Commission on New Minerals and Mineral Names (CNMMN for short). This commission drafted a set of rules that any report on a newly discovered mineral needed to comply with to recognise the mineral in question as a new species. These rules explain the minimum characteristics (formula, structure, properties, and appearance) which must be examined and described before the decision can be made whether or not a mineral is a new species, which is sufficiently distinct from all of the previously described species. During the recognition process, the mineral gets a temporary codename: e.g., stavelotite-(La) was known as IMA 2004-014 until it was officially recognised as a new species.



The members of the CNMMN then examine the report and individually vote on the recognition as a new species and the proposed name; they may also request additional information. If the commission members eventually approve the mineral, two things are required:

- The original specimen which has been used to describe the mineral species (the so-called "holotype") must be deposited in a public scientific museum, in case additional research is needed later;
- The data on the new mineral species must be published in a scientific magazine, and its name is first made public in this magazine.

The report (as well as the publication) must also state where the original specimen (the holotype) came from: this is the so-called type locality.

The CNMMN also performs other related tasks, such as examining reports to "discredit" mineral species, e.g. because modern science has proved that they are identical to other previously described species, or because the original description was based on erroneous data (e.g. because a species turned out to be a fine-grained mixture of already existing species). Like the recognition process, the "discreditation" process follows a formal procedure, including voting and publication. The opposite ("re-approval") also happens, e.g. because new research has shown that there are enough differences between two species that were previously considered to be identical. A well-known example of "re-approval" is the mineral wiluite, which was considered a variety of vesuvianite for a long time, but which differs from this species because certain locations in its crystal structure are primarily occupied by boron instead of aluminium.

Sometimes subcommissions are established to research the existing classification of mineral groups, to draft rules to set the limits of these groups and to streamline the nomenclature. Examples of groups, which have undergone reclassification, are:

- the pyroxene group (whose most familiar members are augite, diopside and enstatite),
- the mica group (in which the previously valid species biotite and lepidolite lost their official status as species and became part of a series),
- the zeolite group, in which a suffix (the so-called "Levinson modifier") was added to the species name to distinguish between them, because different elements can dominate within the same crystal structure in this group.

An example of a mineral in this last group is heulandite, which used to be a single mineral. Today it is a group of minerals containing a number of different species: heulandite-Ca, heulandite-Na, heulandite-K, heulandite-Ba, and heulandite-Sr; in these species calcium, sodium, potassium, barium, and strontium are the dominant metals respectively.

Another important ground rule that was established is the nomenclature of minerals, which contain rare earths. This group of elements is also known by its scientific name of "lanthanides", after the element lanthanum, symbol La. These elements all have very similar chemical properties.

Therefore, if a mineral contains one of these elements, it will also contain all of the others in the group. Minerals containing these elements are named as follows: first the species name, then a hyphen and finally the chemical symbol of the dominant species of rare earth between brackets.

Examples: monazite-(Ce), which we found in Opprebais once, and monazite-(Nd), in which cerium and neodymium are the dominant rare earth element respectively. Sometimes the abbreviation REE ("Rare Earth Elements") is used to indicate these elements; In French they are known as TR (of "terres rares").

Minerals that had already been described before the CNMMN started its activities in 1959, and which had always been regarded as valid mineral species, automatically received the status "grandfathered": they were considered valid species without any further research. This group of grandfathered species is subdivided into two more groups. First there are the minerals which have been known for a long time, sometimes even since Antiquity. Examples of minerals in this group are gold as a precious metal; topaz as a gemstone; cassiterite as tin ore and quartz in the form of rock crystal, smoky quartz, and amethyst. The type locality of these minerals is obviously unknown. The second group are the minerals, which have been discovered and described since the end of the 18th century: the locality where they were originally found was recorded, and therefore the type locality is now known. Sometimes museums still house specimens donated by the people who originally described them: these specimens can be considered the holotype. However, these "valid minerals", like all others, can still be discredited, their name can undergo changes or they can be redefined (especially when mineral groups are being re-examined). By the way, you can consult all CNMNC (Commission on New Minerals, Nomenclature, and Classification) reports (since 2002) at http://www.ima-mineralogy.org/CNMNC_Strategy.htm.

Minerals with a Belgian type locality

In total, 265 mineral species have been found in Belgium so far. For 18 of them, the locality where they were found is also the type locality (situation in July 2013; source: Mindat). The vast majority of Belgian type localities are located in two small regions around Liège and Vielsalm. Bertrix (near Bouillon), Engis (between Liège and Huy), and Blaton (in Hainaut Province, near the French border) complete the list of Belgian type localities.



Map of Belgian type localities.

The following table lists the minerals with a Belgian type locality, sorted by province.

Province	Type Locality	Mineral Species
Hainaut	Mont-des-Groseillers, Blaton, Mons	ferristrunzite
Luxembourg	Salmchâteau, Vielsalm, Stavelot Massif	ardennite-(As)
	Ottre, Vielsalm, Stavelot Massif	davreuxite, ottrelite
	Hourt Quarry, Grand Halleux, Vielsalm, Stavelot Massif	graulichite-(Ce)
	Le Coreux, Salmchâteau, Vielsalm, Stavelot Massif	stavelotite-(La)
	La Flèche Quarry, Bertrix	pumpellyite-(Al)
	Bihain, Vielsalm, Stavelot Massif	vantasselite
Liège	La Mallieue, Engis	viaeneite
	Château de Berneau, Berneau, Dalhem, Liège	delvauxite
	Argenteau, Visé	destinezite
	Richelle, Visé	drugmanite koninckite
	Altenberg (Vieille Montagne), Moresnet, Kelmis, Verviers	fraipontite hopeite willemite
	Angleur, Liège	halloysite-7Å halloysite-10Å

This table clearly shows that Flanders has not exactly been well endowed by Mother Nature... There are no type localities in Flanders at all! The Stavelot Massif is still in first place. On the other hand, localities such as Blaton and Haut-Le-Wastia host several interesting but usually unsightly microscopic minerals (mainly phosphates), so surprising new species, which have gone completely unnoticed until now, are highly likely to turn up there in the future.

Delvauxite

André Hubert Dumont, father of André Dumont, Professor at the Catholic University of Leuven and well-known expert on coal and coal mining, discovered the mineral in 1793 near Berneau, Dalhem, Liège. It was named after Professor J. Delvaux de Fenffe (1782-1863), a well-known doctor and chemist/physicist/metallurgist. The formula is $\text{CaFe}^{3+}_4(\text{PO}_4, \text{SO}_4)_2(\text{OH})_{8.4-6}\text{H}_2\text{O}$; the mineral is amorphous (i.e. it lacks long-range regularity in its crystal structure) (Deliens, 1987). That is why it was close to not being accepted as a mineral species; if it had been discovered and described only recently, the IMA would most likely not accept it as a species. It occurs as yellowish to reddish brown masses, and is related to both diadochite and destinezite.

It has so far been discovered at a number of different localities in Belgium:

- Mont-des-Groseillers, Blaton, Hainaut
- La Rochette, Chaudfontaine, Liège
- Andrimont Mine, Theux, Verviers, Liège
- Argenteau, Visé, Liège
- Brichtembeau quarry, Visé, Liège
- Richelle, Visé, Liège (Van Tassel, 1959)
- Haut-le-Wastia, Anhée, Namur
- Gralex quarry (now "Sagrex"), Beez, Namur



Delvauxite mass (diameter: 7 cm) from Beez, Namur, Belgium. Collection and photo © 1991 Johan Maertens.

It can be found at a few dozen localities worldwide. Miners used to call this mineral coliphon. Other synonyms are fouchéite, fouchérite, fuchérite, picite, and borickyite (Cech & Povondra, 1979) (Pabst A., 1980).

Delvauxite specimens do not tolerate moisture at all: when subjected to water, aggregates crumble to little pieces. The specimens which were offered as “mineral of the month” in 1992 (which came from Beez) were treated with Fixacryl (acrylic adhesive sealant) beforehand and have largely remained stable since then (Maertens J., 1992).

Ottrélite

The final verdict about the discovery of this mineral is still not in. We *do* know that it was found in Ottré in the early 19th century. For more details concerning the discovery and description of ottrélite, we refer to Pelckmans (2010).

The formula is $(\text{Mn,Fe,Mg})_2\text{Al}_4\text{Si}_2\text{O}_{10}(\text{OH})_4$ and it crystallises in the monoclinic system. It occurs as greenish black poorly formed crystals and mica-like plates in the rock. The mineral belongs to the chloritoid group, which also contains chloritoid *sensu stricto* (which contains more iron than manganese and magnesium) and magnesiochloritoid. Chloritoid and ottrélite are indistinguishable from each other without analysis. In many specimens labelled as “ottrélite”, iron is actually the dominant element, which by definition makes these specimens chloritoid.

To complicate the nomenclature some more, there are several synonyms for chloritoid, e.g. barytophyllite, bliabergite, bliabergsite, chloritoidite, masonite and strüverite (of Brezina) and sismondine (not to be confused with gismondine, a member of the zeolite group).

It occurs at the following localities in Belgium:

- Rahier, Stoumont, Lienne valley, Stavelot Massif, Liège
- Sur les Roches Quarry, Bastogne, Luxembourg
- Vielsalm, Stavelot Massif, Luxembourg
- Bihain, Vielsalm, Stavelot Massif, Luxembourg
- Tier des Carrières, Cahay, Vielsalm, Stavelot Massif, Luxembourg
- Ottré, Vielsalm, Stavelot Massif, Luxembourg

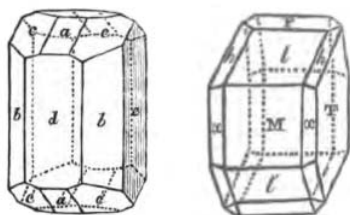
It also occurs at dozens of other localities worldwide.

Ottrélite aggregates in quartz, from the type locality of Ottré. Specimen width 4 cm. Collected and identified by Zélimir Gabelica. Collection and photo © Erik Vercammen.



Hopeite

Hopeite was discovered in 1820 in the Altenberg zinc mine as clear orthorhombic crystals in a cavity. Unfortunately, it was a one-time-only find, and there was not enough material to be able to describe the new mineral properly; very few museums have a specimen of this original material in their collection. It was not until new specimens were found later at the Broken Hill Mine (now called Kabwe) in Zambia, that Brewster was able to describe it properly, and he named it after British chemist T.C. Hope (1766-1844). The formula is $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$.



Hopeite crystals from Altenberg (Moresnet mining district, near Aachen). After Brewster, 1823.

Later, another mineral was found in Zambia with the exact same formula. However, it crystallises in a different system (the triclinic system instead of hopeite's orthorhombic system), which by definition makes it a different mineral species: this new species was named parahopeite.

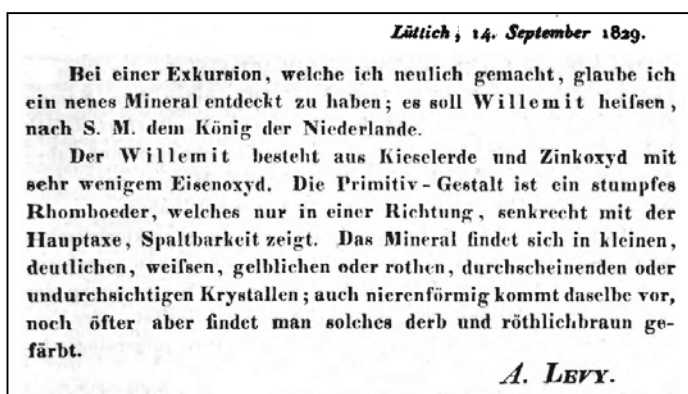
Halloysite-7Å and halloysite-10Å

Say what? Two different names for a single species? Upon closer inspection, halloysite turns out to exist in two distinct versions, so-called polytypes. The difference, which we will not be discussing in detail in this article, is the distance between two identical sequences of layers. In other words, in halloysite-7Å, this identical sequence repeats itself every 7Å and in halloysite-10Å, this happens every 10Å. Both minerals are considered distinct species and show different x-ray diffraction patterns.

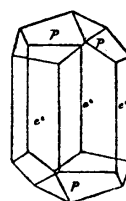
Professor d'Omalius d'Halloy discovered both minerals at Angleur near Liège, and Berthier named them in his honour in 1826. The formula is $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ and they both crystallise in the monoclinic system. They are both microscopic clay minerals; no crystals that are visible to the naked eye are known to exist. They are important minerals for the ceramics industry.

Willemite

Willemite was discovered at Altenberg in 1829. French scientist Lévy (who had fled the country because he was of Jewish descent) named it after King William I of the Netherlands. Details on its discovery as a new mineral species can be found in Ernst Burke's article in this issue.



This announcement's header sounds very weighty: "Announcement intended for the Secret Council of Leonhard". After Lévy, 1829.



The formula is Zn_2SiO_4 and it crystallises in the trigonal system. It occurs (or better "occurred", because the mines are now closed) in Belgium as prismatic crystals of a few millimetres tall, as crusts and massive. The colour is usually tan to yellowish or brownish. Willemite from the region of Moresnet barely shows any fluorescence, unlike willemite from numerous other localities (especially New Jersey). Later willemite was also found at Angleur, Bleiberg (Plombières), Engis, Fossey, La Calamine (Kelmis), Le Rocheux, Pandour and Theux.

The mineral is primarily known from the former zinc mines near Franklin and Sterling Hill in New Jersey (USA) where large reddish brown manganese-bearing crystals have been found. It is this manganese content, which makes these specimens light up under ultraviolet light, which makes for an unforgettable sight. In fact, willemite had been discovered here a little earlier than in Belgium, but it was not adequately described or named at the time (Vanuxem en Keating, 1824). That is why Altenberg is now the official type locality.

Davreuxite

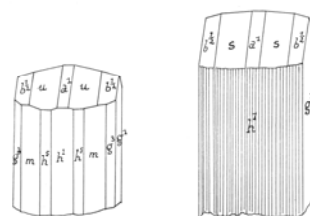
This mineral was discovered in Ottré in 1850. Laurent Guillaume De Koninck (see also koninckite) described it and named it after Charles Joseph Davreux (1800-1863), mineralogist at the University of Liège (Dalry and Deliens, 1993).

The formula is $Mn^{2+}Al_6Si_4O_{17}(OH)_2$ and it crystallises in the monoclinic system. Davreuxite occurs as white fibrous masses in quartz together with pyrophyllite. Belgium is still the only country it has been found in so far, in four different localities:

- Salmchâteau, Vielsalm, Stavelot Massif, Luxembourg
- Ottré, Vielsalm, Stavelot Massif, Luxembourg
- Tier des Carrières, Cahay, Vielsalm, Stavelot Massif, Luxembourg
- Recht, Sankt-Vith, Liège

Ardennite-(As)

Ardennite-(As) is the pride of our Belgian minerals because of its beauty (yellowish brown crystal bundles in white quartz), its peculiar composition, and the fact that our country was the only known locality for a long time. Later it has been found in dozens of other localities, e.g. Greece, Northern Italy, Japan, India, New Zealand, Macedonia, Russia, and Great Britain. However, please allow us to be a little chauvinistic for once: the specimens of ardennite from the Belgian Ardennes are still the biggest and most beautiful ones☺.



Ardennite-(As) crystals from Salmchâteau, Luxembourg. After Victor Goldschmidt 'Atlas der Krystallformen' (Band 1).

It was discovered at Salmchâteau in 1872 and Von Lasaulx named it after the locality in the Ardennes. The very complicated formula is $Mn^{2+}_4(Al,Mg)_6(SiO_4)_2(Si_3O_{10})[(As,V)O_4](OH)_6$ and it crystallises in the orthorhombic system.

Barely a few months later Professor Pisani also published a description of this new mineral, which led to a bitter dispute about priority. He named it dewalquite, after Professor Dewalque; this is now an older synonym, but the term still occurs in the literature, especially in older works. The history of its discovery is a different story (more on this... next time!). When a new species of ardennite was discovered in Italy in 2005 (Barresi A.A. et al., 2007), in which vanadium (V) dominates over arsenic (As), it was first named "IMA 2005-037", and subsequently renamed to ardennite-(V). All specimens of ardennite from other localities had to be redefined. Since then, "our" ardennite is called ardennite-(As). Aside from the type locality of Salmchâteau, it has also been found at Bihain and Ottré, in the same geological region.



The quartz vein with ardennite-(As) - named ardennite in 1972 - in quartz phyllite along the railroad at Salmchâteau. Try hunting for ardennite while trains are whizzing by at a distance of less than a metre behind your back... We never shied away from danger at the time. Nowadays the locality is completely off-limits, and rightly so. Photo © Rik Dillen.

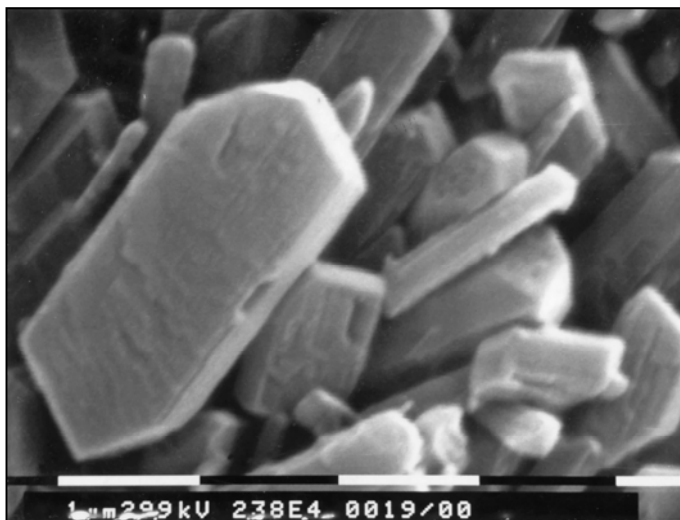
According to the literature, ardennite-(V) also occurs in Belgium, namely at Bierleux, Werbomont, the Lienne Valley, the Stavelot Massif and at Bihain (Pasero et al, 1994, en Barresi A.A. et al., 2007). Barresi and his team also re-examined ardennite specimens from Salmchâteau with the electron microprobe, and their analyses showed strong variations in the As/V ratios. In some cases, they even observed zoning, which Cesàro had noticed through his microscope as early as 1910. To my great surprise, I even found my own name (Rik Dillen, Ed.) in the acknowledgments of Barresi's article.

Barresi and his team had eventually shown that there is a virtually complete series between ardennite-(As) and ardennite-(V).

Destinezite

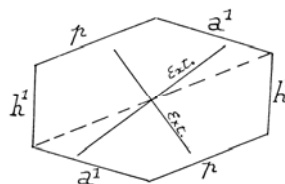
Destinezite was discovered at Argenteau, east of Richelle in 1879. H. Forir named it after P. Destinez, a laboratory assistant at the University of Liège. G. Cesàro analysed the material in 1884. The formula is $\text{Fe}_2(\text{PO}_4)(\text{SO}_4)(\text{OH}) \cdot 6\text{H}_2\text{O}$ and it crystallises in the triclinic system. It occurs as off-white masses, which can grow larger than 10cm in diameter. On the other hand, the crystals are tiny and never visible to the naked eye: they usually reach only a few μm in length.

This mineral was considered identical to diadochite for a long time, which had been described earlier and therefore had priority. However, it was reccredited a few years ago after research had been done on specimens from the USA: destinezite is the triclinic mineral with the aforementioned formula, while diadochite is the amorphous form with the same formula.



←
Destinezite crystals from the type locality. SEM image at 23,800x magnification! The largest crystal is slightly wider than 1 μm and about 4 μm long. SEM image © Rik Dillen.

↓ *Sketch including optical axes of a destinezite crystal from the type locality. After Buttgenbach (1947)*



Richellite

Richellite was discovered at Richelle in 1883. Cesàro named it after the locality. It is amorphous and its formula is $\text{Ca}_3\text{Fe}^{3+}_{10}(\text{PO}_4)_8(\text{OH},\text{F})_{12} \cdot n\text{H}_2\text{O}$. It occurs as tan to yellowish brown masses, which can reach more than fist-size. Aside from Richelle, it has also been found at Beez. It also occurs in a few places in Spain and the USA.

Fraipontite

Fraipontite was discovered at Altenberg (Moresnet, Liège) in 1883. Cesàro named it after the brothers Julien, Jean-Joseph, and Charles Fraipont, all of whom were genuine scientists (mineralogy, palaeontology, biology etc.). Its formula is $(\text{Zn},\text{Cu},\text{Al})_3(\text{Si},\text{Al})_2\text{O}_5(\text{OH})_4$. It belongs to the serpentine

group and can be regarded as zinc-bearing clay. It crystallises in the monoclinic system. Chances are slim that you have any Belgian fraipontite in your collection though, because officially only a single Belgian specimen has ever been stored. No worries though, fraipontite also occurs in dozens of other places worldwide. Today there are even two polytypes known, fraipontite-1H and fraipontite-1M. A variety which contains a lot of copper, so-called "cupro-fraipontite" is pale blue and occurs e.g. at the Silver Bill Mine, Courtland-Gleeson District, Cochise Co., Arizona, USA.



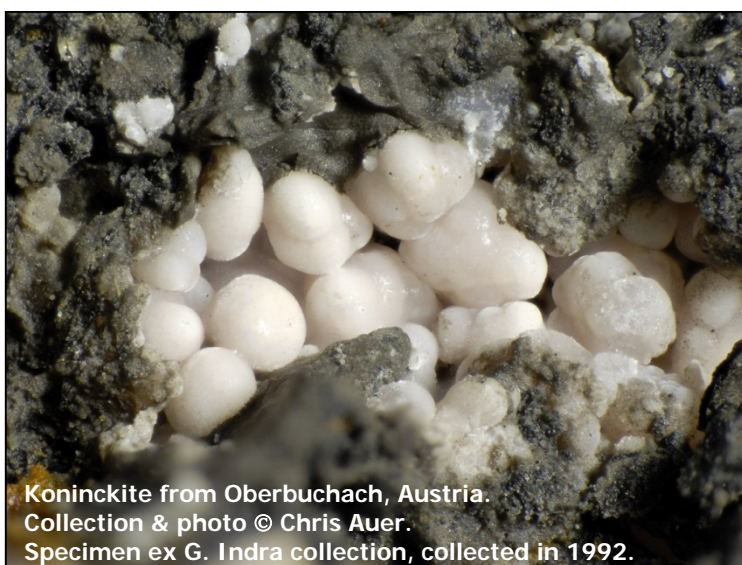
Koninckite

The type locality of koninckite is again Richelle, where it was discovered in 1884. Cesàro named it after Professor Laurent Guillaume De Koninck (1809-1887), a palaeontologist and chemist born in Leuven. He taught at the University of Ghent.

The formula is $\text{FePO}_4 \cdot 3\text{H}_2\text{O}$ and it crystallises in the tetragonal system; it occurs as tiny spheres in cavities in amorphous iron phosphates (Van Tassel, 1968). In 1968, it was only known from Richelle, but since then it has been found at about twenty localities worldwide.

In 1968, Van Tassel decided to examine the structure and to thoroughly describe koninckite. To do this he used a few specimens in the RBINS collection, which still had Cesàro's original labels. Using x-ray diffraction (Debye-Scherrer method), he was able to describe the structure in detail. Koninckite from Richelle is tan in colour because of a richellite crust; the underlying koninckite is pure white.

Attractive snow-white koninckite appeared in 1997, at the so-called "Geo-trail" near Oberbuchach, Carinthia, Austria (Puttner, 1997). At the construction site of a geologic trail a rock face collapsed (luckily without anyone getting injured), which surprisingly revealed a zone full of cavities encrusted with acicular koninckite crystals, usually in attractive radial fans of aggregates with a silky lustre.

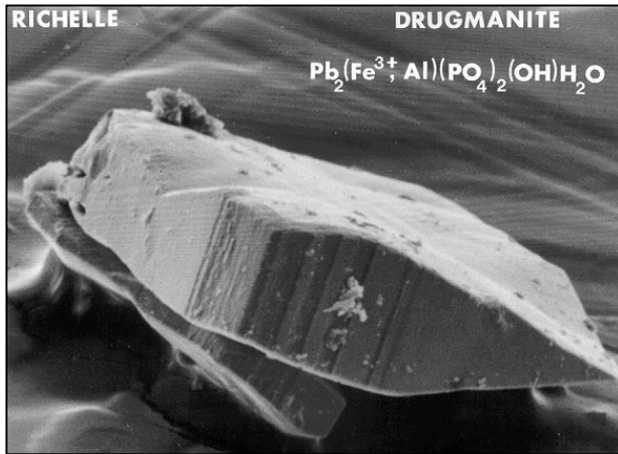


Koninckite from Oberbuchach, Austria.
Collection & photo © Chris Auer.
Specimen ex G. Indra collection, collected in 1992.

Drugmanite

Drugmanite was discovered at Richelle in 1979. René Van Tassel named it after Julien Drugman (1875-1950), a Belgian mineralogist who donated his large collection to the Royal Belgian Institute of Natural Sciences (RBINS) in 1950. King and Sengier-Roberts examined its structure later (1988).

The formula is $\text{Pb}_2(\text{Fe}^{3+}, \text{Al})\text{H}(\text{PO}_4)_2(\text{OH})_2$ and it crystallises in the monoclinic system. It only occurs microscopically and is very rare. For quite some time it was only known from Belgium, but in 1999, it was also discovered in the Eifel area in Germany (Schnorrer en Schaeffer, 1999). At Richelle, it occurs in crystalline limestone as tan to colourless tiny platy crystals of up to 0.2mm together with pyromorphite, anglesite, corkite, and phosphosiderite (Daltry and Deliens, 1993).



Drugmanite crystal from Richelle. SEM image © RBINS (J. Cillis).

Vantasselite

Vantasselite was discovered at Bihain in 1986. Fransolet named it after René Van Tassel, the Nestor of the Belgian mineralogists and honorary member/godfather of the Mineralogische Kring Antwerpen. He passed away this spring at the age of 96. In fact, specimens with what later would be called vantasselite had been known for about 10 years. However, most collectors at the time thought it was wavellite (which also occurs abundantly at Bihain); collectors often called it "mica carré." The following table lists the most prominent differences between the two:

Wavellite from Bihain	Vantasselite from Bihain
Large surfaces covered with radial fans of aggregates of up to 1-2cm. The fans limit each other's growth.	Individual rosettes of up to a few millimetres
Colourless-translucent	Milky white
Icy lustre	Typical pearly lustre
Acicular crystals	Predominantly platy or lath-like crystals

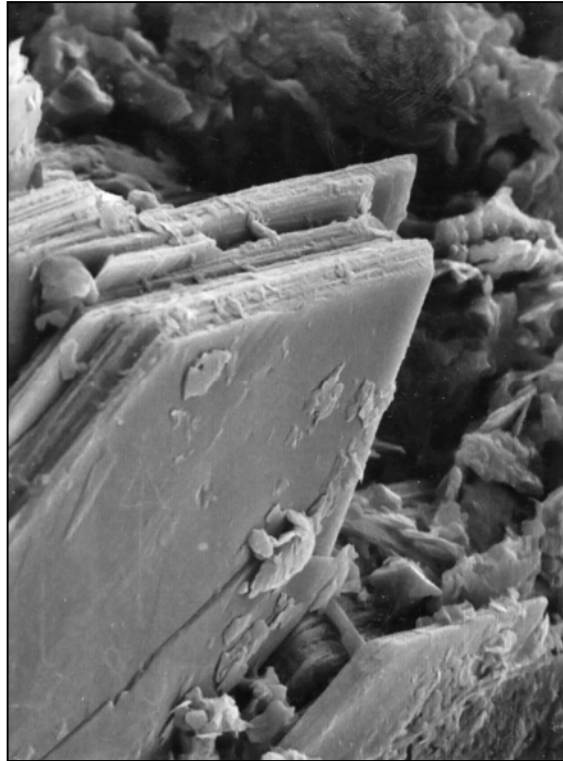
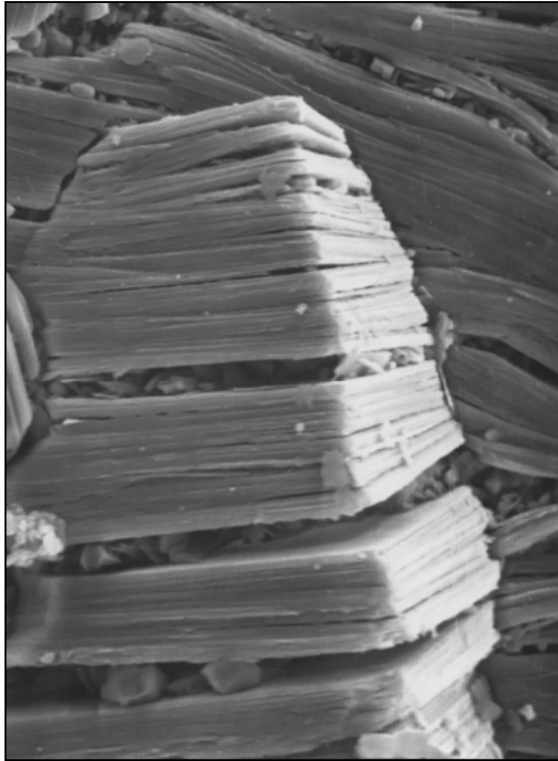
In fact, vantasselite was not even as rare (locally) as you might think. However, in the meantime the locality has been completely cleared out and covered with vegetation. As far as we know, no vantasselite has been found at the locality in recent years. Vantasselite has also been discovered at two localities in Germany, as well as in Japan.

The formula is $Al_4(PO_4)_3(OH)_3 \cdot 9H_2O$ and it crystallises in the orthorhombic system. The composition shows a certain analogy to that of vashegyite, $Al_{11}(PO_4)_9(OH)_6 \cdot 38H_2O$, and not just chemically: we don't know whether it is a coincidence or not, but René Van Tassel was also the first to identify vashegyite as occurring in Belgium (Van Tassel, 1985).



Vantasselite occurs as white rosettes on the fracture planes of dark schist, which produces an attractive contrast. The aggregates are sometimes beautifully fan-shaped and occur in/on cleavage or fracture planes of the schist or in quartz veins in quartz phyllite rock in which coticule also occurs (*coticule is a type of rock which contains microscopic garnet crystals and is used as a whetstone, Ed.*).

← René Van Tassel (1916-2013). Photo © Rik Dillen.



Top left
Vantasselite cleavage. Image width approx. 0,15 mm. SEM image © Rik Dillen.

Top right
Tabular vantasselite crystals. Image width approx. 1 mm. SEM image © Rik Dillen.

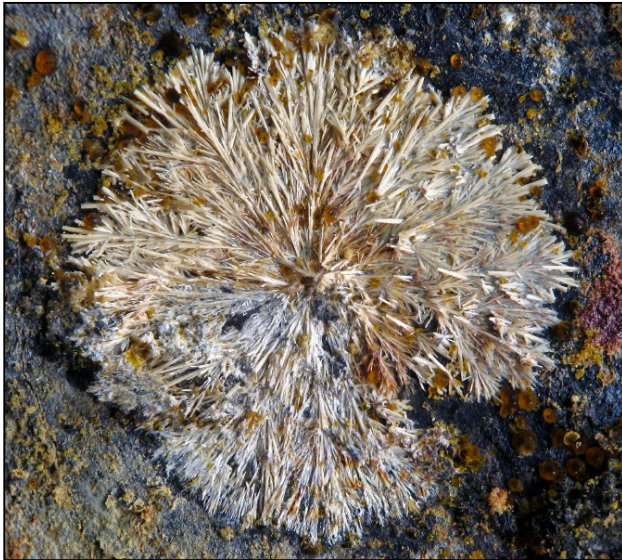
Left
Vantasselite rosettes from Bihain, Luxembourg. Collection and photo © Harjo Neutkens.

Vantasselite also often occurs on and inside the layers of cuticle. It is white in colour, and isolated lamellar crystals are translucent. The crystals have good cleavage, often almost mica-like. The cleavage planes show a distinct pearly lustre.

Ferristrunzite

This mineral had been known from the locality of Blaton for some time before the American Peacor finally described it and subsequently submitted it to the IMA in 1987. The “problem” was that it strongly resembles ferrostrunzite. However, it had previously been established that the mineral from Blaton differed from ferrostrunzite. In ferrostrunzite, the iron is divalent (“ferroan”), while in ferristrunzite the iron is trivalent (“ferrian”). Nevertheless, it took a long time before it was officially described. Compare the chemical formulae:

strunzite	$\text{Mn}^{2+}\text{Fe}^{3+}_2(\text{PO}_4)_2(\text{OH})_2 \cdot 6\text{H}_2\text{O}$
ferrostrunzite	$\text{Fe}^{2+}\text{Fe}^{3+}_2(\text{PO}_4)_2(\text{OH})_2 \cdot 6\text{H}_2\text{O}$
ferristrunzite	$\text{Fe}^{3+}\text{Fe}^{3+}_2(\text{PO}_4)_2(\text{OH})_3 \cdot 5\text{H}_2\text{O}$



Ferristrunzite aggregate associated with brownish yellow cacoxenite spheres. Image width 0.8 mm. Mont-des-Groseillers, Blaton, Hainaut. Collection and photo © Harjo Neutkens.

When ferrostrunzite evolves into ferristrunzite, Fe^{2+} oxidises to Fe^{3+} , which is compensated by a molecule of water, which converts into an OH group. All three minerals are triclinic.

Ferristrunzite forms aggregates of pale yellow to brownish hair or lath-shaped crystals, but randomly oriented single crystals

of up to 2 mm occur as well. Upon weathering it turns pale yellow to tan and sometimes even almost white. The individual crystals are often bent or distorted.

René Van Tassel started to research the mineralogy of the Mont-des-Groseillers at Blaton in 1956. At the construction site of the Nimy-Blaton Canal an outcrop with a 25-metre profile had been laid bare. The first mineral that was described was crandallite (Van Tassel, 1956), and many more phosphates would follow. In 1966, Van Tassel described a number of phosphates occurring at Blaton (strengite, phosphosiderite, cacoxenite, and strunzite). This article was in fact the start of the research of ferristrunzite. Van Tassel namely already distinguished between manganese-free strunzite and strunzite from most other localities. He wrote: "*une analogie entre la composition de la strunzite manganésifère de Hagendorf, de celle de Seixeira et du minéral de Blaton ne se dégage pas facilement. Les analyses disponibles sont encore trop rares et même discordantes (celle de Blaton est la première pour un strunzite non-manganésifère) pour justifier, pour l'instant, la distinction spécifique entre le minéral belge et la strunzite.*"

[Translation: "An analogy between the composition of the manganese-bearing strunzite from Hagendorf, the one from Seixeira and the mineral from Blaton is not easily clarified. The available analyses are still too rare and even too variable (the analysis of the mineral from Blaton is the first for a non-manganese-bearing strunzite) to justify, at this moment, the specific distinction between the Belgian mineral and strunzite."].

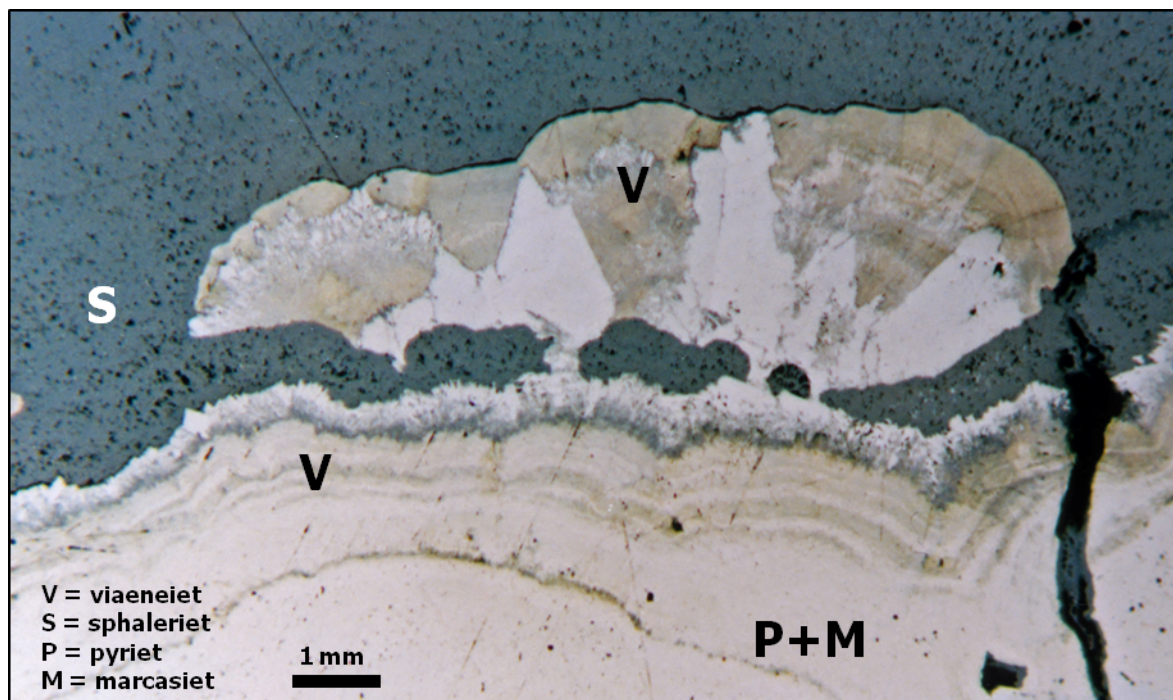
When, through research by Peacor et al. (1987), the strunzite from Blaton turned out not only to be manganese-free, but to also contain Fe^{3+} ions, they concluded that it had to be a new species.

Meanwhile ferristrunzite had also been identified at Haut-le-Wastia, Anhée, Namur (Dillen and Van Goethem, 1990). Mineralogically speaking, Blaton remains one of the "smash hits" with around thirty different species.

Viaeneite

Viaeneite is a "difficult" mineral in many aspects: it is not easily recognised, it is not easily stored in a collection, and to understand the history of its discovery and its structure, some knowledge of chemistry and testing methods is required.

Its formula looks simple at first sight: $(\text{Fe,Pb})_4\text{S}_8\text{O}$. The problem is that sulphur assumes two different valences, depending on its place in the structure. We can rewrite the formula as $\text{Fe}_{12}[(\text{S}_2)^{2-}]_{11}[(\text{S}_2\text{O}_3)^{2-}]$, in other words there are both disulphide and thiosulphate ions in the structure. If you want to know more about it in detail, please refer to a previous article in Geonieuws (Dillen, 1996).



The Polish professor H. Kucha discovered viaeneite. He was a guest researcher at the Catholic University of Leuven at the time, studying the Belgian lead and zinc ores. While he was examining material from the "La Mallieue" deposit in the Engis lead and zinc mine (halfway between Liège and Huy), he discovered the mineral in ore aggregates of pyrite, marcasite and sphalerite. It does not exactly look spectacular (to be honest, it is even barely recognisable) and forms aggregates of 0.05 to 0.5 mm, rarely up to 4 mm. The aggregates are made up of minuscule crystals of up to 80µm. It quickly weathers in air and therefore only occurs as inclusions in other minerals. That is why you can only recognise and study it in a (freshly) polished cross-section. However, even that is not sufficient: the polishing needs to be done without water (e.g. with oil), because the mineral would otherwise immediately oxidise.

Viaeneite was named after Prof. Willy Viaene (1940-2000), geologist at the Catholic University of Leuven (1940-2000) and a keen fan of the MKA.

Graulichite-(Ce)

A number of Walloon collectors who were regularly active in the Hourt Quarry, collected a number of secondary minerals in a paragenesis with arsenopyrite. An interesting mineral they found associated with arsenopyrite was... native gold (Hanson et al., 1999)!

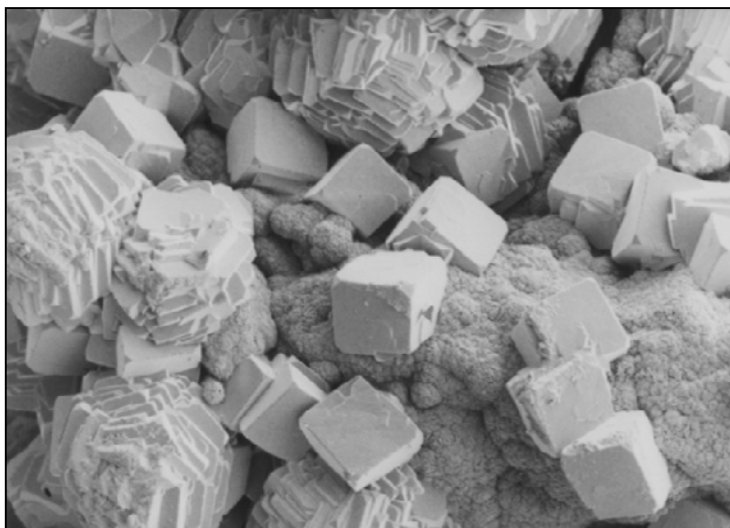
Brownish tan, sometimes greenish crusts of rhombohedral crystals turned out to be a phosphate. A preliminary analysis showed that it was a Fe³⁺-rich equivalent of arsenoflorencite, CeAl³⁺₃(AsO₄)₂(OH)₆, which had not been described yet. Pierre Lefèvre showed in his master thesis that it was indeed a new species. It was submitted to the IMA (CNMMN) as IMA 2002-001 with the proposed name graulichite-(Ce).

A preliminary x-ray diffraction study had already shown that it had to be a mineral in the crandallite group. To obtain statistically dependable results, more than 30 individual wavelength dispersive x-ray analyses in a microprobe were done, giving the following results (only the concentrations of elements exceeding 0.1% are mentioned in the table below):

As ₂ O ₅	31,20
Al ₂ O ₃	3,09
Fe ₂ O ₃	30,65
SrO	0,24
BaO	3,95
La ₂ O ₃	2,26
Ce ₂ O ₃	15,73
Nd ₂ O ₃	2,08
H ₂ O (*)	8,37

(*) *calculated*

*Graulichite-(Ce) crystals; size 50 μm,
from Hourt Quarry.
SEM image © Frédéric Hatert.*



As you already know, Ce always occurs accompanied by (usually lower concentrations of) other rare earth metals, mainly La and Nd. The other rare earths also occur, but in much lower concentration, so much lower in fact that we can disregard them here. Part of the stoichiometrically expected rare earth ions have been replaced by Ba²⁺ (and Sr²⁺), and because these ions are divalent as opposed to the trivalent rare earth ions, this has to be compensated in the formula by replacing a few OH groups with H₂O. A few minor problems remain concerning a small deficiency in As, which can be explained by vacant locations in the structure.

Graulichite-(Ce) was named after mining engineer and former honorary director of the Belgian Geological Survey, Jean-Marie Graulich (1920-2001), who during his lifetime had done a lot of scientific research on the geology of the Stavelot Massif. The IMA's CNMMN ("International Mineralogical Association's Commission on New Minerals and Mineral Names") officially accepted the name. Examples of the so-called "holotype" (the official type specimen) are kept in the collections of the laboratory for mineralogy of the University of Liège (reference 20325) and of the Royal Belgian Institute of Natural Sciences in Brussels (reference RN 6419).

To read more on graulichite-(Ce) and its discovery, please refer to Dillen, Dehove, and Detaille (2004). Meanwhile graulichite-(Ce) has also been discovered in the Clara mine, Oberwolfach, Black Forest, Germany.

Stavelotite-(La)

Werner Schreyer discovered stavelotite-(La) in 2004 while researching the metamorphism of the rocks near Le Coreux; he named it after the type locality, the Stavelot Massif (Stavelot is also the name of the nearest city).

The formula is La₃(Mn²⁺)₃Cu²⁺(Mn³⁺,Fe³⁺,Mn⁴⁺)₂₆(Si₂O₇)₆O₃₀, in other words lanthanum is the dominant rare earth element; it is a very unusual formula, containing copper *and* manganese *and* rare earths. The mineral crystallises in the trigonal system; it occurs as microscopic grains and specialist research is required to positively identify it.

Stavelotite-(La) was discovered on a specimen on which very iron-rich kanonaite had been identified in 2004 (Schreyer et al., 2004). The specimen came from Le Coreux, about 1 km from Salmchâteau, from the western flank of the Salm valley, where a number of other manganese-bearing minerals had previously been found. The description by Bernhardt et al was published in 2005. Associated minerals are strontiomelane, muscovite, kanonaite, hollandite, hematite, braunite, albite, and various oxidic manganese minerals.

In the formula $\text{La}_3(\text{Mn}^{2+})_3\text{Cu}^{2+}(\text{Mn}^{3+}, \text{Fe}^{3+}, \text{Mn}^{4+})_{26}(\text{Si}_2\text{O}_7)_6\text{O}_{30}$ La is partially replaced (in decreasing amounts) by Nd, Ca, Sc and Ce. In this case, the Ce-La-Nd-Pr ratio is very different from what we usually see in rare earth elements. Very few rare earth minerals are known where La is the dominant element, followed by Nd; usually Ce is in first or second place. During its formation a peculiar "fractioning" of the rare earth elements has apparently occurred. This can be caused by a high oxidation potential, which leads to the formation of Ce^{4+} instead of Ce^{3+} , which does not fit as well in the crystal structure.

The occurrence of various minerals containing rare earth elements is well-known (e.g. florencite-(Ce), $\text{CeAl}_3(\text{PO}_4)_2(\text{OH})_6$).

It is a trigonal sorosilicate. Stavelotite-(La) is black, opaque with a metallic lustre. It occurs as grains of 10 up to 160 μm ... Not exactly the kind of thing you would put on display! The calculated density is 4.489 g/cm^3 .

Pumpellyite-Al

In 2005 the IMA approved another mineral with a Belgian type locality, IMA 2005-016, which was renamed pumpellyite-(Al) after the publication of Hatert et al. (2007). The formula is $\text{Ca}_2\text{Al}_3(\text{SiO}_4)(\text{Si}_2\text{O}_7)\text{O}(\text{OH})\cdot\text{H}_2\text{O}$, and pumpellyite-(Al) is monoclinic. It occurs as small radial to fibrous aggregates of more or less acicular crystals, together with calcite, feldspar, and chlorite.

The type locality is the well-known La Flèche Quarry near Bertrix, where a number of other interesting things have been (and still are being) found, such as bastnäsite and several zeolites.



*Pumpellyite aggregates from La Flèche Quarry, Bertrix, Luxembourg.
Image width 6 mm.
Collection and photo © Harjo Neutkens.*

Discussion

We notice that, coincidentally or not, all minerals with a Belgian type locality are phosphates or silicates, viaeneite being the only exception.

Surface processes or low-grade metamorphism form all of them, and manganese plays an important role.

Geographically the discoveries are not spread homogeneously: Most of them are concentrated in the areas around Richelle, Moresnet, and Vielsalm.

Also typical is that a lot of discoveries were made in the 19th century (until 1888), then there was a pause of about 100 years, and Van Tassel picked up the thread in 1979 with the discovery of drugmanite.

“Pseudominerals” and “nearly new” minerals for Belgium

For completeness' sake, we must not forget that the mineral calclacite was also described in 1945. The formula is $\text{CaCl}_2 \cdot \text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 10\text{H}_2\text{O}$. It was discovered on limestone that was kept in oak drawers at the RBINS, the Royal Belgian Institute of Natural Sciences. It is a product of the reaction between the limestone and the saps in the oak. Because it originated through human intervention, the CNMMN would not accept it as a valid species today. A number of books and several websites also mention the mineral viseite for Belgium, but the IMA already discredited it in 1997 (Coombs et al., 1997). It turned out to be a mixture of poorly crystallised crandallite and other minerals, mainly opal.

The following is a list of minerals which were once described from Belgium but which have since been discredited. However, you can still find the names of these minerals in older works:

- **bastonite**: discovered near Bastogne; a variety of phlogopite
- **belgite**: from Altenberg (= Vieille-Montagne), Moresnet, synonym of willemite
- **franquenite**: from Franquénies in Walloon Brabant; identical to the previously described iron sulphate slavikite
- **gosseletite** and **lohestite**: both a form of manganese-bearing andalusite
- **moresnetite**: from Altenberg; a mixture of the zinc silicates hemimorphite and sauconite
- **salmite**: discovered in the metamorphous region around the river Salm; a variety of chloritoid

Then there is another mineral, which *is* a valid species, but we “missed” it in Belgium. Our researchers did not have the proper equipment to be able to complete their research on time, to describe it and to submit it for recognition on time. It is an iron oxide, which was first discovered at Richelle, but which was later formally described using material from Akagane, Japan. It is now known as akaganeite, and the type locality is in Japan.

Finally yet importantly, a few minerals should have had a Belgian type locality but do not:

- **Strontiomelane**: was discovered in the manganese deposit of Praborna near Saint Marcel (San Marcello) in the Aosta valley. It is related to the more abundant hollandite ($\text{BaMn}_8\text{O}_{16}$), but more than 50% of the barium is replaced by strontium, making it a different species: $(\text{Sr},\text{Ba})\text{Mn}_8\text{O}_{16}$. The name is derived from the strontium content and the Greek word “melanos” in allusion to the black colour. It occurs at Le Coreux, Salmchâteau, Vielsalm, Luxembourg.
- **Kanonaite**: closely related to andalusite, the formula is $(\text{Mn}^{3+},\text{Al})\text{AlSiO}_5$. If manganese is present during its formation, this will replace one of the aluminium atoms in the crystal structure. Thus originates a green variety, which we have already found on our trips in the Ardennes, and which was previously called “viridine” (this name is now discredited and replaced with “manganese-bearing andalusite”). When more manganese than aluminium is present in a specific location in the crystal structure, it becomes a new mineral called kanonaite after its type locality (Kanona in Zambia). Belgium is now the second locality worldwide and here the mineral is even richer in manganese than at the type locality (In Belgium, the aluminium is completely replaced by manganese with minor iron, while the material from Zambia still contains about 23% of aluminium.)

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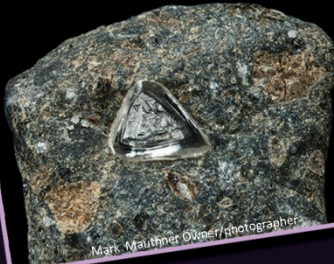
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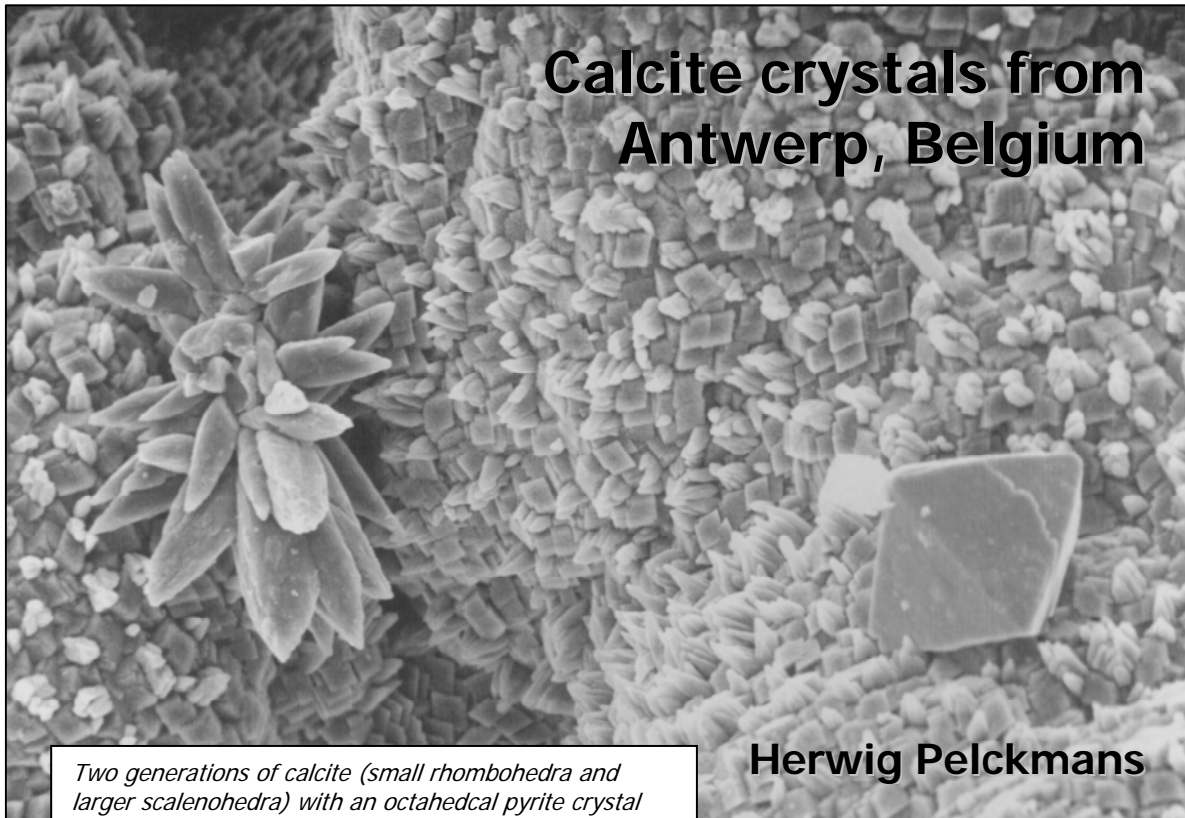


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Calcite crystals from Antwerp, Belgium

Two generations of calcite (small rhombohedra and larger scalenohedra) with an octahedral pyrite crystal from the clay quarry in Rumst, Antwerp Province, Belgium. Image width 0.4 mm. SEM image © Rik Dillen.

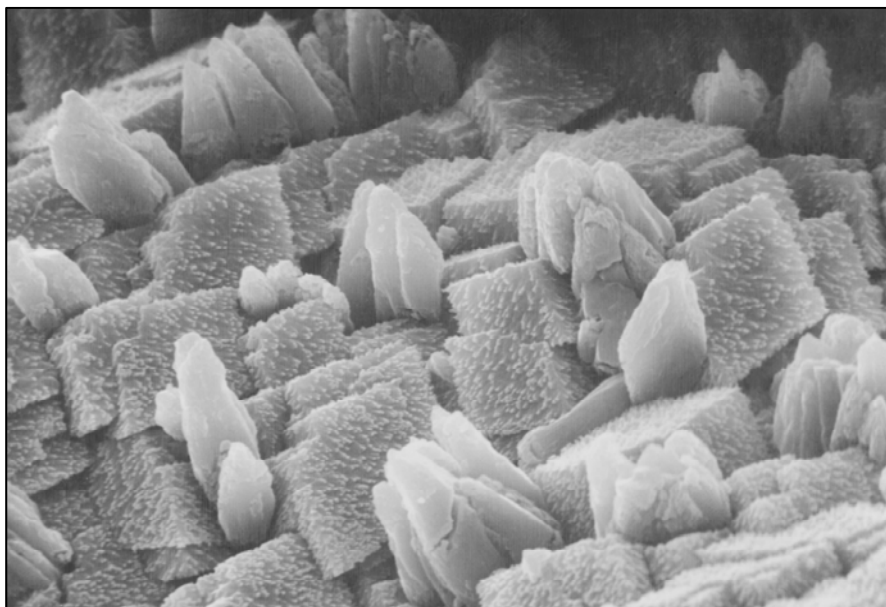
Herwig Pelckmans

Minerals in Flanders

The Belgian region of Flanders is not exactly famous for its mineral localities. This has everything to do with its subsurface. When looking at Belgium's geological map, it is quickly obvious that the younger deposits can be found predominantly in Flanders, while the older rocks predominantly form outcrops throughout the region of Wallonia. Belgium's younger rock layers, i.e. those dating from the Tertiary and Quaternary, have not been subjected to any noteworthy geological forces, and thus are still just the loose, sedimentary rocks: sand, loam and clay. Almost all Tertiary deposits are of marine origin and are teeming with fossils. This might be something of a wet dream for fossil fanatics; mineral collectors are not exactly impressed. At least, not yet...

Certain layers in the Flemish subsurface are well known among mineral collectors. The most well known is undoubtedly the so-called "Boom clay formation" (Oligocene, Rupelian), because of the "clay breads" that are sometimes found within it. The inner walls of these septarian concretions are usually covered with a layer of yellow calcite, which in turn is sometimes covered by (spherical aggregates of) pyrite crystals. The same layer of clay is also well known among Belgian mineral collectors for its localised occurrence of beautiful gypsum crystals. For example at the former Bete-kom Quarry (<http://www.mindat.org/loc-175669.html>), where in the 1970s gypsum crystals of up to 20 cm could be salvaged. Belgium's undoubtedly most beautiful gypsum crystals originated from this locality.

When you go out looking for minerals in sand deposits, you usually quickly give up and go back home empty-handed even though sand in and of itself is nothing more than a mix of fine-grained minerals! Nonetheless, the mineral glauconite is worth mentioning. This mineral causes the dark green colour of the Miocene sands in Antwerp and its surroundings. Unfortunately, this silicate's formless "sand" grains are not exactly beauty contest winners, so they are often omitted from most regional mineral collections. The vivianite nodules from Herentals and its surroundings



Two generations of calcite (small rhombohedra and larger scalenohedra) from the clay quarry in Rumst, Antwerp Province, Belgium. Image width 70 μ m. SEM image © Rik Dillen.

are more popular, even though they rarely contain aesthetic microcrystals of this iron phosphate. Belgium's largest vivianite crystals (up to 2 cm) were found a long time ago in calcareous septaria from the Eigenbilzen Formation (Limburg province), but to my knowledge these are to be considered a very rare mineralogical oddity.

For completeness' sake, we should also discuss the remarkable concretions that were found in the Merksem Sands in Antwerp (Plio-Pleistocene). After mineralogical research by Van Tassel (1964) these cylindrical concretions turned out to consist mainly of apatite and siderite.

Unfortunately, these concretions do not contain any aesthetic crystals, but they do show a clearly biogenic structure with a straight central tube as their most striking feature. After an in-depth study by de Heinzelin (1964), these concretions were identified as fossil 'living tubes' of pogonophore worms (giant tube worms). A fun fact about these ichnofossils is that they were named *Tasselia ordamensis*. The genus name *Tasselia* honours Prof. Van Tassel, a recently deceased honorary member of the MKA. The species name *ordamensis* refers to Ordam, an Antwerp polder.

Minerals in fossils

It is a well-known fact that fossils can give rise to the formation of minerals. The "mineralised fossils" that capture my imagination the most are undoubtedly the emerald snails from Colombia. In the same way that quartz or calcite can replace a fossil, emerald – very rarely - did exactly that in Colombia! So far, only about four specimens are known from a single locality: the Matecaña Mine. On Ronald Ringsrud's website (see below), you can find more information and a bad quality photo. You can find much better quality photos on page 38 of the second English-language issue of *extra-Lapis: Emeralds of the World*.

True classics in this case are the exquisite vivianite crystals from the Kertch peninsula's ironstone (Ukraine). Here the crystals were deposited in the cavities that were left behind after the original shell material had (sometimes completely) leached and disappeared. Apart from vivianite, cavities with thin layers and small stalactites of rhodochrosite were also found. The locality's anapaite specimens can also be considered "world class" because of their exquisite green crystals, which have formed beautiful and large crystal aggregates the likes of which have never been found anywhere else in the world. To those of you who would like to examine the mineralogy of this deposit further, we would like to recommend the book by Chukanov (2005).

Much more recent, but by no means less interesting, are the calcite crystals found in fossils from Florida. In this case, we are talking about crags in lime sandstone of around 2 million years old (Pliocene) which through the ages have been partially leached by groundwater. The calcium carbonate that was dissolved in the process luckily found the place and time to redeposit as beautiful honey-coloured crystals in the cavities left behind by the fossils. The crystals mainly grew in the cavities formed by both shells of the bivalve *Mercenaria*. Gastropods (in this case the shells of fossil snails) containing calcite crystals from this locality are rare. You can find more information and numerous beautiful full-colour photos in the article by Claeys & Weiß (2004).

Well-crystallised minerals have also been found inside fossils in Flanders. The most widespread and best-known are undoubtedly the millimetre-sized quartz crystals in the petrified wood found in Hoegaarden. A few years ago (2002) Werner Heirman described these in detail in *Geonieuws*.

Calcite crystals from ... Antwerp!?

Sometime in the last century, two guys from Antwerp were studying geology at the University of Ghent. Since their field of study was traditionally the one with the least amount of students on the entire campus, they soon came into contact with each other. Both students were also passionate mineral collectors, and that is why one evening I was given the chance to check out Jan Claessens' new finds while visiting his dorm room. Among them was, tucked away in a small Jousi box, a calcite crystal from... Antwerp!? When Jan saw my amazement and disbelief, he told me he had found the calcite scalenohedron – which measured well over 1 cm – while cracking open fossil shells he had found in the area surrounding the Antwerp harbour!

I had never heard of calcite crystals in fossils from Antwerp and its surroundings and thought it was a remarkable find, one I never forgot about. Since this find and others like it have previously never been described, we can in fact say that this is a remarkable first, which suits this issue of *Geonieuws* perfectly.

According to Jan, the specimen was not a one-time-only find, but the fossils which contained these calcite crystals, *were* rare. After several years of searching for fossils and minerals in and around Stabroek, he knew from experience that the calcite crystals could only be found in the shells of a single species of fossil snail: *Neptunea angulata*.

This species used to be called *Neptunea contraria*, because its shell – unlike most other Gastropods – was left-handed instead of right-handed. However, since *Neptunea contraria* is a recent species which indeed does differ morphologically from the fossil species, the current correct name for this fossil species is *Neptunea angulata* (Marquet, 1998).

Neptunea angulata, 11 cm tall,
found during excavations for the
4th harbour dock of Kallo (Eastern
Flanders Province, Belgium) in the
Oorderen sands (Middle-Pliocene).
Collection and photo
© Herwig Pelckmans.





*Calcite crystals, formed inside the windings of a *Neptunea angulata*, clearly visible in this fragment (width 13 mm). Found by Jan Claessens in newly developed terrains of Antwerp Harbour (precise origin unknown) Collection and photo © Herwig Pelckmans.*

This well-known fossil is very common in the Oorderen Sands (Middle Pliocene) and the Kruis-schans Sands (Upper Pliocene) (Marquet, 1998) and can thus regularly be found on dumps and reclaimed harbour grounds. Dock construction sites and other parts of the harbour are nearly always off limits to collectors, which is why Jan has never been able to sample the calcite-bearing *Neptu-nea's* 'in situ'. Moreover, most of the snail shells only contain some sand and only about one shell in a hundred contains calcite crystals. Passionate fossil collectors are more than likely to have a heart attack knowing that at the time, Jan has cracked thousands of fossil *Neptu-nea's* looking for the highly sought-after crystals!

Acknowledgements

We certainly owe sincere thanks to Jan Claessens, who after all these years had already stored his geologic collection safely in his garden shed. After some insisting by the author, Jan finally showed what he was made of, diving fearlessly into the huge pile of boxes to go looking for the calcite specimen from the days of yore. Unfortunately, that particular specimen has yet to be rediscovered, but other similar calcite specimens *did* turn up. These are now in the author's regional mineral collection.

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<http://www.emeraldmine.com/museum2.htm>

The mystery of the Zoological Society's mineral collection - episode 2



Chris Deroo

In February 2010, Herwig Pelckmans published an article titled "*The mystery of the Zoological Society's mineral collection*" in our highly esteemed monthly magazine. While strolling around on the "Mineralogical Record" website, Herwig had stumbled upon the fact that our well-known Antwerp Zoo had apparently once housed a mineral collection. Two yellowed labels saying 'Société Royale de Zoologie d'Anvers' (*Royal Zoological Society of Antwerp, Ed.*) and 'Minéraux de Belgique' (*Minerals of Belgium, Ed.*) proved to be the tangible witnesses in this case. For many years, our club had kept in close contact with the Antwerp Zoo (e.g. as a member of the "Contact Committee for Natural Sciences & Nature Study Clubs in the Antwerp area"). We regularly organised lectures and exhibits in the Zoo's halls and auditoria, and we could always count on the collaboration of the Zoo staff. That is why it was so much more fun to get to the bottom of this mystery.



The labels in question saying 'Société Royale de Zoologie d'Anvers' ('Royal Zoological Society of Antwerp', Ed.)

The origins of the Zoo

Now is the time for us to find out more about the history of the Antwerp Zoo.

On 1 March 1843, the 'Zoologie d'Anvers' (the abbreviated French name for the Antwerp Zoo) bought the first one and a half hectares (*3.7 acres, Ed.*) of land in the then fifth district, the so-called Groenenhoek, next to the wooden train station in Borgerhout (built in 1836). On 21 July of that year, the Antwerp Zoo already opened to the public, but obviously a few years of preparation and planning had preceded this event.

Antwerp city council member, later mayor (1848-1862) and representative Johannes Franciscus Loos (°1799 - †1871) had already suggested the idea of a local zoo in 1840. He got the idea while visiting members of his family in Amsterdam, where he had also visited the Artis Zoo. A preliminary board of directors had convened for the first time on 19 June 1841. On this occasion, the "Zoological Society" was established and Jacobus Franciscus Kets (°1785 - †1865) was officially appointed permanent director of the Antwerp Zoo.

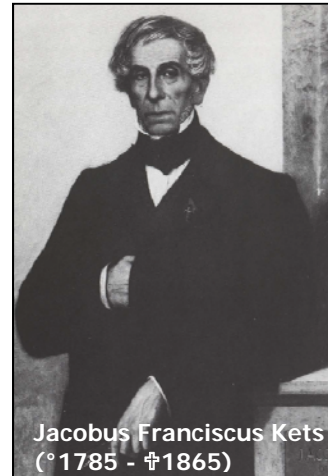
Architects Auguste Demarbaix (°1795 - †1845) and A. Lambeaux (°1819) were in charge of the execution of the building plans. Architect Emanuel van Cuyck (°1786 - †1863) was in charge of designing the garden. His design took into account any possible expansions of the domain, so that

any later increase in the available area would not detract from the original design. Through the years, one would namely try to expand the garden and in doing so protect it against the suffocating chokehold of the expanding city around it. A. Lambeaux had designed all of the planned buildings – except for the “Museum”, which Demarbaix had designed.

In 1844, construction of the “Chalet Suisse”, the director’s house, the “Museum” housing a number of animal quarters on the ground floor and the clubroom in the shape of a traditional Javanese planter’s hut was completed. When King Leopold I (°1790 - †1865) inaugurated these buildings that same year, the society officially became the “royal society”.

Jacobus Franciscus Kets (°1785 - †1865)

He was born on 10 November 1785 in Antwerp as the son of Jacques Kets, a fabric dyer, and Johanna-Katherina van Breda. His father, who was a keen hunter, passed his fascination for the natural world on to his young son. Jacobus, who turned out to be a good pupil, went out to finish his botany and zoology studies successfully and later qualified in taxidermy. In 1815, because of the quality of his work, he was allowed to embalm a horse (called “Wexy”) which had belonged to William Frederick George Louis (°1792 - †1849), Prince of Orange-Nassau, which had died in the battle of Waterloo (18 June 1815).



Jacobus Franciscus Kets
(°1785 - †1865)

Kets’ Cabinet of Curiosities.

Around 1828, Jacobus had opened a public “cabinet of curiosities” in the Kloosterstraat (*Convent Street, Ed.*) in Antwerp: *[...] il ouvrit à Anvers, dans la 4^e section, N°1956 (rue du Couvent) un Cabinet d'Histoire naturelle public, où, en dehors de divers animaux tropicaux, plantes, minéraux, coquillages et objets ethnographiques, étaient exposés également deux cent quarante-deux espèces d'oiseaux européens, représentés par quatre cent deux exemplaires. [...]*

Translation: [...] he opened in Antwerp, in the 4th section, N°1956 (Convent Street) a public Natural History Cabinet, where, aside from several tropical animals, plants, minerals, shells and ethnographical items, two hundred and forty-two species of European birds, represented by four hundred and two specimens were also exhibited. [...]: Rare artefacts, which were often imported from outside Europe, were considered “curiosities”. These items were not just Roman artefacts and coins, unusual shells, ostrich eggs, stuffed exotic animals and dried plants, but also minerals, crystals, gemstones, pearls etc.

↓ *The famous ‘Museum Wormianum’, owned by Danish physician Ole Worm (°1588 - †1655).*

Cabinets of Curiosities were especially popular in the 17th and 18th centuries. The popularity of such cabinets was mainly due to the increasing contact (after 1600) with exotic, tropical places and interest in plants and (mythological) creatures, whether they were in the Bible or not.

The word ‘cabinet’ was initially only used for the piece of furniture in which the ‘curiosities’ were stored. Gradually, the name shifted to the room the ‘cabinets’ were in and eventually the term covered the entire collection.



Kets had expanded his cabinet through several trips in Europe (Germany, the Netherlands, France, Switzerland) and a foreign exchange programme in exotic plant species and artefacts pertaining to natural history, through ship-owners from Antwerp and correspondents from overseas, e.g. from the United States. By the way, the Kets Cabinet was apparently somewhat renowned, according to the 'Guide de voyageur en Belgique et en Hollande' (*Traveller's Guide for Belgium and Holland, Ed.*) (1839). French author and book dealer Jean Marie Vincent Audin (°1793-†1851) wrote: "*Le beau cabinet d'histoire naturelle de M. Kets, rue du Couvent, l'un des plus riches et le mieux classé qui puisse se rencontrer, trouve sa place à la suite de ces collections*".

Translation: "Mr Kets' beautiful natural history cabinet, in Convent Street, being one of the richest and most highly classified one can ever encounter, is worth a visit because of its collections."

The minerals in the Kets collection.

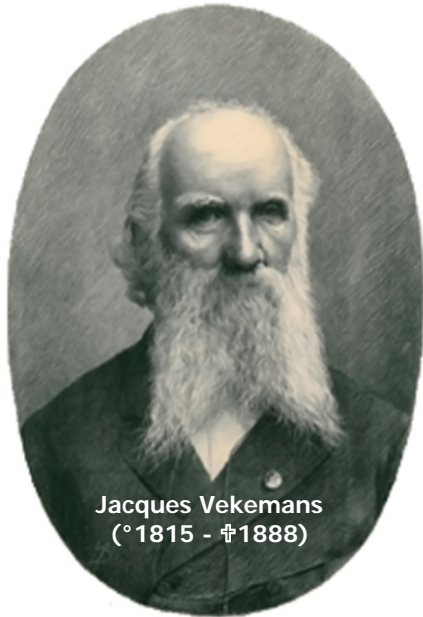
Suddenly, it dawned on me. Could the aforementioned minerals be the ones that had later belonged to the Zoological Society? In other words, could these have once been part of the Zoo director's personal collection of "curiosities"? It is entirely possible, because when the Zoo opened to the public in July 1843, there were only a small number of animals in just two cages. The biggest crowd-pleaser at the time did indeed turn out to be director Kets' "Cabinet of Curiosities", which was housed in the "Museum" building. By the way, Kets had only accepted the position of director on condition that a building would be provided to him to store his cabinet. After all, the city had decided to start using Kets' original rented house for other uses, so he had been obliged to move out.

What happened to Kets' cabinet of curiosities afterwards is unfortunately as clear as mud. Jacobus Franciscus Kets died on 1 February 1865, after having built up the "Royal Zoological Society of Antwerp" to an independent and lively cultural organism. Jacobus had remained a bachelor all his life and did not have any children. His cousin and closest assistant, ornithologist Jacques Vekemans (°1815 - †1888), succeeded him as director of the Zoo.

However, the number of mineral specimens in the Kets cabinet would surely have been rather modest, as the collection centred on the 400 or so stuffed birds. In 1861, French-speaking poet and author Eugène Gens (°1814 - †1881) from Leuven wrote about the rest of the collection, among which there were "a number of minerals" in a tourist guide, the 'Promenade au Jardin Zoologique d'Anvers' (*A Walk in the Zoological Garden of Antwerp, Ed.*):

The "Museum" building, where Kets' cabinet of curiosities was housed, around 1850.





Jacques Vekemans
(°1815 - †1888)

'L'hémicycle nous présente quelques objets qui, sans appartenir précisément à la Zoologie, ne sont pas sans rapport avec l'histoire naturelle. Ce sont des armes, des vêtements et des ustensiles de sauvages; des idoles, des modèles de jonques et des canots, etc. Puis, une collection de Serpents de l'Amérique centrale, conservés à l'esprit de vin, quelques minéraux, des zoophytes et des fossiles'.

Translation: The semicircle shows a number of objects, which, without exactly belonging to the field of zoology, relate to natural history. These items are things like weapons, pieces of clothing and tools of savages, idols, models of Chinese sailing boats, canoes etc. Next, there is a collection of Central American snakes, zoophytes (animals resembling plants, such as anemones, Ed.) and fossils.

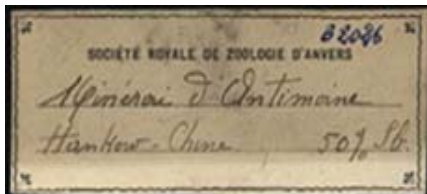
The same booklet mentions only a small number of donated mineral specimens: *'Du Bois Guill. from Antwerp – mineral specimens'* and *'Van Regenmortel Eg. - 2 Barbary sheep, Minerals.*

This strongly suggests that, if there is a connection between the mineral specimens in the Kets cabinet and the ones belonging to the Zoological Society, in no way either of these collections would have been a "serious" collection, but more of a mix of specimens that were occasionally gathered. Kets obviously was a well-trained botanist and zoologist, but - most likely - he was not as skilled in the field of mineralogy. This would e.g. explain why the labels do not have any locality printed on them, which seems rather unprofessional. Probably the minerals in Kets' cabinet were only the start of a mineral collection with a limited number of specimens.

The Zoo's mineral collection.

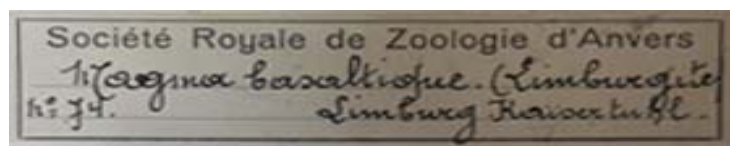
By the end of the 19th century (1895 - 1897) the Zoo's cultural function had taken precedence, e.g. concerts were being organised. Therefore, it was decided to tear down the museum and to replace it with a concert hall. Moreover, a large function hall, the predecessor of today's Queen Elisabeth Hall, a marble hall and a winter garden were designed and subsequently built. The museum's collections were housed on the first floor (or the second, if you count the ground floor) of the new complex.

The First World War was a black page in the zoo's history books. Not only were many animals slaughtered, all the buildings were severely damaged, with disastrous consequences for the collections housed inside. Consequently, it was decided to get rid of part of the mineral collection in 1926. On 23 November, around 350 mineral specimens were donated to the "Royal Belgian Institute for Natural Sciences" in Brussels. "Mineral specimens" are not exactly the right words though. Most of them were actually rock samples from Germany and the Czech Republic. Currently there are 46 of these samples left, which is considerably more than what is left of the actual mineral specimens.



→
"Rock" label from the
1926 donation to the RBINS.

← Original mineral specimen label from the 1926 donation to the RBINS.





Today, only three (!) of the mineral specimens that were part of the original donation remain in the RBINS' collection. Only one of them still has its original label.

The Second World War had the same disastrous consequences as the first one. Again all predatory animals were killed to prevent them from escaping and to make matters worse, many valuable animals froze to death in the harsh winter of 1940. During the course of the war, bombs destroyed the hippo quarters, the winter garden, and the museum, which meant that again a large part of the collections was lost. Near the end of the war a 'flying bomb' hit and destroyed the aquarium, the reptile quarters and the bird quarters.

On 20 May 1963, the city of Antwerp came to an agreement with the Royal Zoological Society of Antwerp to lend part of the so-called "Van Heurck" collections. "Collections" (plural) is the right word in this case. These consisted, among other things, of a collection of microscopes and optical instruments, historically important natural history collections together with a scientific library, collections of botanical, zoological and mineralogical artefacts and the matching furniture to exhibit these collections. Antwerp botanist Henri Ferdinand Van Heurck (°1838 - †1909) had built these collections during most of his life. In 1909, after he had died, they were donated to the city of Antwerp, which had initially housed them in the "Botanic Garden" of which Van Heurck had been the director.

At the turn of the 21st century, it was decided to close the museum as such and to use the space that was freed up for other more commercial and lucrative purposes. Both the city of Antwerp and the Zoo were more interested in conference space than in scientific collections and so all of these disappeared from public view. Some time later, the storage facilities had to be cleared out again because they were in the way of the planned complete renovation of the Queen Elisabeth Hall. At that moment, it was decided to donate the museum of natural history's (almost entire) collection (the part that the Royal Zoological Society owned) to the Royal Belgian Institute for Natural Sciences in Brussels.

On 21 September 2010, more than 1,000 stuffed animals were donated to the institute. However, at this moment the mineral collection still remains packed in crates and boxes awaiting an evaluation of the material and further dispatching by the services of Collection Policy, Preservation and Management of both the city of Antwerp as well as the RBINS' services. However, as usual in times like these, these services are all chronically understaffed and it will undoubtedly take a whole lot longer before the Zoo's mineral collection will finally see the light of day again.

Conclusion.

It is perfectly clear that until recently the Antwerp Zoo owned a mineral collection, presumably starting from the "cabinet" owned by then director Kets, stocked with occasional donations, among which there were at times highlights such as the "Van Heurck" collection. Presumably, it was not a "thoroughbred" collection, but more of an accumulation of both rock and mineral samples, which had come about more by chance than intentionally.

However, it looks as if the Zoo would rather keep its mineral collection in storage than to exhibit it, because it lacks both the necessary space and the work force, but mostly because it just does not fit the concept any longer. Consequently and unfortunately, the Zoo's mineral collection is now collecting dust in some obscure warehouse.

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- 'Openbaar Kunstbezit Vlaanderen' for their cooperation, and especially for their permission to use the images published in 'Openbaar kunstbezit in de Zoo' volume 24 (April, May, June) 1986 n°2. Portrait of Jacques Kets and litho zoo approx. 1850 - www.tento.be
- Herman Snoeck, of the Royal Antwerp Micrography Society, for providing the image of Paul van Heurck.



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Mineral finds in and around Aarschot

Erik Vercammen

Introduction

The following article is based on my personal experiences and observations as a mineral enthusiast and collector over the course of many years. However, it should be made clear that most of the finds described below date back to the early 1970s. Back in those days, there were still a number of extensive public works being carried out in the area, such as the construction of a school and the “Stadsfeestzaal” and other public works along the Demer River.

Moreover, a number of brickworks were still in operation at the time, complete with steep-sided “clay pits” and deep tailing ponds, dredging machines, small trains to transport the excavated clay to be processed and several drying warehouses. All these areas that were under development at the time offered opportunities for finding minerals which are now largely lost: the buildings are abandoned now and are surrounded by vegetation, and the clay quarries have been completely backfilled, in some cases with material of dubious nature and provenance.

Geography and geology of the area

Aarschot is located in the northeast of the province of Flemish Brabant, on the banks of the Demer River: the river's alluvial valley forms the centre part of the city. In the south, steep slopes with higher plateaus, the so-called Hageland hills, border the city. In the north, there are sand dunes, which formed there during the ice age. A similar area, also belonging to the “Campine” region, is located between the city centres of Aarschot and Gelrode: 's Hertogenheide, nestled in the Hageland hills. Deep below the surface is the ancient Brabant Massif, sloping down to the north. Younger layers that wedge out to the south are stacked against this Massif. To the north, these younger layers become ever thicker and are covered by ever-younger layers. The Hageland hills were formed by a sea during the Miocene 7 million years ago. In the flat northern half, the so-called Boom Clay Formation - which formed during the Oligocene - is located underneath a young upper layer of around 1 to 2 metres thick.

Finds

The Hageland hills

The Hageland hills formed during the Miocene, as sandbanks in a turbulent sea, and their pattern resembles that of the sandbanks in the North Sea. They consist primarily of sand, the weathering and erosion product from e.g. the Vosges Mountains, intermixed with the mineral **glauconite**. This mineral gets its name from its green colour, and when excavating the hills deep enough, large amounts of this green sand sometimes emerge. However, closer to the surface there is no glauconite: the mineral contains iron, and under the influence of water and oxygen in the atmosphere, this iron



starts to oxidise, in other words "rust". It is this rust that causes the hills' distinctive colour and which locally binds the sand grains together well enough to be quarried as building blocks, especially for churches. This natural rust is not just "any old mineral", but a mixture of iron, oxygen and hydrogen compounds. **Goethite** (named after German scientist J.W. von Goethe) occurs most frequently, followed by **lepidocrocite**. Both of these minerals have the same formula (FeOOH), but since they have a different crystal structure, they are by definition two distinct mineral species.

Specialist research is necessary to distinguish the two, unless they form larger crystals, which does happen in rare cases, but unfortunately not in the Hageland hills. For practical reasons, we therefore call them both by their generic name of "limonite", which also comprises amorphous (non-crystalline) iron oxyhydroxides, and usually sand, clay and/or manganese and aluminium oxides as well. All this does not mean that attractive specimens do not exist here. On the contrary, these minerals occur as small but considerably solid layers with a yellow, brown and sometimes even red surface. These layers can look lacquered or show surprising and bumpy surfaces. This is not just extremely decorative, but specimens like these have been gathered since the Iron Age and up to the Middle Ages to serve as ore in bloomeries which were fuelled by charcoal from the local forests.

During the period of 'autarky' (the so-called 'closed economy') during the interwar period of the 1930's, a new effort to mine the iron ore was made, on the so-called "Ijzeren Berg" (*Iron Mountain, Ed.*) in Gelrode. In the train station, a sidetrack was laid where the freight cars were loaded with ore for subsequent transport to the blast furnaces in Tubeke. Unfortunately, the ore's iron content proved to be too low to be profitable (only about 20%, while 30% was the required minimum) and a few years later the mining operation was completely shut down.

Demer valley

The soil here is acidic and swampy. In such conditions, dissolved iron reacts with phosphor from deposited organic material, and the mineral **vivianite** forms, which was named after its discoverer.

Abraham Gottlob Werner first described vivianite in 1817. He named it after John Henry Vivian (1785-1855), an English (Welsh-Cornish) politician, mine owner and mineralogist living in Truro, Cornwall. Vivian had discovered it in the Wheal Kind, West Wheal Kitty Group, Saint-Agnes, Cornwall, England, UK. Note: Many references erroneously state his full name was "J.G. Vivian", but the middle initial seems to have been a typographical error, which was later copied by other authors.

Vivianite's formula is $\text{Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$. Vivianite is usually pale green when it is completely covered by soil, but it turns blue when the mineral is dug up: this happens because some of the iron, which is divalent in the oxygen-poor soil, oxidises to trivalent iron when it is subjected to the atmosphere. Unfortunately, the vivianite in this region only forms earthy masses, so no crystals whatsoever: In Cameroon, 1-metre long blades have been found in a lakebed! The locations where I managed to find vivianite are the SIBA construction site along the Laak River, the "Stadsfeestzaal" construction site in the Demer valley and public works along the Demer River in Betekom, close to the bridge to Gelrode.

Clay pits

There weren't any clay pits in Aarschot itself, but there were two in the neighbouring community of Ramsel (now part of the community of Herselt) and one in Betekom (now part of the community of Begijnendijk). Strictly speaking, only this last pit is located in the (judicial) province of Flemish Brabant, but:

- All of them are located at approximately the same distance from Aarschot city centre
- All of them work the same layer, i.e. the Boom Clay Formation
- It is interesting to compare the finds from the different pits.

This is why these clay pits are discussed together.



*The Betekom
clay pit in 1972.
Photo © Rik Dillen.*

Clay deposits often contain septarian concretions, and the Boom Clay Formation is no different. These concretions look like hard, grey loaves of bread and are full of cracks inside. This is where they get their name from: the Latin word "septum" means "partition". The word "concretion" indicates that the "growing together" of foreign substances in the clay - when it was still soft and malleable - formed these masses.

When the clay eventually dried and shrank, the originally more or less round balls were compressed - which led to their flattened shape - and this is also how the cracks formed. The mineral, which primarily contributes to the formation of septarian concretions, is **calcite**, CaCO_3 . Calcite crusts sometimes occur on the "septs" of these concretions. In one case, this crust was several millimetres thick, grey and somewhat translucent, in another case it consisted of tiny crystals and sometimes the crust is nothing more than just pale brownish yellow coatings.

Especially on septs like these, there are sometimes layers of metallic shiny crystals, usually yellow in colour but sometimes also beautifully iridescent. At first sight, one is inclined to think these crystals are chalcopyrite due to this discolouration, because the striking iridescence of this mineral is mentioned in the descriptive literature. However, taking a closer look with a magnifying glass, I noticed these tiny crystals were octahedral: this is typical for **pyrite**, FeS_2 . The occurrence of pyrite also matches the origin of the concretions: together with the clay, organic matter, which contains sulphur, was deposited. Combine this sulphur with the iron deposits in the region and hey presto, you end up with pyrite! Besides, chalcopyrite is a copper-bearing mineral: firstly, one would never expect copper in clay deposits, and secondly, from this decomposing copper, oxidation minerals would arise, and there is no trace of these either. By the way, oxidation causes the aforementioned iridescence: a very thin film forms on the pyrite crystals, which then refracts the light, analogous to the colours in a thin layer of oil on a body of water.

In the clay pits, pyrite also forms as nodules, another form of concretions. They have an irregular, bumpy surface, a dull lustre and are yellowish grey in colour. The biggest ones I found weighed 3 and 5 kilograms respectively, but unfortunately, they did not survive for long in my collection. After a few months, they started to pulverise and fall apart, there where white hairs growing out of them and they gave off a strange smell. When I removed what was left of them from my collection, it turned out that there were also a few holes that had been eaten away in the paper underneath. This was my first encounter with the phenomenon of pyrite oxidation, with which I would have to deal many more times later.



Left: Gypsum crystals from Betekom. Collection and photo © Alfons Quadens.

Right: aggregate of fourling crystals from Betekom. Collection and photo © Erik Vercaemmen

In short, this means that pyrite will oxidise under the combined influence of water and oxygen, in which case the pyrite's sulphide transforms into sulphate. Mixed with water this sulphate generates sulphuric acid, which in turn is very hygroscopic, meaning that it draws even more water from the air. This water keeps the process going. Moreover, a number of the newly formed compounds have a greater volume than the original pyrite they originated from, so they pry everything apart even more. In short, this is a self-perpetuating process, which leads to a whole bunch of complex iron, sulphate and water compounds fusing into each other; the simplest form of these compounds in the literature is **melanterite**, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

This phenomenon does not only occur in collections, but obviously also in nature, where the minerals are part of the rock cycle. The classic mineral that forms in clay pits is **jarosite**, $\text{KFe}_3[(\text{OH})_6/(\text{SO}_4)_2]$. As you can see from its formula, it is a compound of iron and sulphate (from oxidised pyrite) with hydroxide groups (from water) and potassium from the clay minerals in the deposit. Jarosite occurs as powdery masses in the "cracks" in the clay and has a distinct (brownish) yellow colour. At first, we erroneously concluded that it was free sulphur, which can also form when pyrite oxidises. However, x-ray diffraction later unmistakably identified a sample as jarosite.

The sulphuric acid which forms when pyrite oxidises can also react with "chalk" – instead of the clay itself – present in the clay deposits, especially in the form of (the remains of) shells. When this happens, a substance forms which we know from its uses in both construction and medicine: **gypsum**, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. It forms crystals in various shapes: needles, thick plates, and large crystal groups, which can look like porcupines. Twinned crystals frequently occur in groups like these. In its pure form, gypsum is colourless and transparent, but in the clay pits, the crystals contain many clay inclusions: this turns the crystals darker and opaque. However, while they may look unattractive in daylight, they show both fluorescence and phosphorescence under an ultraviolet light. These phenomena are explained in detail in another article in this issue.

On top of the clay is another layer, which contains fossils and pebbles. This layer formed when a turbulent sea flooded the region and washed away the lighter material down to the resistant clay deposits. Only the heavier material was left behind and formed so-called "basic gravel": "gravel" because of the coarse-grained granulometric composition and "basic" because it forms the basis of a series of deposits. Allow me to explain: first, there is the turbulent wave-breaking zone in which the gravel forms. However, when the sea becomes deeper and calmer, first sand and gradually finer material will settle, and eventually material will deposit in so-called "haffs" (a type of coastal

lake similar to a lagoon, cut off from the sea by a sandspit) and rivers when the sea fills up and dries again. The basic gravel in the clay pits contains many fossils: shark and dolphin teeth; ribs; shells and crabs... From and in between these fossil remains, "phosphorite nodules" formed: these consist mainly of **carbonate-hydroxylapatite** ($\text{Ca}_5[(\text{OH},\text{CO}_3)/(\text{PO}_4,\text{CO}_3)_3]$), sand, glauconite and the remains of bones and shells.

The differences between the finds in the Betekom and Ramsel pits are remarkable, because they are no more than 5 kilometres apart, as the crow flies. In Ramsel, I was able to find many septarian concretions with calcite and pyrite growing in and on them. Gypsum on the other hand was rare here: regardless of a few tiny needles, I only found 1 larger specimen, a thick plate with poorly formed end planes. However, in Betekom I have only seen 2 or 3 septarian concretions over the course of the years, together with the aforementioned giant pyrite nodules and especially lots of jarosite and gypsum. The gypsum's dimensions varied between spherical aggregates of only a few centimetres in diameter to large (25 centimetre) crystal groups with crystal points sticking out in all directions and platy twinned crystals. Even a few fourling crystals ended up in my collection, one of which was very small and clear, the other a thick 9 by 7 centimetre plate. I have never seen basic gravel with fossils and phosphorite in Betekom. On the other hand, this *did* occur in both pits in Ramsel; however, crab fossils only occurred in the most northern pit.

Locally rock forming

Often overlooked, 'soft' rocks such as sand, loam and clay are also composed of minerals. Most of the time these are too small to be viewed without a microscope, but for completeness I mention them here anyway.

Quartz: this is the same mineral we know as purple amethyst in geodes or as rock crystal and smoky quartz from the Alps. It forms the "sand mountains" (ancient land dunes) we used to play on when we were kids, and a large part of the Hageland hills.

Clay minerals: these are tiny and specialised research is necessary to ID them correctly, yet, they are of vital importance for agriculture and therefore our very existence and survival. They form the thick deposits in the Boom Clay Formation, which are quarried in clay pits and can be found in loam soils and in the Demer valley.



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A nightly escapade: The search for Belgian autunite

Jacques Jedwab

Professor emeritus ULB

It is obviously no secret, but a mineralogist (amateur or professional) is only human too... In most cases anyway. Therefore, he or she is, like the rest of us, subject to what psychologists call emotions such as fear, surprise, hatred, distraction, boredom, joy etc. Nevertheless, we tend to ban such feelings from scientific texts meant for publication. This could give a psychologist the impression that scientists are sensible creatures who have any given situation under control at all times, and that they perform everything they do perfectly and in the perfectly correct order.

Such an attitude of reservation is a positive thing, because none of the people reading the publication are interested in the psychological experience of the mineralogist in question during his escapades, except maybe his or her "bar buddies". If we were to describe all aspects of our emotions in our articles, no holds barred, any article would quickly turn into a series of anecdotes.

Anyway, just this once I will treat you to a mineralogical anecdote, at the risk of launching a new joke about "those stupid Belgians" you will only be sharing with your friends at the pub.

Nearly 60 years ago, a few years before the MKA was founded, Belgian (and French) uranium mineralogists were living in a permanent state of excitement, a situation that has long since been forgotten. Uranium ores were being discovered all over the planet, or just about. Visions of strictly peaceful uses - such as a never-ending supply of energy - provoked wild enthusiasm, mainly due to two UN conferences on peaceful applications of nuclear energy, better known as the Geneva Summits (1955 and 1956).

Around the time of the Second World War, exploration had been mainly restricted to granites and granitic pegmatites following the examples of the Morvan, Limousin and Madagascar. Later, coal mines, sedimentary phosphate deposits, black schists, bituminous shales etc. were added to the list (compare e.g. Mas d'Alary). As for Shinkolobwe, people were constantly looking for "the" hypothetical granite. The discovery of the French uranium localities such as La Crouzille, les Bois Noirs (Saint-Priest-la-Prugne), L'Ecarpière and Lodève date from this period.

In 1955, the Belgian Geological Survey, under the management of the indefatigable Robert Legrand (not the man after whom legrandite was named!) took the initiative to draw up a map of the distribution of radioactivity in the Belgian soil. Our country was neither a terra incognita in the field of nuclear science, nor a mineralogical desert, because earlier, radioactive minerals had already been found at Vielsalm. Not to mention the minerals from Katanga, which the UMHK (Union Minière du Haut-Katanga) had been distributing to the Belgian universities since before 1940.

The development of the scintillation counter, a lightweight and dependable device to measure radioactivity, played an important role in Robert Legrand's first discoveries. For example, he discovered considerably radioactive phosphate deposits in the regions of Argenteau and Richelle. This is the area where e.g. delvauxite, richellite and destinezite had been known to occur for a very long time. However, no trace of radioactive minerals had yet been found here, at least not in crystals that were large enough to be seen with the naked eye.

Legrand really wanted to share his joy with other mineralogists. Therefore, he organised a field trip to Argenteau (just north of Liège) for the Belgian Geological Society on 26 June 1958. All participants were wildly enthusiastic, and later, in his report on this field trip, Legrand stated *"La splendeur géologique de ce site - la carrière de la Folie à Bombaye - fit perdre aux participants toute notion du temps."* (Translation: *"The magnificent geologic setting of this site – the La Folie quarry in Bombaye – caused the participants to lose track of all notions of time"*).

Personally, I was lucky enough to find a few tiny, scattered crystals, which I was easily able to identify unambiguously as torbernite the day after the field trip (Jedwab, 1958). To my amazement, my findings, which I presented at the Belgian Geological Society's meeting in June 1958, immediately became front-page news. The title of the article, printed on the first page of a Belgian newspaper (Le Soir, 17 August 1958) bluntly stated: *"De l'uranium exploitable en Belgique?"* (*"Exploitable uranium deposits in Belgium?"*). If this statement were to be published in a newspaper today, we would consider it utter nonsense. However, the author was apparently very enthusiastic about it: *"On sait combien les chercheurs sont prudents en ces matières; néanmoins ils ne cachent pas leur impression que les chances d'un 'intérêt économique' véritable sont 'sérieuses' [Translation: "We know how careful scientists are in these matters; however, they are not hiding their impressions that there is a considerable chance that they (the deposits, Ed.) are 'of real economic interest'."].* Journalists and scientists alike had clearly been swept off their feet by pure unadulterated uranium fever.

In reality, most mineralogists who knew about the place were terrified that it would not take long before the locality would be completely overrun by interested collectors. This feeling was strengthened even more because the locality was actually just a road cut and a small Geiger counter would suffice to find the uranium-bearing rocks. Moreover, because the material was fluorescent (due to the presence of autunite and meta-autunite, later identified by René Van Tassel in 1959) René Van Tassel and I decided to organise a nightly expedition to collect material rich in fluorescent minerals.

I cannot remember the exact date of this trip anymore, but I am sure it was sometime during the summer of 1958. The fact that Belgium is not exactly big meant we could manage the roundtrip in a single day. Moreover, René Van Tassel, being as enthusiastic as he was, managed to produce an x-ray diffraction pattern within 12 hours of finding the stuff we were after, which allowed him to prove the presence of meta-autunite on material which had not undergone any pre-treatment whatsoever.

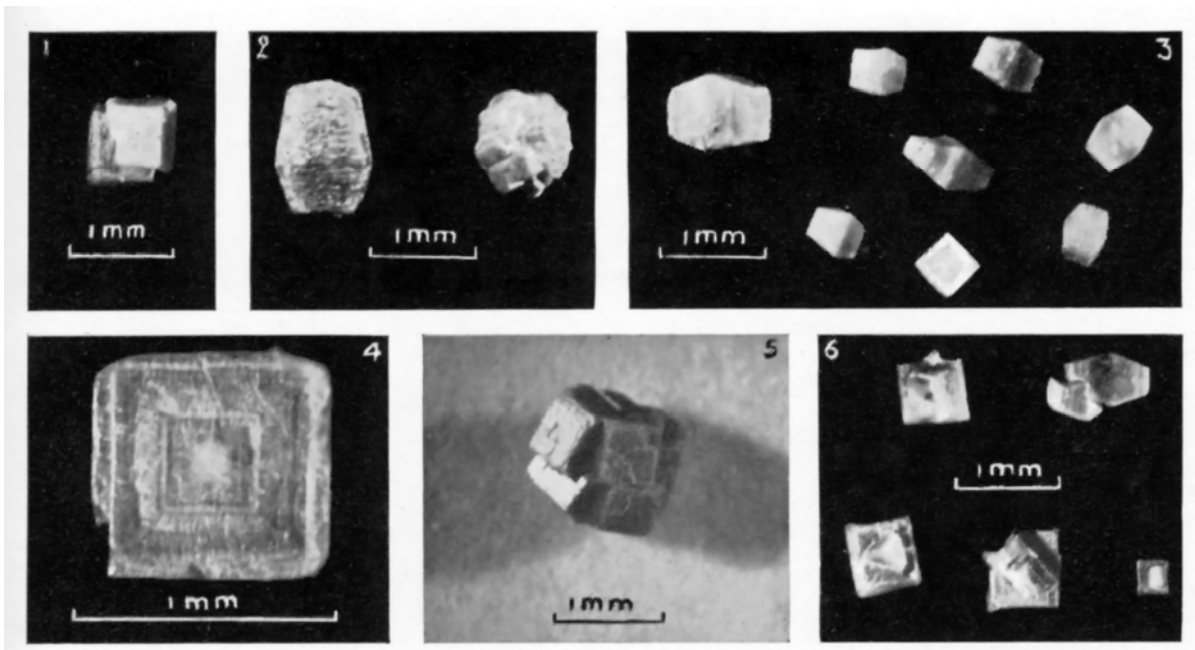
This time we came much better prepared than during the first trip. Arriving at the scene in the early evening, we had armed ourselves with Geiger counters and portable UV lights (which, by the way, was not at all self-evident at the time, Ed.). Granted, it was not exactly the safest place to be at dusk, just underneath a road travelling over the top of a quarry wall, which was several dozens of meters high. All sorts of things could be hiding in the thicket, and obviously, we could not just wave our flashlights around all the time: our eyes had to stay adjusted to the darkness to be able to see the tiny dots lighting up in the UV light. All this just to clarify that both René and I were pretty nervous crawling around on the ground in almost complete darkness, the only light coming from our UV lamps. Taking dumb risks is typical for overly enthusiastic researchers.

At a certain moment, I looked to the heavens and lo and behold... I saw dozens of tiny autunite crystals twinkling in the... starlit sky. The same yellowish fluorescence, the same light intensity, the same distribution of shiny dots. However, the illusion did not last long: reason soon takes over and reclassifies these emotional observations – from the mix of both emotional and rational observations – as merely belonging to the class of the fireflies.

This adventure has left me with vivid memories, both literally and figuratively, which unfortunately do not belong in a purely scientific magazine.

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1. Tabular torbernite/autunite crystals
 2. Barrel-shaped torbernite/autunite crystal (left) and cauliflower-shaped torbernite/autunite aggregate (right)
 3. Nearly perfect tiny torbernite/autunite crystals
 4. Thin section of torbernite/autunite. The alternating torbernite and autunite layers are visible as zonation
 5. Small group of 4 torbernite/autunite crystals
 6. Small groups of torbernite/autunite crystals
- All crystals are from Richelle. After Van Tassel, 1959.

This article was originally published in Le Cahier des Micromonteurs nr. 105, 26-27, "Autunite voletant dans la nuit" (2009).

Translation and editing by Rik Dillen.

*Tiny autunite crystal from Richelle.
Collection Zélimir Gabelica.
Photo © Roger Warin.*



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Rhodochrosite, Capillitas Mine, Argentina

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A remarkable fluorite crystal from Wellin, Belgium

Herwig Pelckmans

When I learned that the 2009 Tucson Gem and Mineral Show's theme would be "Mineral Oddities", I thought to myself: "Why don't I put together a lecture on "Fluorite Oddities"?" As you know, fluorite is well-known for its numerous strange crystal forms. However, since I am not a good photographer of mineral specimens, using the e-min mailing list I called upon my fellow mineral enthusiasts to upload photos of unusual fluorite specimens. One of the responses to my request was a photo of a fluorite crystal found by Christel (Axel Emmermann's wife) during an excursion (which was organised by the MKA) to the Wellin limestone quarry (Luxembourg Province, Belgium) (Verploet, 2010). Even if you took part in it, reading the detailed report of this trip to the **Carrière du Fond des Vaulx** (Emmermann, 2007) is very much worth the effort. In any case, I gratefully accepted the photo (see figure 1) and I showed it during my lecture as an example of a remarkable fluorite crystal.

In 2013, the Tucson Gem and Mineral Show's theme was Fluorite, so I decided to put together a new lecture called Fluorite Fantasies. This time I also wanted to discuss and illustrate the incredible wealth in fluorite crystal shapes, from the classic cube to the exotic hexoctahedron and their potential combinations. Axel's photo was right up my alley, as a perfect example of a... Hang on a minute... What crystal form was this thing again?

When I re-examined the crystal in the photo up close, I was convinced it was a tetrahexahedron. One can best picture this crystal shape as a cube which has an Egyptian pyramid glued to every crystal face. Instead of the 6 square cube faces, you get $4 \times 6 = 24$ triangular faces (see figure 2). Note that the original Greek name refers to the exterior of the crystal form: *tetra-(kis)-hexa-hedra* can be somewhat freely translated to four-(faces on)-six-faces. The crystal had already been described as such in Axel's report (Emmermann, 2007), but to be honest we had already forgotten most of the details.



*Figure 1
an older photo of the
fluorite crystal from the
Carrière du Fond des Vaulx
in Wellin.
Axel Emmermann
photo and ©*

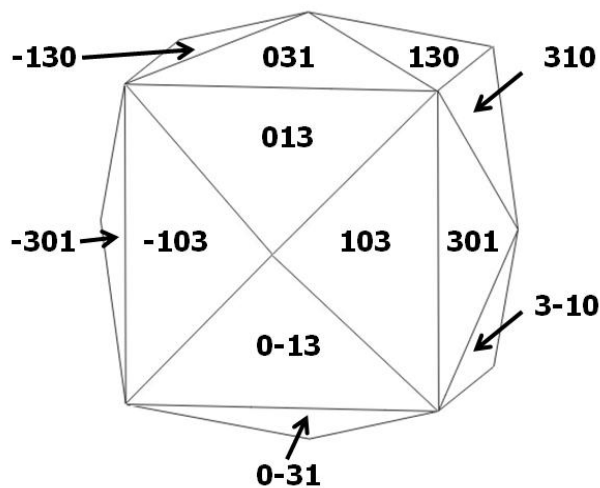


Figure 2
Fluorite's most common tetrahexahedron: the {310}.

A few members of the MKA disagreed, especially since the photo was not very sharp and because only about four faces were clearly visible. They thought the crystal was possibly an octahedron, or even more likely a dodecahedron. One thing was clear: the specimen needed to be examined in detail, and if possible, better photos had to be taken. Since crystals are three-dimensional, nothing works better than to manipulate the specimen itself to view all crystal faces from every visible angle. The necessary arrangements were made during the MKA meeting, and to make sure that "The Wellin Belle" would look good, her owner gave her a few (ultrasonic) baths.

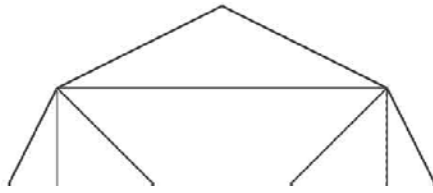
At the meeting and under the binocular microscope, she finally revealed her secret. At first sight (from a distance) I involuntarily thought of 'bloated, rounded cubes', but when I looked at the crystals up close, I could clearly see the triangular faces which, by their orientation and number, quickly showed that they were tetrahexahedra. This was interesting, yet fun and frustrating at the same time because, as is often the case in mineralogy, the answer to the first question immediately gave rise to the next question: what kind of tetrahexahedron was it?

In contrast to the octahedron, the cube and the dodecahedron, the tetrahexahedra are part of fluorite's variable crystal forms. Fluorite's invariable crystal forms always have the same Miller indices: the octahedron is {111}, the cube is {100}, and the dodecahedron is {110}. On the other hand, fluorite's tetrahexahedra can be regarded as a group of forms, which all look almost the same, but have different Miller indices. Holzgang (1930) lists no less than 24 different forms. According to this author, fluorite's most common tetrahexahedron is {310}, and {210} is a close second. Then there is {730}, which is slightly less rare than both {410} and {10.3.0}.

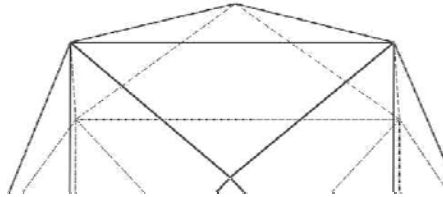
In the meantime, everyone was convinced that it was a tetrahexahedron, but to determine what kind exactly, we had to measure the angles between the faces. Just like the faces of a cube are all perpendicular to each other, there are defined, fixed angles between the faces of the different forms of tetrahexahedra. In the old days, these were measured with a goniometer, but that instrument has sadly become so obsolete in the course of the years, that we could not find anyone who could measure the crystal for us. So what now?

Then I got the idea to have the crystal photographed in profile in such a way that I could measure the desired angle directly from the digital photos. On the other hand, using the Miller indices and a bit of trigonometry I could make a list of the angles for the different forms. Once I had measured the angle, it would suffice to check the list to find the corresponding tetrahexahedron. The plan seemed perfectly feasible to me, so I sent Axel the following guidelines:

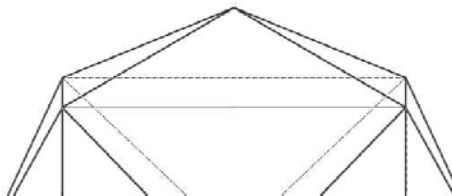
You have to turn the crystal in such a way that you are looking straight down on the "cube" of the tetrahexahedron.



Next you have to make sure that of the 3 visible top ribs of the "cube" only 1 is visible as in the drawing above. However, you must not take the picture "too low", because then the angle will be wrong: see (exaggerated) drawing below:



You must not take the picture "too high" either, because then the angle will be wrong as well (see exaggerated drawing below again):



It is best you position the crystal as mentioned above, and then slowly rotate it until the upper ribs on the sides of the "cube" disappear, then you will get the correct profile (see the first drawing). Then rotate the crystal 90°, and photograph the crystal again under the correct angle, please. I hope everything is clear. I can't wait to see the results!

Meanwhile I started calculating to eventually come up with the following table for the most common tetrahexahedra:

Tetrahexahedra, sorted by "increasing obtuse angle" (= flatter pyramid)	
{210}	angle between (201) and (-201) = $63.43 \times 2 = 126.86^\circ$
{730}	angle between (703) and (-703) = $66.80 \times 2 = 133.60^\circ$
{310}	angle between (301) and (-301) = $71.57 \times 2 = 143.14^\circ$
{10.3.0}	angle between (10.0.3) and (-10.0.3) = $73.30 \times 2 = 146.60^\circ$
{410}	angle between (401) and (-401) = $75.96 \times 2 = 151.92^\circ$

Unfortunately, a theory is not always applicable in reality. The crystal that was in the best condition and therefore best suited for this measurement could not be photographed sharply in the above-mentioned position! Every single time Axel tried to put it in the correct position, the thing simply disappeared just over the edge of the matrix! Axel decided to make the best of it by turning the requested orientation 45° around its c axis so that I could now measure the angle between two opposite pyramid ribs instead of the angle between two pyramid faces. That meant I had to recalculate the entire table, to which Axel obviously did not object!

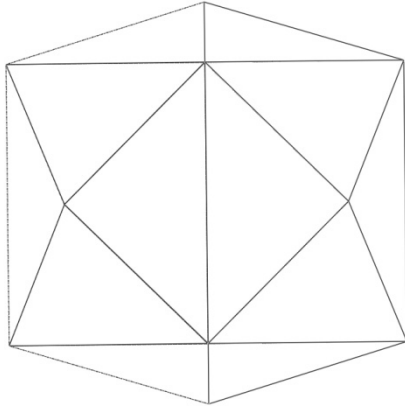


Figure 3
The new, alternative orientation of the crystal (before measuring the angle between the opposite ribs).

The new orientation chosen by Axel (see figure 3) should work just as good, although I was under the impression that it would be even more difficult to correctly line up the crystal in this position to photograph the angle between ribs. The result was better than I expected, see figure 4. Despite the fact that it was not an ideal crystal (these only exist in literature) and that the right side of the obtuse angle was a bit curved (almost all tetrahexahedral faces were somewhat curved), I came up with a digital angle measurement of 147.5°. Taking into account the not-so-optimal orientation of the crystal and a margin of error in the measurement, this corresponds fairly well to the calculated angle of 146.28° for the {730} (tetrahexahedron) form (see table below):

Tetrahexahedra sorted by "increasing obtuse angle" (= flatter pyramid)	
{210}	angle between opposite ribs = $70.5286 \times 2 = 141.06^\circ$
{730}	angle between opposite ribs = $73.1410 \times 2 = 146.28^\circ$
{310}	angle between opposite ribs = $76.7372 \times 2 = 153.47^\circ$
{10.3.0} and {410}	angle between opposite ribs => higher values

Figure 4
Detailed photo of another crystal (width 1.8 mm) on the same specimen in the new orientation.



A review of literature on fluorite shows that a few forms of tetrahedra have already been described from Belgium. Hatert et al. (2002) mention 3 forms; the {210} from Ave-et-Auffe and Villers-en-Fagne, the {310} from Denée and Pondrôme, and the {410}, also from Denée. Fluorite from Wellin is only described in their book as “plages violettes saccharoïdes” (“purple, sugary spots”).

Neutkens' and Orinx's (2007) article does show two photos of fluorite tetrahedra from Wellin (pages 16 and 17), but they do not elaborate on it in the article itself. On Mindat, we find two images (Neutkens, 2005 and 2008) of Wellin fluorite mentioning that they are *tetrahedral*, but without further details on their crystal form.

Therefore, we think we may conclude that the fluorite tetrahedron {730} is new to Wellin in particular and to Belgium in general.

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All drawings were made by the author using *KrystalShaper*.
All photographs were taken by Axel Emmermann, of a fluorite crystal in his private collection.

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The minerals of Bertrix

Erik Vercaammen

Since 2006, the La Flèche Quarry near Bertrix is on record in the mineralogical archives as the "type locality" of a new mineral called pumpellyite-(Al). However, mineral collectors do not know this small town in the Ardennes and its surroundings for that fact alone. Other interesting things (particularly for Belgium) have been found in this region as well, e.g. zeolites and "rare earth" minerals. Moreover, a number of minerals and crystals can be found here that one would sooner expect to find in alpine-type fissures.



Like most natural phenomena, minerals should always be examined in their natural environment: rocks. In this case, we are talking about a specific type of rocks, namely metamorphic rocks. In the early Devonian Period, around 400 million years ago, this entire region was a sea in which sands and clays were continually being deposited. These sediments were the remains of the Cambrian Mountains, of which the Serpont Massif east of Bertrix is a remnant. Later, these deposits were pushed upward in the collision between Laurentia, Avalonia, Armorica and Gondwanaland, which led to the formation of several mountain ranges all across Europe: the Variscan (or Hercynian) orogeny. During these events, the rocks

around Bertrix were transformed by temperatures of up to 400-500° Celsius and pressures of between 2 and 4 kilobar. What this means is that these particular rocks were pushed down several dozens of kilometres into the earth's crust during the orogeny. However, the minerals we find today were not formed during this event, but at a later stage, when the rocks were closer to the earth's surface because of the erosion of the overlying mountains. By then the conditions had already changed: temperatures had dropped to between 179 and 280° Celsius and pressures were below 3 kilobars.

In metamorphism, the degree of transformation of rocks is subdivided into 10 "grades", depending on the different combinations of pressure and temperature the rocks in question were subjected to. These 10 "grades" are named after the minerals that were formed in a specific type of basalt or a specific type of gabbro under these specific circumstances. In rocks with a different composition, other minerals may of course have been formed, but to name a specific grade of transformation the original name of the rock that was formed from a specific type of basalt is kept, with the added suffix "facies". The aforementioned peak conditions of the Hercynian orogeny all fall under the so-called "amphibolite facies": from a specific type of basalt so-called amphibolite – a type of rock which consists mainly of amphibole and calcium-rich plagioclase - is supposed to have originated. However, the minerals we find today were formed - at a later stage - in the "zeolite facies" or the "pumpellyite-prehnite facies", which both form at lower temperatures and pressures.

The La Flèche Quarry is mined for quartzite that is locally transitioning into slate. Quartzite is a hard type of rock, which is why it can be used – after crushing - as rubble in e.g. road construction. Inside the quarry, we can indeed find the minerals that give the "pumpellyite-prehnite facies" its name, particularly pumpellyite. In fact, according to the IMA, pumpellyite is not (or no longer) a single mineral but a **group** of minerals with the general formula $\text{Ca}_2\text{XAl}_2(\text{SiO}_4)(\text{Si}_2\text{O}_7)\text{O}(\text{OH})\cdot\text{H}_2\text{O}$ which all crystallise in the monoclinic system. The X in this formula can stand for the metals magnesium (Mg), divalent manganese (Mn^{2+}), divalent iron (Fe^{2+}), trivalent iron (Fe^{3+}) or aluminium (Al).



The La Flèche Quarry as seen from the east, standing on level -1 and viewing level -3. The recently added level -4 can be seen in the background (situation 11 October 2011). This image illustrates the countless fractures under the influence of Hercynian metamorphism under conditions of low pressure and average temperature. A process of slow continuous cooling (Hatert and Theye, 2005) can explain the occurrence of zeolites together with prehnite and pumpellyite-(Al) in these fractures. Photo © Alain Hanson.

The different species of pumpellyite get their name from the element that is involved, e.g. pumpellyite-(Mg). The name "pumpellyite" (without an added suffix) is used for specimens that have an unknown (or not completely known) composition, as well as for the group itself. In addition, there is a closely related family of minerals, julgoldite, in which trivalent iron has taken the place of the aluminium and in which the exact species name (i.e. the suffix, also known as a "Levinson modifier") also depends on the element that takes the place of the X in the aforementioned formula. These minerals are all closely related to the better-known mineral epidote, and they sometimes occur together with it. They all belong to the class of the silicates with a combination of single and double silicate groups.

Everything you have read in this article so far serves as an introduction to explain that the mineral that occurs in this quarry is not just "any old pumpellyite", but that it is the type locality of a specific species of that mineral, namely **pumpellyite-(Al)** with the formula $\text{Ca}_2\text{Al}_3(\text{SiO}_4)(\text{Si}_2\text{O}_7)\text{O}(\text{OH})\cdot\text{H}_2\text{O}$. This means that the mineral, in the form it has been – and still is – found there, is the worldwide reference to which all new finds need to be compared. That is why the specimen that was used to do the original research on (which is called the "holotype") must be fully documented and included in the collection of a public scientific organisation: in this case, the Laboratory for Mineralogy at the University of Liège. Now, specimens of pumpellyite with high aluminium content have previously been found, but these were never formally described and no report had ever been filed with the International Mineralogical Association to recognise these specimens as a new species. However, a report *was* filed for the occurrence of the mineral at this particular quarry, and that is why it is now the type locality. The opposite has happened before as well though: the late Professor Van Tassel recognised akaganeite from Wezet as a new mineral, but he lacked the means to fully investigate it at the time. That is why this mineral was not officially described until later, and the Akagane mine in Japan is now the official type locality.

Pumpellyite-(Al) crystals occur as white to pale green radial-fibrous aggregates, which form small "suns" in cracks in the rock. The acicular crystals are only up to a few millimetres long, often shorter, but they do occur in small "carpets" of several square centimetres across.

Pumpellyite-(Al)

- formula:
 $\text{Ca}(\text{Al,Fe,Mg})\text{Al}_2[(\text{O,OH})_2/\text{SiO}_4/\text{Si}_2\text{O}_7]\cdot\text{H}_2\text{O}$
- sorosilicate with single and double groups
- monoclinic system, prismatic class
- good cleavage in two directions: (001) and (100)
- splintery fracture
- colour: white to pale green
- streak: white
- translucent to transparent, vitreous lustre
- hardness: 5,5 on the Mohs scale
- density: 3,24



Pumpellyite-(Al) aggregates from La Flèche Quarry, Bertrix, Luxembourg, Belgium. Image width 6 mm. Collection and photo © Harjo Neutkens.

The occurrence of a number of **zeolite** species in the La Flèche Quarry can be considered “special” for Belgium. At first only laumontite was known to occur, later chabazite-(Ca), stilbite-(Ca) and natrolite have also been described. The first three minerals all contain calcium as the dominant cation. Laumontite is only known in a calcium-dominant variety, so the Levinson modifier is not obligatory; in the other two, different elements, e.g. sodium can be dominant instead of calcium, so the Levinson modifier must be added to determine the exact species. In natrolite, the name itself explains which cation is dominant. Zeolites are silicates with an open skeletal structure that contain water, which can be adsorbed and released. The cations in zeolites are also partly interchangeable (which is why these minerals are used as water softeners: they can remove calcium ions from “hard” water):

- **chabazite-(Ca)**, $\text{Ca}_2(\text{Al}_4\text{Si}_8\text{O}_{24})\cdot 13\text{H}_2\text{O}$, very small rhombohedral crystals which look like little “blocks”, which are in fact triclinic sixlings; twinning of rhombohedra sometimes occurs (see image); white, vitreous lustre.
- **stilbite-(Ca)**, $\text{Ca}_{0.5}\text{K,Na}_9(\text{Al}_9\text{Si}_{27}\text{O}_{27})$, very small clear columns, square in cross-section (these are in fact eightling crystals!); monoclinic; occurs together with the more frequent chabazite-(Ca) in small cracks which are locally stained brown by iron oxides.
- **laumontite**, $\text{Ca}_4[\text{Al}_8\text{Si}_{16}\text{O}_{48}]\cdot 18\text{H}_2\text{O}$, no freestanding crystals, but white to tan crusts; sometimes radial crystals can be distinguished in these crusts; the mineral can lose its water content and crumble; monoclinic; fairly common.

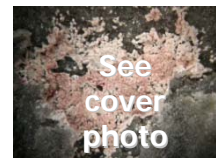
Left: Chabazite-XX from La Flèche Quarry, Bertrix. Collection and photo © Richard De Nul.

Right: Laumontite aggregate from La Flèche Quarry, Bertrix. Collection and photo © Richard De Nul.



- **natrolite**, $\text{Na}_2[\text{Al}_2\text{Si}_3\text{O}_{10}]\cdot 2\text{H}_2\text{O}$, rhombic and monoclinic; white acicular crystals; Mohs hardness 5 to 5,5.

Minerals that contain elements in the “rare earth” group also occur in this quarry. Such minerals are rare in our country: monazite and xenotime have been described from a few small quarries in the Brabant Massif that have meanwhile disappeared, and in the late twentieth century, a few of them were discovered in the Stavelot Massif. One of them was stavelotite-(La), another mineral with a Belgian type locality. Through careful research rare earth minerals have also been found in the La Flèche Quarry, and for a few of these species this quarry is the first (and up to now the only) locality in Belgium. They occur embedded in the matrix between other crystals:

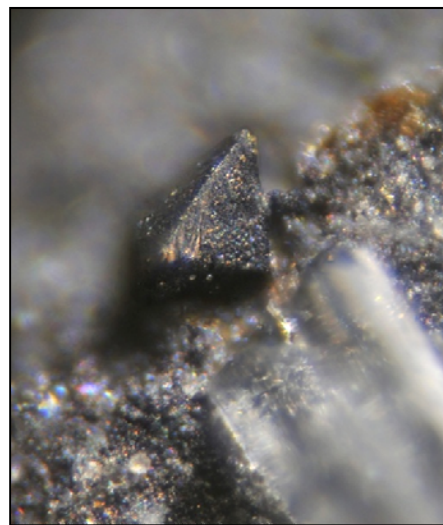


- **bastnäsite-(Ce)**, $(\text{Ce},\text{La})(\text{CO}_3)\text{F}$, very small brown hexagonal plates;
- **calcioancylite-(Ce)**, $(\text{Ca},\text{Sr})_{4-x}(\text{Ce},\text{La})_x(\text{CO}_3)_4(\text{OH})_x\cdot(4-x)\text{H}_2\text{O}$ (with $x < 2.1-3.0$), very small brown blocky monoclinic crystals;
- **synchysite**, most likely the Ce(rium) dominant species as well, so $\text{Ca}(\text{Ce},\text{La})(\text{CO}_3)_2\text{F}$, very small greyish yellow trigonal columns.

In the literature, a series of other minerals – however, always small to very small examples - are mentioned as occurring at the La Flèche Quarry. Worth mentioning here is prehnite which together with pumpellyite-(Al) is eponymous for the degree of metamorphism of the rocks. Unfortunately, it is rather insignificant and small here, no beautiful green crusts such as in some basalt layers or freestanding crystals like the ones from Asbestos, Canada. The rocks also contain small rhombic dodecahedrons of garnet, black acicular tourmaline, graphite flakes and green epidote.

The joints are usually filled with quartz and calcite with inclusions of e.g. chlorite and biotite; the variety of biotite occurring in this area was described in the past as “bastonite”, named after the city of Bastogne. Black metallic platy inclusions are neither biotite nor hematite, but ilmenite. In the cavities in the cracks of the rock are clear orthoclase triangles in the form of adularia. In the same kind of cavities, the rare earth minerals can also be found as well as anatase, rutile, apatite, titanite and most zeolites. Laumontite can completely fill cracks on its own, so when cleaving a rock real “suns” can appear. The pumpellyite also occurs this way.

*Left: pyrite crystal on laumontite from the La Flèche Quarry, Bertrix. Coll. and photo © Richard De Nul.
Right: calcioancylite-(Ce) crystal from the La Flèche Quarry, Bertrix. Coll. and photo © Dario Cericola.
This specimen comes from Michel Blondieau's collection.*



Filling the cracks is also a series of ores: pyrite, marcasite, galena, sphalerite and the copper ores chalcopyrite and covellite. These gave rise to the formation of oxidation minerals such as malachite, gypsum, goethite, wroewolfeite and manganese dendrites.

The La Flèche Quarry is located north of Bertrix, but interesting finds can also be made south of the town. The road from Muno to Herbeumont leads through La Haie forest. There are a number of small quarries here, some abandoned and some still active, and there are quartz blocks lying on the side of the road and around farmlands as well. Inside these quartz blocks, two different parageneses can be found. The first one contains lead minerals: galena and the oxidation minerals cerussite, anglesite and pyromorphite, a classic example of ore paragenesis.

The second paragenesis is even more interesting: the titanium minerals anatase, brookite, rutile, ilmenite and titanite; fluorapatite, muscovite, xenotime-(Y) and chamosite, an iron-rich variety of chlorite.

Even though they are small specimens, some of them are very attractive and they can be found in our own country, you do not need to travel to the Alps to find them. Moreover, the author has found a few specimens here that definitely remind one of the Alps, especially rutilated quartz: another name for this mineral is "Venus' Hair Stone" (from which we could deduce that the goddess Venus had straw-yellow blonde hair). The best rutilated quartz specimens were found in 1896 on the Piz Ault west of Vals (Switzerland): crystals of up to 30 centimetres. Rutilated quartz can also be found in Brazil. In these specimens, the rutile needles are sometimes growing in the shape of a star on top of a platy hematite crystal. Rutilated quartz has also been found in other places in our country, but it is always special to find specimens like these yourself.

Sometimes there are also freestanding but incredibly thin and tiny acicular rutile crystals, which are almost only visible when they reflect the light, scattered among the platy albite crystals.

However, that was not the final discovery. While doing more research on the finds, there were also a few acicular rutile crystals *inside* a number of albite crystals. In his 40 years of collecting, the author had never read about, heard of, or seen pictures of such "rutilated albite". Maybe this is because in these specimens the quartz is considered the most important, or maybe because albite is only seldom transparent. Whichever the case may be, this seems to be a novelty, especially for Belgium. Meanwhile similar specimens from this locality have been described, and exploration will likely produce a few more surprises. Now for the moral of this story: keep exploring and keep your eyes open, because surprises are sometimes (literally) tucked away in a tight corner.



**More images
on the
covers!**

*Albite crystal with acicular
rutile crystal inclusions.
La Haie forest, Bertrix,
Luxemburg, Belgium.
Find and collection
Erik Vercammen,
Photo © Richard De Nul.*

Acknowledgements

We owe sincere thanks to Richard De Nul, Harjo Neutkens, Dario Cericola and Alain Hanson for the photos they provided for this article.

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Internet (MINDAT):

- La Flèche Quarry: www.mindat.org/loc-12422.html
La Haie forest: www.mindat.org/loc-67749.html
Les Rochettes quarry: www.mindat.org/loc-192199.html



←

Albite crystal with acicular rutile crystal inclusions from Les Rochettes quarry, Bertrix. Image width 6 mm. Collection and photo © Harjo Neutkens.

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Les Rochettes quarry, Bertrix, situation 2005. Photo © Harjo Neutkens.



A list of Belgian fluorescent minerals – from concept to implementation

Richard Loyens



As a member of the MKA (Mineralogy Club of Antwerp), I regularly joined their fieldtrips to Belgian quarries. Because I am a passionate collector of fluorescent minerals, I concentrated my attention on that specific group of minerals. Unfortunately, this yielded few results. We had only limited access to the localities and I had read somewhere that there are (or better, were once) more fluorescent minerals to be found in Belgium. That is why I hatched the idea to compile a list of all fluorescent minerals that had ever been found in Belgium.

The next step was to find a collection that was suitable for me to do my fluorescence research on. For that purpose, I contacted Professor René Van Tassel in 1991. Some time later, he sent me a letter saying I could contact Michel Deliens, the then curator of the mineral collection of the RBINS (the Royal Belgian Institute of Natural Sciences) in Brussels. After several contacts, we came to an agreement and - together with a few 'fellow fluorescence lovers' – we were allowed to do our fluorescence research on the RBINS' collection of Belgian minerals.

Our first visit took place on 3 January 1992. In total, we would have to go back 10 more times to complete the list. The entire investigation took place under difficult circumstances, because we had no way of darkening the room where the minerals were kept.



You might ask yourself what this mineral depository looked like. Well, it consisted of a central hallway with 6 side-passages on either side. In each side-passage, there were 7 built-in cabinets, each containing some 15 drawers (some drawers taller than others) in which the minerals were stored. The first two side-passages on either side were reserved for Belgian specimens.

Richard Loyens and Fred Balck at work in the RBINS' mineral depository. Photo © Eric Saeys (+)

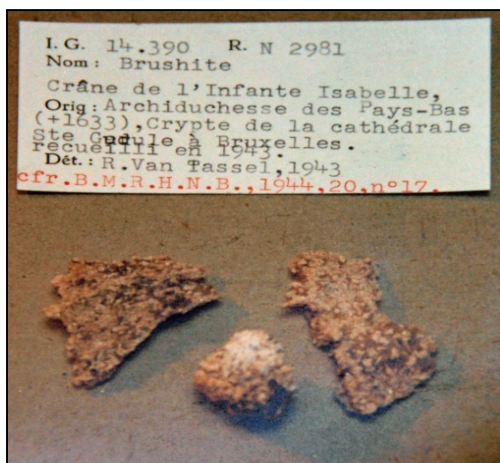
We would stand at the end of a side-passage where it was sufficiently dark to be able to do our research. For long wave UV, we used a 250W light with a long wave filter, and for short wave UV, we used a 9W TUV light with a short wave filter.

Richard Loyens, Axel Emmermann and Gerard Barmarin were in charge of observing the colours because they had already been collecting fluorescent minerals for a long time, and therefore they had an equivalent experience with colour perception. A few other MKA members aided them in handing them the specimens and diligently recording their observations.

In total, we managed to find about 2,500 fluorescent mineral specimens, large quantities of which were calcites in a variety of different colours:

Mineral	Number of localities	Mineral	Number of localities
albite	2	halite	1
allophane	3	halloysite	4
andalusite	2	hemimorphite	9
anglesite	3	hydrozincite	2
apatite	8	kaolinite	7
aragonite	10	pickeringite	1
baryte	19	pyromorphite	3
brushite	1	pyrophyllite	3
calcite	153	quartz inclusion	2
cerussite	15	scheelite	1
crandallite	1	silicon concretions	1
dolomite	8	smithsonite	4
epidote	1	spessartine	1
evansite	3	sphalerite	23
fluellite	2	wavellite	2
fluorite	13	willemite	2
gypsum	29	wulfenite	1

We enjoyed a number of fascinating finds, including fluorite from Seilles of which a few specimens showed a red fluorescence under long wave UV light. In this context, allow me to refer you to an article by R. Vochten, K. Van Doorselaer and H. Dillen, which was published in 1994 in the *Zeitschrift der Deutschen Gemmologischen Gesellschaft (Journal of the German Gemmological Society, Ed.)*: "Fluorite from Seilles, Andenne, Belgium: colouration, fluorescence and a remarkable crystal geometric discolouration phenomenon". Red fluorescence in fluorite is in itself rather rare.



Another remarkable find is the fluorescence of brushite. The original label says "Brushite, Skull of the infant Isabella, Archduchess of the Netherlands († 1633), Crypt of St. Gudula cathedral in Brussels, collected 1943; ID by R. Van Tassel 1943". I can honestly say, holding a piece of history like that does something to a man.

After further investigating this particular specimen, I came upon an article of the Royal Belgian Museum of Natural History, written by the late Prof. René Van Tassel in 1944 (*Bulletin du Musée Royal d'Histoire Naturelle de Belgique* 22, no. 17) "Présence de Brushite dans une crypte de l'église Ste-Gudule à Bruxelles".

(*Bulletin of the Royal Belgian Museum of Natural History 22, no. 17, "Presence of Brushite in a crypt of the St. Gudula cathedral in Brussels, Ed.*) The article in question tells the whole story of this historic specimen.

The following table lists the number of Belgian fluorescent minerals we found in the RBINS' collection, sorted by province.

Province	Number of localities	Number of minerals
Antwerp	6	3
Brussels	1	2
Hainaut	58	10
Limburg	7	2
Liège	73	25
Luxembourg	11	10
Namur	57	14
Flemish Brabant	4	3
Walloon Brabant	8	6

In the presence of René Van Tassel and Michel Deliens, we eventually handed the complete list of Belgian fluorescent minerals in the RBINS' collection to the then curator of the mineralogy department, Herman Goethals (See *Geonieuws* 33 (10) December 2008). We look forward to the publication of the list. For the purpose of this publication, a number of photos of specimens in the RBINS' collection were taken, and spectra of a number of fluorescent minerals were measured to identify the respective fluorescence mechanism.

No less than 3 generations of RBINS mineralogists were present when we handed over the CD containing the fluorescence data of the Belgian minerals in the RBINS' collection: from left to right Herman Goethals, René Van Tassel and Michel Deliens. Photo © Axel Emmermann.



Fluorescent gypsum from Betekom, Flemish Brabant, Belgium

Axel Emmermann

The fact that the colour of the fluorescence (bluish green) of gypsum specimens from Betekom differs from the colour of the phosphorescence (green) is fascinating. Although gypsum is an economically valuable mineral to the industrial world, it is not really highly sought-after for the strategic or economically valuable metals it potentially contains. This could be the reason why the fluorescence of gypsum has never been studied as thoroughly as that of e.g. sphalerite.

The same type of luminescence can be observed in gypsum specimens from all over the world. Gypsum from Poland, the UK, Canada, the USA, France etc. often exhibits the same typical luminescence.

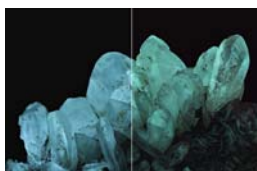


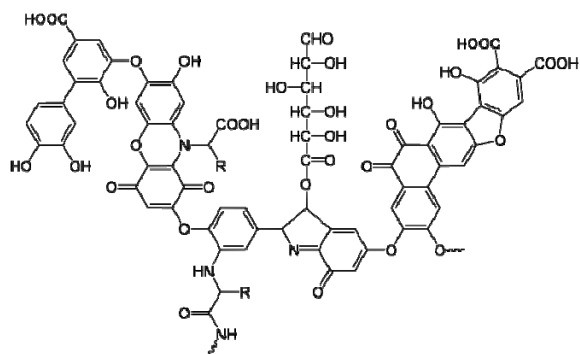
Fig. 1. Fluorescence (left) and phosphorescence (right) of a gypsum specimen from Betekom under short wave UV. Collection and photo © Axel Emmermann. Image width approximately 15 cm. Larger photo on inside cover page.

Gypsum usually contains a small amount of strontium, replacing calcium. In the specimens from Betekom, this ratio amounts to one in every 50,000 atoms (0,002%) in the older crystals and about one in 200 atoms in the younger crystals (Vochten and Stoops, 1978 and 1982). It is rumoured among mineral collectors that this strontium is the fluorescence activator. However, the literature (Marfunin, 1979) clearly shows that this is unlikely because the electron structure of the alkaline earth metals does not allow for this.

The uranyl ion $[UO_2]^{2-}$ is also often reported as a plausible cause for the fluorescence of gypsum (Robbins, 1994). Sure, the uranyl ion is perfectly capable of generating a very strong green fluorescence in gypsum, but it lacks the long-lived green phosphorescence and has a very distinct spectral fingerprint.



Gypsum crystals from Betekom (1972). Collection and photo © Rik Dillen. Specimen size 5 X 5 cm.



Structural formula of a humic acid.

While the gypsum crystals are growing in the soil, plant material is being subjected to rotting processes aboveground. When plant material decomposes, organic so-called "humic acids" form. These organic compounds are easily absorbed into minerals such as gypsum and several other evaporites and karst minerals. Moreover, they are strongly fluorescent. These acids contain a number of functional groups, each with their own specific luminescence properties. Humic acids contain e.g. aromatic rings, heterocyclic groups and carboxyl groups (Gorobets and Rogojine, 2001). The emission spectrum below (fig. 2) shows a number of characteristics that allow us to discover the cause of the fluorescence of gypsum specimens from Betekom.

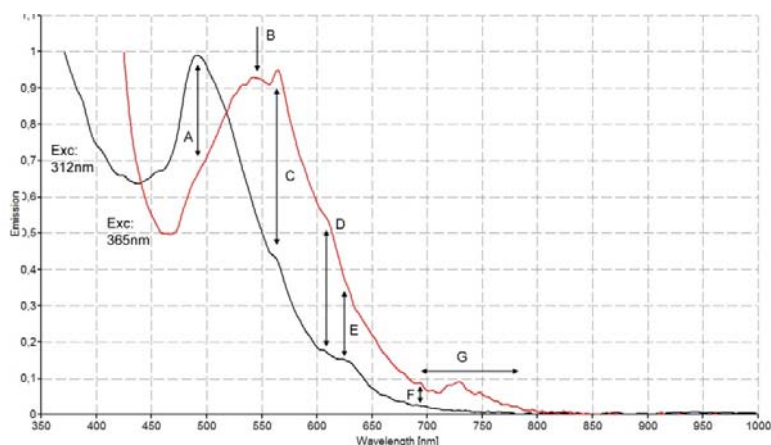


Fig. 2. Normalised spectrum of gypsum from Betekom under 312 nm and 365 nm UV light respectively.

We can clearly see that this is a real broadband emission. This is a distinctive property of the fluorescence of humic acids (Gorobets and Rogojine, 2001). In humic acids, which contain many polycyclic aromatic and heterocyclic groups, the fluorescence shifts from the UV to the blue part of the spectrum when the number of aromatic rings per molecule increases (Gorobets and Rogojine, 2001).

Excitation of these molecules happens exclusively by absorption of UV photons by the electrons in the π -bond of the double-bonded carbon bonds, resulting in the typical blue fluorescence of humic acids (Gorobets and Rogojine, 2001).

Another phenomenon, which is not so easy to explain, is the green phosphorescence. Its source is a different, quite complex mechanism, which results in a longer fluorescence wavelength, i.e. in the green part instead of the blue part of the spectrum (Gorobets and Rogojine, 2001).

In this case, we are talking about the forbidden triplet-singlet transition. "Forbidden" means that in reality the relaxation is "delayed" and this delay can mount from seconds to even minutes. The transition $T - S_0$ bridges a smaller energy gap than the $S_1 - S_0$ transition of the fluorescence. This causes the wavelength of the emitted light to be larger, green, than that of the fluorescence, blue.

The same green phosphorescence is often observed in other minerals occurring in soils or rocks that are easily penetrated by organic matter. A good example is the well-known aragonite from Sicily, which fluoresces pink under LW and white with a pinkish tinge under SW UV light. The latter tint is actually a combination of a red fluorescence caused by Sm^{3+} replacing Ca^{2+} , and a bluish green fluorescence caused by humic acids.

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top of
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When the UV source is removed, the short-lived Sm^{3+} fluorescence "dies" within a few dozen nanoseconds. The blue fluorescence of polycyclic carbohydrates "lives" only a fraction longer. However, the green phosphorescence of the T-S_0 transitions has an afterglow of a few seconds, long enough to be captured on camera.

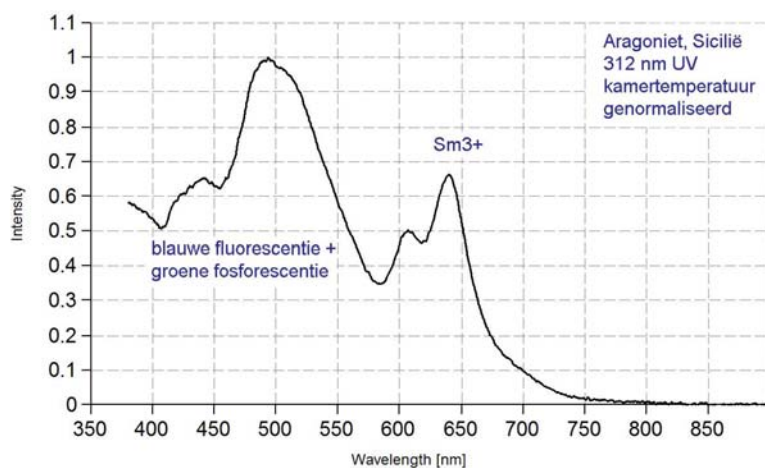


Fig. 7.
Normalised spectrum of aragonite from Sicily at room temperature under 312 nm MW UV showing blue fluorescence and green phosphorescence.

The emission spectrum of gypsum from Betekom exhibits a number of small deviations, which do not belong to the emission of organic material. The wavelength where we find these artefacts corresponds to known transitions of elements from the lanthanide series, the so-called "rare earths." It is impossible to confirm these elements using only "solid state" spectroscopy (as we do with our spectrometer). However, three results support this assumption:

1. The emission wavelengths match the values published by Gaft and Gorobets (Gorobets and Rogojine, 2001).
2. The emissions are more intense when using longer excitation wavelengths than when using short ones. The emissions between 700 and 800 nm even completely disappear when using excitation wavelengths below approximately 370 nm.
3. The remains of clay between the gypsum crystals often fluoresce orange, primarily under long wave UV. Wavelengths between 370 and 400 nm are ideal to excite the strongest emissions of samarium, europium, and dysprosium.

To confirm the presence of these elements a more sophisticated spectrometer or a very sensitive analysis such as ICP-mass spectrometry are necessary. The lifespan of rare earth emissions is measured in nanoseconds and is typical for the ions in question. The concept of lifespan is a function of the time during which a luminescence centre (activator) remains excited on average after the source of the excitation is turned off.

The most plausible explanation of the emission peaks in the spectrum in figure 2:

- | | |
|-------------------|---|
| 490 nm (A) | organic material |
| 540 nm (B) | organic material |
| 565 nm (C) | Most likely Sm^{3+} |
| 605 nm (D) | Most likely Sm^{2+} |
| 630 nm (E) | organic material |
| 690 nm-810 nm (F) | probably rare earth metals (Dy^{3+} , Eu^{3+} , Sm^{2+} and possibly Nd^{3+} , Tm^{3+}). |

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Twinned gypsum crystals from Betekom, Flemish Brabant, Belgium. Collection and photo © Ludo Van Goethem.

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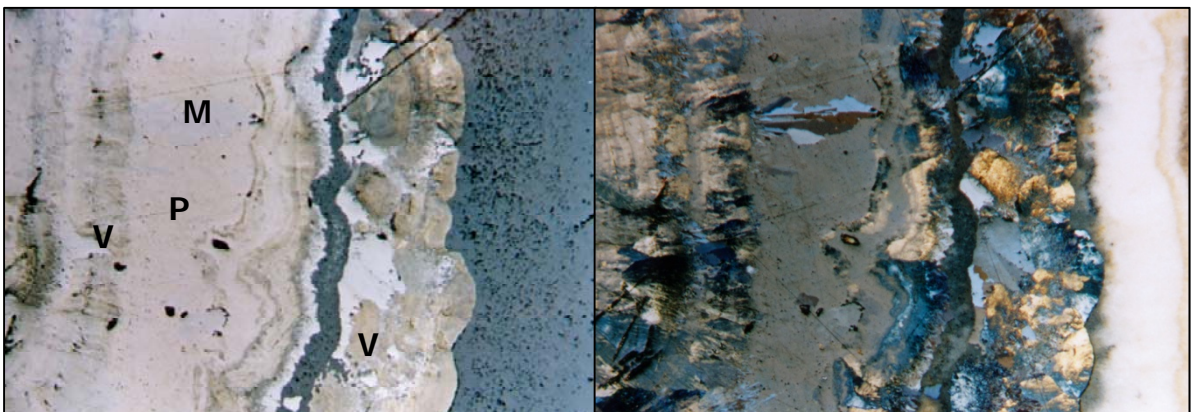
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Top: fluorescence (left) and phosphorescence (right) of a gypsum specimen from Betekom, Flemish Brabant, BE under short wave UV. Image width approximately 15 cm. Collection and photo © Axel Emmermann.

Bottom: aragonite, Sicily, Italy under LW UV, SW UV and phosphorescence after SW UV irradiation.



Viaeneite (V), marcasite (M), pyrite ("melnikovite") (P). Oil polished cross-section as observed through the ore microscope. Top: parallel Nicols, bottom: semi-crossed Nicols. La Maillieue deposit, Engis, Liège, BE. Image width 1.35 mm. Photos © Willy Viaene (†).



Aggregates of koninckite, this time not from Belgium but from Oberbuchach, Kirchbach, Carinthia, Austria. Image width 9 mm. Collection and photo © Chris Auer.



Rutile fibers on quartz crystals. Old quarry, La Haie forest, Bertrix, Luxembourg, BE. Image width 8 mm. Collection and photo © Harjo Neutkens.



Rutile fibers on quartz crystals. Old quarry, La Haie forest, Bertrix, Luxembourg, BE. Image width 6 mm. Collection and photo © Harjo Neutkens.