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August 2017
Quarterly Publication

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WORLD GEM FOUNDATION

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Editor Geoffrey M. Dominy

May 2017 Issue

Geoffrey M. Dominy is the author and creator of the digital e-book 'The Handbook of Gemmology, founder of the World Gem Foundation and editor of Gemmology Today.

World Gem Foundation Founder
Geoffrey M. Dominy

We live in a strange world. A world where you can seemingly get people to do anything you want provided you give them the sense that they are part of the parade rather than simply watching the parade.

Today, within 100 metres, twelve people were fully engaged on their mobiles. Connected to somebody or something but totally disconnected from the world around them.

Do you remember the De Beers ads suggesting that we spend two months salary on our diamond? Started back in the late 1930's, the ad campaign, created by N.W Ayer & Sons, originally recommended one months salary, however this was changed in the 1980's to reflect 'current' times. The marketing concept 'A Diamond is Forever' was not only designed to tug at our heart strings but also to discourage the reselling of diamonds. Clearly for a company that at that time had a monopolistic grip on the diamond market, involved in every aspect of the diamond industry, reselling diamonds would not have been good for business.

Longer than I care to remember, a nice lady came into my store and asked to see our selection of peridot rings. I have always liked peridot but clearly I am in the minority. I made a comment about peridots and she responded 'I hate peridot but it is my birthstone so I have to have one'.

Wow! Just like the frightened man who willingly divulged his monthly salary so that he could 'conform' to what society (and De Beers) expected, this lady was prepared to spend her hard earned money on something she hated but felt compelled to wear.

I didn't sell her a peridot, although she had to admit that there was a world of a difference between the sickly yellowish green peridots she had seen in most of the jewellery stores she had visited and the stunning Burmese peridot I had to offer. She liked the colour blue and once I had dispelled the belief that everyone born in the month of August had to wear a peridot, she felt liberated.

Sadly we have all been tricked into consumerism, influenced by the ads we see on the television, in newspapers and magazines and by what our 'peers' are buying. Plastic 'crocs', torn jeans, imperfect leather, clothes that look like they have been through the wash a million times, you name it, we will buy it.

Jewellery is a very personal thing. A reflection of who we are, not what somebody deems us to be. It should last a lifetime, it should be passed down from generation to generation because at the end of the day, quality, like cream, will always rise to the top.

JAN ASPLUND is the joint CEO of the Scandinavian Gem Academy. He received his FGA (Diploma in Gemmology) and DGA (Gem Diamond Diploma) through Gem-A in 2011, his BA in History from the Mälardalens University in 2000 and studied geology and gemmology at Luleå Technical University (2005 – 2007).

The formation of the first European Diamond Trading and Cutting Centers

The discovery of diamonds in South Africa in the 1860s changed everything when it comes to diamonds. For the first time diamonds were found in their mother rock resulting in growing understanding on how diamonds are created putting many bright minds to the question on how to synthesize them. Much of how the business was formed during the decades following the discoveries in South Africa is still recognizable today and the amounts of diamonds appearing on the market made them available for every jeweler, goldsmith and designer.

It is with South Africa the modern history of diamonds starts and today diamonds are traded in bourses and fairs all over the world. How does the history of the development of diamond trading and cutting centers look like in Europe?

For public and business professional's alike Antwerp is probably the city most associated with diamonds and Antwerp is undeniably one of the most important diamond centers throughout the history of Europe. Antwerp has been a diamond center for 600 years but there have also been many other important centers for diamonds in Europe throughout the centuries. How and why did Antwerp and other important centers emerge and develop during the establishing of a diamond industry in Europe in the 14th – 16th centuries?

The first important diamond center in Europe was Venice where most of the trade from the east passed through on its way to the rest of Europe during the 13th and 14th centuries and Venice had monopolized the trade with diamonds from India in Europe. The earliest evidence of diamond cutting in Venice is from around 1330 and it is toward the end of the 14th century cut diamonds started to appear in different parts of Europe. (Harlow 1998 p 131, De Bie 2016 p 271)

Guillebert de Metz describes in "Ville de Paris au XVe siècle" (Paris in the 15th century) from 1434 diamond cutting being done in the La Couraire district in Paris. As the earliest known record of diamonds in Paris mentions existing diamond cutting, the first diamonds must have arrived in Paris significantly earlier. The documentation by de Metz mentions a diamond polisher named Herman, a German name supporting the theories on an emerging diamond industry in southern German cities such as Nuremberg already in the 14th century. South Germany had continuous trade with Venice from the early 14th century securing a supply of rough diamonds. It is at this time the art of diamond cutting developed into something similar to what we still see today (de Metz 1855 p 84, Maillard 1982 p 28-29, De Bie 2016 p 271).

From the 1380s cut diamonds start to appear more commonly in European jewellery and the fashion of wearing diamonds spread resulting in a growing demand for diamond cutters in other parts of Europe, not just Venice and southern Germany. The increasing number of high quality diamonds finding their way to Europe from India added to the demand for the development of diamond cutting skills and equipment (Harlow 1998 p 131).

Another important diamond center was Bruges that had in a relatively short time became an important trading center for various goods in the 13th and early 14th centuries, thanks to a storm in the 13th century that broke through natural barriers creating a channel by which ships could sail all the way to Bruges (Charlier 2011). There are indications of rough diamonds occurring in Bruges considerably earlier than the first reliable historical documentation from 1465 and as the first historical record is on an existing industry, just like with the documentation concerning Paris, obviously diamonds must have occurred there for quite some time before then (De Bie 2016 p 271). There were also a significant number of merchants from Venice who had settled in Bruges giving the two cities an important bond and making Bruges an important stop along the trade route from Venice – Milan – over the Alps, through the Rheine valley into the Low Countries. Since the trade route was long and dangerous, transporting rough gemstones was considerably less risky than transporting polished gemstones and this is perhaps another reason Bruges and other cities developed diamond-cutting industries in the 15th century (Maillard 1982). The Low Countries was controlled by the dukes of Burgundy and their interest in diamonds and other gemstones made the local diamond centers important enough to compete with and eventually surpass Paris as the most important diamond-cutting centers (Harlow 1998 p 133).

There was some competition between Antwerp and Bruges on being the most important trade-center in the area during the 14th and 15th centuries. Antwerp became the most important diamond center in the Low Countries around the turn of the 15th century because of several reasons. The increasing population of Bruges and natural erosion had eventually lead to the silting of the Zwin river preventing larger ships from reaching the harbors of Bruges. This resulted in the city losing much of its status as a treading-center to Antwerp (Charlier 2011). About the same time, 1498, Vasco da Gama had opened up the sea route from Lisbon to India resulting in Venice starting to lose its importance as a trade center. In Lisbon a major diamond trading, cutting and polishing center emerged that would last for 200 years (Staebler & Mitchell 2017, p 5). Diamonds arriving in Lisbon were distributed to Antwerp since Bruges still had tight bonds with Venice. Antwerp's importance as a distribution center of Indian goods kept growing while Bruges declined. Diamonds were also sold to Amsterdam and the emerging diamond center in London. Venice had now lost its monopoly on rough diamonds and eventually the Portuguese cut Venice from the trade routes resulting in Venetian cutters having to buy their rough from Lisbon (Maillard 1982 p 29-30).

In the case of Antwerp, evidence of diamond trading are several decades older than the first documents on diamond cutting, 1447 and 1476 respectively. The earlier document from 1447 consists of a proclamation from the Antwerp City Council prohibiting the trade in false or imitated precious stones and specifies the fines for anyone trading with imitated diamonds, rubies, emeralds or sapphires (De Bie 2016 p 272, Van Roey, Sankovitch 2017, Maillard 1982 p 30). It is logical to first find trade then develop cutting, since during this time jewellers and their clients started to demand more advanced cuts in their jewellery instead of simple point cuts or rough crystals that might just have been slightly polished. An important event for the future of diamonds in jewellery occured in 1477 when the Hapsburg emperor Maximillian I gave a diamond engagement ring to Mary of Burgundy (Harlow 1998 p 133).

The Diamond industry was exposed to large changes in the coming centuries. In 1510 the Portuguese had conquered Goa in India and from there they increased their control of trade in a larger part of India than before resulting in a steadier supply of diamonds. It was no longer only the larger diamonds but also smaller stones imported to Europe resulting in a wider market for diamond jewellery. From the 1560s Amsterdam started to grow as an important trading center and together with the increased Spanish influence in Antwerp in the 1580's, business and skilled cutters moved away from Antwerp to Amsterdam and other cities such as Frankfurt (Maillard 1982 p 33).

From available documentation the early history of diamond cutting and trading in Europe begins in Venice probably in the 1330s. Germans buying diamonds from Venice, during the 14th century, resulted in the development of an early diamond industry in southern Germany. From there the technique to cut diamonds spread west to France and the Low Countries. According to available historical documentation diamond cutting was established in Paris sometime before the 1430s, in Bruges before 1465 and Antwerp no later than 1476. However the assumption that cutting was preceded by diamond trading is less well documented (de Metz 1875 p 84, Harlow1998 p 131, Van Roey & Sankovitch 2017).

The history of the first established European centers for the trading and cutting of diamonds is quite similar to how trade and cutting centers are developing today, with some gaining importance while others decline or are forced to adapt. One major difference seems to be that during the early renaissance the challenge was to keep up with the growing demand for more diamonds and of a better quality. Today, one gets the impression, particularly from reading trade publications, is that the challenge is to perpetuate consumer demand for diamonds, while the technical challenges are centered more around the detection of treatments and synthetics rather than developing new techniques and methods for cutting. One suspects the Antwerp City Council of the 1440s might have had some interesting thoughts about this.

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Pear Shape Diamond (D Colour, IF Clarity) (64.83 carats) (Photo by Tino Hammid)

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Connoisseurship: The Finer Points
Crystal - The Fourth 'C'

Most discussions of gemstone grading reference the four C's: color, cut, clarity and carat weight. Color is normally divided into the categories of hue, saturation and tone. Cut primarily addresses the percentage of brilliance in the stone viewed face up and, secondarily, the gem's proportions. And although some systems distinguish between eye and loupe clean stones, Clarity generally addresses eye flawlessness, or the relative lack thereof, in a gem viewed face up. Carat weight, being merely a quantitative measure, has no place in the discussion at all.

In Philosophy a distinction is made between conditions that are necessary and those that are sufficient. In the formation of a human embryo, the male sperm and the female egg are both necessary conditions. But, it takes two to tango. Both are necessary, but neither is sufficient. Only when they come together do they create the sufficient condition.

The attempt to use the three C's as the only criteria for quality grading gems creates a difficult situation. All three - color, clarity and cut - are necessary conditions, but when taken together, particularly when grading higher quality gems, they are not sufficient.

A Tale of Two Sapphires

What is it that visually distinguishes a fine natural blue Sri Lankan sapphire from its heated counterpart? Answer: transparency, crystal or what gemologists call diaphanity. Few would argue that generally speaking the natural stone has a limpid crystalline quality that distinguishes it from a heated stone. A treated stone may have exactly the same hue, saturation and tone, be perfectly clean, and be exceptionally well cut, but because heating tends to muddy the crystal it will often be less transparent. In fact it is not possible to verbally distinguish the two stones without using adjectives like transparency, limpid and crystalline, all of which are synonyms for diaphanity or what I have chosen to call crystal.

A Gem of the Finest Water

The crystal criterion is not a recent discovery. As a grading criterion, Crystal has a strong historical foundation. It has simply been forgotten, somehow, in the grading systems developed in the last century.

In the 4th century BC, Kautilya, the ancient Indian Machiavelli, lists among the qualities of a good gem… (That it be) "Transparent and reflecting light from inside" [1].

The famous seventeenth century gem merchant, Jean Baptist Tavernier, used the phrase "gem of the finest Water" to describe the finest diamonds and pearls he saw on his six voyages to India. Closer to home, Robert Shipley (the founder of GIA) made the following observation about diamonds in the first GIA gemology course published in the early1930s:

"Transparency is of great importance but as few persons recognize the finer grades of transparency it is not ordinarily considered. Some diamonds are more transparent than others.[2]"

Robert M. Shipley, 1936

In the sixth edition of the Dictionary of Gems & Gemology, Shipley defines water as a term occasionally used "…as a comparative quality designation for color and transparency of diamonds, rubies and other stones…" Color and transparency together equal "water". Shipley goes on to mention a hierarchy - first water, second water etc.- so clearly the quality of diaphanity was recognized as an important and indispensable criterion in quality grading from earliest times. Why is this a surprise to some critics? We are talking about the broad class of gemstones known as "transparent."

Natural Blue Sapphire (Kashmir - India) (Photo by Tino Hammid)

Do ultra-transparent Indian diamonds really exist? Yes, they are known scientifically as type IIa. “Place a Golconda diamond”, Benjamin Zucker suggests, “alongside a modern, recently cut D-colour diamond and the purity of the Golconda stone will become evident.[3]” In an essay on Golconda diamonds written for Christie’s, Mary Murphy Hammid maintains, “I’ve seen the incredible transparency that people say is characteristic of Golconda diamonds in stones the GIA graded G and H.” And, why not? Crystal and color are distinct qualities. Diamonds such as these are therefore higher quality and regularly bring premiums of as much as fifty percent at auction, all because they are truly gems of the finest water.

One might argue that diaphanity is nothing more than a subset of clarity. In other words, that it is really extremely tiny inclusions that cause a stone to exhibit poor crystal. That argument is made in a review of Secrets Of The Gem Trade (1st Edition 2004). Other critics site an exception in the sapphires of Kashmir, the finest of which exhibit a sleepy or fuzzy appearance resulting from light refracting through, and reflecting from, myriad tiny sub-microscopic inclusions.

Some Sri Lankan and Madagascan sapphire will exhibit similar phenomena. In these examples it is clear that inclusions are the culprit. When is an opaque sapphire more beautiful and valuable than a transparent sapphire? The answer - never! Is there such a thing as a sapphire that is too transparent? Hardly! The velvety phenomenon so desired in Kashmir stones could not exist without a high degree of transparency.

Most times crystal is apparent, but sometimes it is simply inherent. There are a few cases where the highest degree of transparency is not the most desired. The velvety glow of Kashmir sapphire has been noted. The gota de aceite (honey like transparency) or old mine look so admired in Columbian emerald and the blushing lifelike glow of the skin of a fine natural pearl are also exceptions which prove the general rule. Each of these affects somewhat mitigate optimum apparent transparency, but none would exist without a strong inherent transparency (crystal).

Tiny inclusions are one, but only one of the possible causes of poor crystal. Consider a strongly blue fluorescent diamond. Such stones are often described as visibly oily due to a loss of transparency when the diamond fluoresces in daylight. Fluorescence will be noted in a grading report, but its presence or absence cannot be said to affect the clarity grade.

Many varieties of gemstones tend to lose something when viewed in certain lighting environments. Incandescent light is the usual culprit. Different types of light have distinct color temperatures, which are measured by units Kelvin. North daylight at noon, the traditional gemstone-grading standard, is balanced between yellow and blue at 5,500 degrees Kelvin. As Kelvin temperature decreases, light becomes yellower, and as the temperature increases the light becomes bluer. Incandescent or lightbulb light at 2,800 Kelvin is distinctly yellowish. The lighting temperature determines the color of the light, and that in turn impacts the visual appearance of the gem being viewed in that light. Recently, advances in lighting technology (LEDs, etc.) have further complicated the equation.

The tendency of gems to change appearance, lose color, between natural daylight and incandescent light has traditionally been called bleeding. One of the characteristics that make Kashmir sapphire so desired is that it doesn’t bleed color. Due to an absence of chromium, the color of a fine Kashmir sapphire will remain unaltered as the lighting environment changes.

Tsavorite garnet seems to close up in incandescent light while rhodolite turns muddy and brownish. Green and blue tourmaline pick up a gray mask and appear dull and sooty, like the chimney of an oil lamp. Pink to red tourmaline acquires a muddy brownish mask.

The changes described affect not only crystal, but color (hue, saturation and tone) as well. Such effects are general, but not universal. For example, ninety-eight percent of all rhodolite garnet will muddy, turn brownish, losing both transparency and color saturation in incandescent light. This leaves only about two percent, which retain both their color and crystal under the lightbulb. All other C’s being equal, if the stone is of high color, clean and well made, this two percent constitutes the crème de la crème of rhodolite garnet. The same may be said for pink tourmalines that do not muddy and tsavorite, which retains its open color in incandescent light.

Historically crystal has also played a part in the discrimination of the finest pearls. Prior to the introduction of cultured pearls (seeded with an opaque sphere ground from the shell of a freshwater mollusk), transparency, or at least translucency, was very much a characteristic valued in the finest pearls.

In his Travels to India, Tavernier describes the world’s paramount pearl (circa 1670), a gem at that time in possession of a minor prince of Muscat.

“This prince possesses the most beautiful pearl in the world, not by reason of its size for it only weighs 12 1/16 carats nor on account of its perfect roundness; but because it is so clear that you can almost see the light through it.[4] “

Tavernier also repeatedly uses the term water to discriminate between the relative qualities of diamonds and other gems.

As we have shown, diaphanity, transparency or crystal is a necessary grading criterion that deserves more than just a footnote in the discussion of quality in gemstones. Several factors, including sub-microscopic inclusions, ultraviolet fluorescence and the color of the lighting environment, may impact on crystal..

The distinctions made here reflect observable phenomena, which affect the beauty and desirability of gemstones. Crystal has a long and distinguished history as a grading criterion. It is a distinct and vitally important criterion without which it is impossible to adequately describe the finest gemstones. With a few notable exceptions, highly crystalline gemstones are simply more beautiful and hence more valuable in the marketplace. In short, crystal is the true fourth 'C' of gemstone quality evaluation and connoisseurship.

Note from the Editor:

So what do you think of Richard's assertion that 'Crystal' should be the 4th 'C'? We would love to hear from you if you feel otherwise and hopefully create dialogue and a point/counterpoint article in the November 2017 issue.

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Artist or Gem Cutter; Gemstone or Art? Victor Tuzlukov is another celebrated gem cutter who is pushing the limits of gem cutting by creating gemstones that blur the line between what is considered a gemstone and what is considered a piece of fine art.

In the May 2017 issue, we interviewed award winning gem cutter John Dyer. John gave us a fascinating insight into the life of a gem cutter and his images certainly attracted the attention of our readers.

We thought it would be interesting in this issue to pose the same questions to another award winning gem cutter, Victor Tuzlukov, to see how his 'thought' process compares to John's and how he sees the future of precision gem cutting.

Victor Tuzlukov, founder of the Russian Faceters Guild and winner of the prestigious 'Grand Master' award in 2008 through the U.S Faceters Guild and numerous other awards, has forged his own mark in this fascinating field by using unique facet patterns to form symbols that reflect profound philosophical concepts. Creations such as 'The Great – in the Tiny', 'The World's Treasure', 'The Winner', 'The Mystery of the Universe', 'The Power of Inspiration', 'Cognizing Wisdom', and 'The Birth of the Star' all tell a story, revealing a connection to evolutions cyclicity and a deep and profound understanding of the universe.

GT: Artist or Gem Cutter; Gemstone or Art?

VT: Both. In my opinion, an artist must express some idea in his work and a stone should be not the purpose, but just an instrument, like canvas and paints for an artist. To find amazing rough, to maximize weight, to choose right orientation, to open color, even to make beautiful and/or unusual gem is a mastership, high level of craft, but not a real art. If gemcutter says that his purpose is to express charm and beauty of gemstone – it is not an art, like when artist wants just to show the beauty of this or that paint. To add new technique to faceting process, to cut hundreds of facets, to create beautiful pattern or many reflections – is not an art.

GT: What is the most challenging gemstone you have ever cut?

VT: Definitely it was 'The Initiation' – Cubic Zirconia of 536 carat and 722 facets which I donated to His Holiness Dalai Lama. It was not only due to big size and complexity of design. Of course, technically this design was out of limits of my skills. Actually it was the Kalachakra Mandala – sacred symbol of the Buddhism – by numbers and groups of facets, by geometry, and by spiritual meaning. It was impossible design for me five years ago. When one of greatest world faceters – Stephen Kotlowski (rest in peace) – saw this stone, he just said: "You are crazy…" It was the highest mark for me. This stone was the first, and a few more ones followed him in this collection, but it is another story…

GT: What is the most enjoyable gemstone you have ever cut?

VT: I have enjoyed many stones, but the most, probably was 'The Heart of Planet' – Kunzite of 700 carat from the 'Philosophical Stone' collection, which I cut for STONETRUST Company. Kunzite is a very complicated material (perfect cleavage, sensitivity, etc.), especially in big sizes, and it was a real challenge for myself – the most enjoyable challenge possible.

GT: Talk us through the artistic process from the initial concept and design to the finished gemstone.

VT: According to my reply to your first question, artistic process is creation of design; it finishes when cutting starts. Initially I catch some idea and try to imagine how to realize it in gemstone – which material I need, its color and approximate size. Then I optimize angles for the best optical property – we must not to forget to use all features of the material to maximize its beauty. After that – orientation, dopping, cutting and polishing – is just a technical process, nothing about art. As I know, some faceters cut stones 'on the fly' – without an initial design, following the shape of the rough. But I cannot imagine this. How they can express some idea in their work – maybe just occasionally…

GT: Art and economics don't always work hand in hand. There is often a fine line between the two. How do you approach it?

VT: Between these two is not a line, but wide area – unfortunately. The real art objects – not only gemstones – must include much more than material price and cost of faceter's work time only, as well as a painting costs more than price of paints, canvas and hours of work. But today there are no criteria to evaluate it, no experts to create such criteria and no art-dealers to supply such art objects to the market. If a gemstone artist tries to explain the higher price – he risks losing his customers. Most of them don't understand the difference between a gemstone (probably, very beautiful and unusually designed) and an art object. This art is just forming today, and society needs time to accept it.

GT: What was the defining moment when you decided to cut gemstones?

VT: If you mean the decision that gemcutting will become my life – it was on 2006, when I joined the US Faceters Guild and took part in my first faceting competition. First time I looked at my stone by eyes of judge and saw how perfect it could be. I realized that I can show this perfection to folks and I must do it. If you mean my first experience in gemcutting – it was in Vladivostok (Russia) 8 years before, when my friend – a well-known scientist in marine biology – showed me cutting as a hobby and let me try it. She was my first teacher and I got initial impulse from her.

GT: Natural artistic ability or a learned skill?

VT: Again – both. My first education is marine navigator. That time one of our teachers said, that the formula for the ideal navigator is accuracy plus punctuality plus attention raised to the square plus self-control raised to the cube. Exactly the same I can say about a precision cutter. It is just skills. But to produce art objects, a master must be not only an experienced cutter, but have some creative potential, something to say for the people.

GT: Compared to when you started cutting, is there more awareness and acceptance now for what you are doing?

VT: I hope so.

GT: What advice can you give to somebody who wants to start cutting gemstones? Where would they begin?

VT: If you made a hard decision to start cutting gems, first of all, you need to choose segment of your business/hobby. I cannot advise anything to those who want to cut commercially – it is different planet. But if you want to touch the perfection and to create real masterpieces, you need to pass three steps. Firstly, you have to overcome your fear. Fear of bad results, fear of the equipment, fear of the stone, and so on. FEAR. Secondly, you have to overcome your confidence. After some experience, you begin to be sure that you can do everything and there are no limits for your skills and some negligence could appear in your work. It is mistake. You should take each stone as your teacher, because each stone is unrepeatable. CONFIDENCE. Thirdly, after these two, you have to overcome yourself – it is the most complicated thing. Each master wants to express himself in his works. But to be a Master with capital letter, you should forget about you and try to express what the stone wishes to say (in case of craftsmanship) or what the Life wishes to transmit through you to the people. SELFISHNESS. That is the way to mastership.

GT: If we were sitting down one year from now, what would you say constituted a good year for Victor Tuzlukov?

VT: It was more than a good year. I began to collaborate with two powerful organizations – Gems and Jewelry Institute of Thailand, where I teach faceting under government support, and Pranda Group – the biggest jewelry company in Thailand, which represents over the world and controls more than ten famous brands. First time in history jewelry collection was created on the base of gemstone designs – my 'philosophical' stones. First big presentation will take place in September in Paris, then in Hong Kong immediately afterwards. Besides that I have a few more projects, but it is early to tell you about them!

Submissions

If you would like to submit an article to Gemmology Today, we would love to hear from you.

The deadline for the next issue is
October 15th, 2017

Guidelines:

- We do not accept highly scientific articles. These are better suited to either the Journal of Gemmology or Gems & Gemology
- All articles should be a minimum of one page
- All accompanying photographs must be high resolution and must be accompanied by written permission to use the images unless the author owns the rights
- We reserve the right to refuse articles

E-mail all submissions to information@ worldgemfoundation.com.

‘St. Andrew First-Called’ – Topaz (Irradiated) (30.15 carats) (Photo by Sergey Pryanechnikov)

'The Ariadna Thread' – Tanzanite (17.33 carats) (Photo by Dmitry Stolyarevich)

'Heart of Planet I' – Spodumene (547 carats) (Photo by Dmitry Stolyarevich)

Tourmaline (26.1 carats) (Vigoff Collection) – Face View (Photo by Dmitry Stolyarevich)

Tourmaline (26.1 carats) (Vigoff Collection) – Side View (Photo by Dmitry Stolyarevich)

LAPIS PHILOSOPHORUM collection: ‘Touching to Perfection’ – Lavender Quartz (57.08 carats) (Photo by Dmitry Stolyarevich)

THE ELEMENTS collection: ‘Touching of the Hurricane’ (AIR) – Green Quartz (73.71 carats) (Photo by Arjuna Irsutti)

Money Cent$

Economics for Non-Economists

GEOFF DOMINY is an author, independent gemmologist and founder of the World Gem Foundation. He received his F.G.A through the Gemmological Association of Great Britain (Gem-A) in 1987 passing the diploma examinations with distinction.

Getting blood out of a stone

Citrine Quartz (Photo by Tino Hammid)

The treatment and enhancement of gemstones is one area of gemmology that is constantly changing. The real trick of course is detecting these treatments, sooner rather than later. The longer they go undetected, the more the treaters make and the more unsuspecting buyers are ripped off. While I accept that in a world where money rather than the conservation of angular momentum makes the world go around, I am not a fan of the treatment of gemstones; especially those who seek to deceive and profit from their deceit.

Many will argue that if the treament is permanent, why should it be disclosed and should we even make a distinction in terms of price? Others will argue that any enhancement must be disclosed and there should be distinctions drawn price-wise between treated and untreated gemstones. This of course brings into question our ability to confirm whether or not a gemstone has been treated. In some cases, such as blue topaz or intensely coloured blue or blue-violet tanzanite, it is assumed that the material has been treated. Since there are no pricelists that make reference to treated or natural tanzanite or topaz, whether or not it has been treated is a 'mute' point.

Laboratories can of course detect treatments but the equipment needed is extremely expensive and so too are the tests. While one can imagine verifying the origin of colour for a five-carat extra fine quality golden-yellow sapphire, what about a one carat citrine quartz?

What intrigues me about the enhancement of gemstones is what motivates a person to treat a gemstone and what material makes it economically viable.

I love gemstone pricelists because they not only give us the prices of gemstones based on weight, colour, clarity and cut but they also provide a wealth of information that I am sure many people miss.

The pricing of gemstones is a complex matter. I do not envy those who create pricelists because they seem to draw two very different reactions; appreciation when it confirms the price you want to charge for a gemstone and disdain when they don't. You either love them or hate them; there is no middle ground.

While prices are derived from a number of factors the two that perhaps influence them the most are supply and demand. Taafeite is one of the ten rarest gemstones yet there is little demand for it. Consequently, the prices are quite low. While there is an abundance of blue topaz, the prices are still relatively low even though it is a popular choice for price conscious consumers who want the 'look' of aquamarine without the price tag. Fine quality emeralds, on the other hand, are in short supply but in great demand. This is a fatal combination for buyers and pure nirvana for sellers who can seemingly charge what they like.

So what motivates treaters? Are they doing this to improve our lives, to make gemstones less costly, to make them more readily available? Possibily but in reality, let's face it, their motivation is simply driven by the desire to make money and when it comes to treating gemstones, there is lots of money to be made, trust me.

Gem cutters see the potential in a piece of rough that the average person simply cannot see. The more experienced they are, the more fine-tuned they are to what will produce a truly fine gemstone. The same is true of treaters, they know from experience what rough will ‘accept a treatment’ and what will not. You can’t turn a sow’s ear into a silk purse, but if you know what you are looking for, you can transform an ugly ducking into a more attractive one.

The problem with trying to solve this riddle of what is ‘treatable’ and what is not is hard because for obvious reasons treaters do not want to reveal their secrets.

We know that pinkish coloured tourmaline is irradiated to produce a more intense colour but what pink tourmaline produces the best results and the best return on their investment?

Clearly treaters are not in the business of losing money so we can discount right away that they will treat any material where there is a risk of producing an end product that is less valuable. Of course there is always a risk but experience helps to mitigate these risks.

One gemstone that is treated regularly is amethyst quartz, heat treated to produce citrine quartz, hence the term ‘Burnt Amethyst’. This is an interesting stone because amethyst is far more popular than citrine quartz.

If we look at the Chart A below, we can see that in all qualities, amethyst quartz will sell for more than citrine quartz, so why treat it?

If we look at Chart B, we can start to understand why they treat it. This chart is based on the % difference in price between mid-commercial grade amethyst quartz (2) and citrine quartz in four qualities (4, 6, 8 and 10). We can see that in all weight categories we would need to achieve a ‘post-treated’ colour grade higher than 4 to make any money. Now before we get carried away with the percentages listed for 8 & 10 qualities, you simply are not going to convert mid-commercial grade amethyst into fine or extra fine citrine but hopefully you can start to see where treating lower grade amethyst could be financially viable.

Chart C looks at the % differences between high-commercial grade amethyst (4) and citrine quartz in the four qualities (4, 6, 8 & 10). This paints a completely different picture. Unless we are able to achieve a ‘post-treated’ colour grade of at least 8, it would not be profitable to heat treat the amethyst.

Clearly you will not be able to transform high-commercial grade amethyst quartz into fine grade citrine so based on these numbers we can conclude that only mid-commercial grade amethyst quartz would be viable for treaters to heat treat.

Chart A - Price Comparison between Amethyst & Citrine Quartz

Weight Category	4	6	8	10
0.50 - 0.99ct	150% +	200% +	33% +	75% +
1.00 to 2.99ct	167% +	237% +	59% +	67% +
3.00 to 4.99ct	125% +	200% +	48% +	57% +

Chart B - Price Comparison between Commercial Grade (2) Amethyst & Citrine Quartz

Weight Category	4	6	8	10
0.50 - 0.99ct	-	150% +	650% +	900% +
1.00 to 2.99ct	40% -	60% +	340% +	500% +
3.00 to 4.99ct	20% -	100% +	440% +	600% +

Chart C - Price Comparison between Commercial Grade (4) Amethyst & Citrine Quartz

Weight Category	4	6	8	10
0.50 - 0.99ct	60% -	-	200% +	300% +
1.00 to 2.99ct	62% -	-	175% +	275% +
3.00 to 4.99ct	56% -	11% +	200% +	289% +

Based on GemGuide’s January/February 2017 Pricelist

While we can tell that most of the high-commercial to good grade citrine quartz has been heat treated, it is difficult to determine if yellow sapphire has been treated. The chart below clearly illustrates why a treater would be motivated to 'squeeze' every ounce of colour out of a yellow sapphire.

The colour of yellow sapphire can be improved by either heat treatment or irradiation. In the case of heat treatment, golden yellow sapphires can be produced by heating pale yellow or near colourless sapphires at temperatures in the region of 1000 to 1450 degrees Celsius in an oxidized (oxygen-rich) environment. This causes the ferrous iron oxide (Fe^{2+}) to convert to ferric iron oxide (Fe^{3+}).

In the case of irradiation, it is possible to impart a deep orangey-yellow colour in pale yellow sapphires through exposure to gamma rays. This causes the ferric iron oxide (Fe^{3+}) to convert to ferrous iron oxide (Fe^{2+}) (*Nassau 1984*). Unlike heat treated stones, this treatment is unstable and must be disclosed since stones will fade when exposed to strong sunlight or when heat is applied. The problem of course is that this treatment is rarely disclosed because disclosure on the part of the treater would kill the sale and treaters are not into killing sales, it's bad for business.

Suspected stones can be subjected to a fade test but this is risky. Detection may be possible using a spectroscope since the 450nm absorption line will be absent in irradiated stones, but since this is very faint in untreated stones, conclusive testing can only be done using a spectrophotometer. While this might be practical with larger stones or stones of higher value, it certainly is not practical for smaller stones.

The same is true of pink and red tourmalines with an extra fine four-carat red tourmaline selling for almost one and a half times more than a pink tourmaline of similar quality. This would explain why pink tourmalines are extensively treated with radiation to improve their colour.

Enhanced pink and red tourmalines are produced by exposure to gamma rays which converts the Mn^{2+} to Mn^{3+} (*Manning 1973*). Unfortunately unless the stones are still radioactive, colour enhancement cannot be proven. This technique is used to not only intensify the colour in pink and red stones but also to convert less valuable light pink, green and even olive grey-green stones to more intensely coloured pinks and reds.

Finally, is it likely a treater will treat a stone of higher quality?

Of course it is possible but by doing so, he may 'devalue' the stone if the treatment is detected, not in terms of 'real' value but in 'perceived value'. Logically, if you purchased a stone of higher quality and discovered that it had been treated, you would not only ask why it had been treated but to what extent. This would clearly shift the balance of power from the seller to the buyer and in a game where negotiation is often needed to close a sale, putting yourself at a disadvantage is never good policy.

As the supply of fine quality material continues to decline and the cost of this material continues to rise, treatments will become more inventive, more elusive and more prevalent. It's a game of 'catch up' that we simply cannot afford to lose.

Price Comparision between Heat-treated Yellow Sapphires and Unenhanced Yellow Sapphires

Weight Category	4	6	8	10
1.00 to 2.99ct	40% +	55% +	46% +	50% +
3.00 to 4.99ct	67% +	45% +	88% +	47% +
5.00 to 9.99ct	20% +	6% +	50% +	67% +

Price Comparision between Pink Tourmaline and Red Tourmaline

Weight Category	4	6	8	10
2.00 to 2.99ct	83% +	170% +	444% +	312% +
3.00 to 3.99ct	100% +	272% +	274% +	445% +
4.00 to 4.99ct	212% +	439% +	552% +	648% +

Based on GemGuide's January/February 2017 Pricelist

Treated Blue Topaz (Sky Blue, Medium Blue and London Blue) (Photo by Tino Hammid)

Natural Pink Tourmaline (Photo by Jeff Scovil)

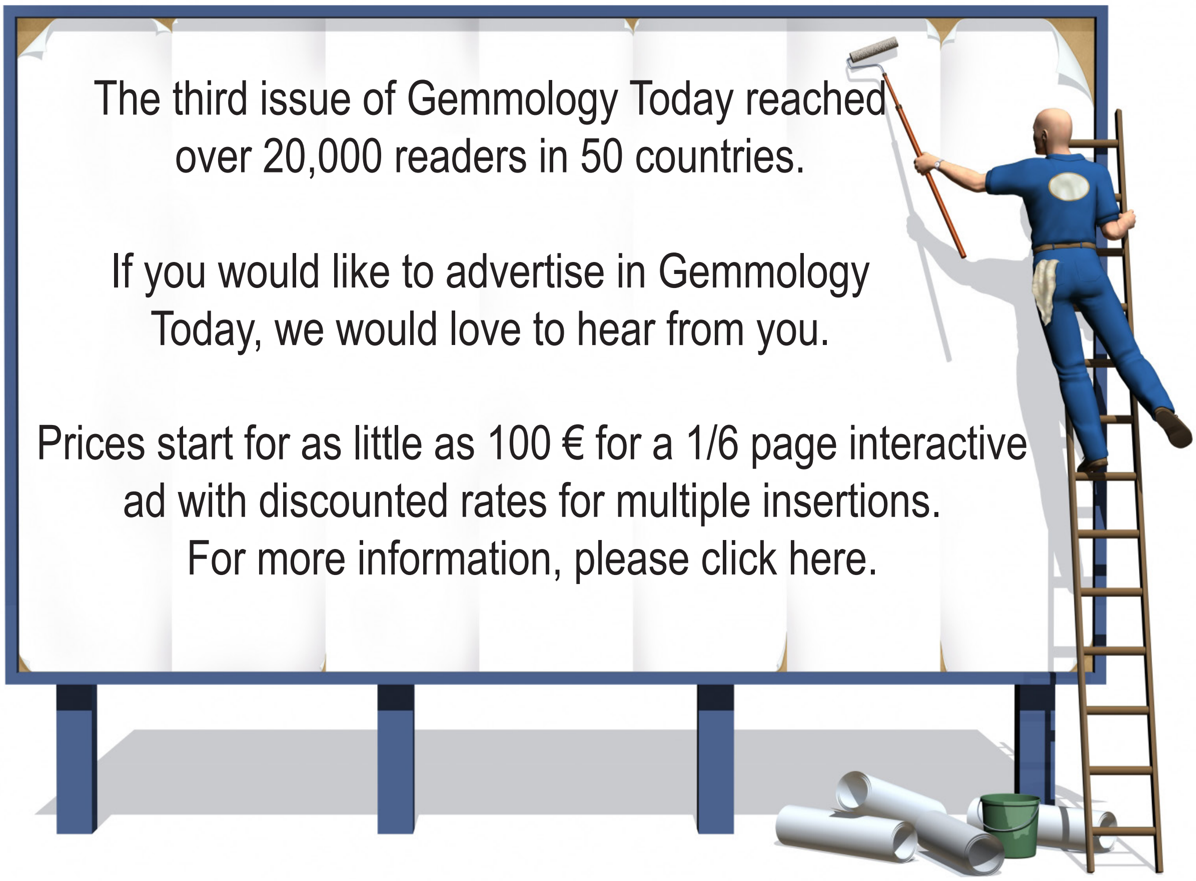
Gemmology Today Quiz #4

This quiz has been designed to test your general knowledge.

There are some tricky questions but as someone once said, the best things in life don't come easy!

Simply click here

START NOW



The Fingerprint File
GEM IDENTIFICATION

In this issue we look at rubies, their admirers and their detractors........

Ruby Tuesday

Gemstone	R.I. Range	D.R.	D	O/S	S.G. Range	H
Sphalerite	2.368 – 2.371	–	.156	I	3.90 – 4.10	3 ½ – 4
Cubic Zirconia	2.15 – 2.18	–	.065	I	5.60 – 6.00	8 ½
GGG	1.97	–	.045	I	7.05	6
Sphene	1.843 – 2.110	.100 – .192	.051	B+	3.52 – 3.54	5 – 5 ½
YAG	1.83	–	.028	I	4.58	8 ½
Zircon	1.810 – 2.024	.002 – .059	.039	U+	3.93 – 4.73	6 ½ – 7 ½
Spessartite Garnet	1.790 – 1.820	–	.027	I	4.12 – 4.18	6 ½ – 7 ½
Almandite Garnet	1.770 – 1.820	–	.027	I	3.93 – 4.30	6 ½ – 7 ½
Ruby	1.762 – 1.778	.008	.018	U-	4.00	9
Lab-created Ruby	1.762 – 1.778	.008	.018	U-	4.00	9
Rhodolite Garnet	1.740 – 1.770	–	.026	I	3.74 – 3.94	7 – 7 ½
Pyrope Garnet	1.720 – 1.756	–	.022	I	3.62 – 3.87	6 ½ – 7 ½
Spinel	1.712 - 1.730	–	.020	I	3.54 – 3.63	8
Topaz	1.630 – 1.640	.008	.014	B+	3.49 – 3.57	8
Tourmaline	1.614 – 1.666	.014 – .032	.017	U-	3.01 – 3.11	7 – 7 ½
Beryl	1.562 – 1.602	.004 – .010	.014	U-	2.66 – 2.87	7 ½ – 8
Sunstone	1.525 – 1.548	.010	–	B+	2.62 – 2.65	6 – 6 ½
Glass (Paste)	1.44 to 1.90	–	–	I	2.00 – 6.00	5

Superficially, there are a number of gemstones that can be confused with ruby. These include sphalerite, cubic zirconia, sphene, the rare-earth garnets (GGG & YAG), zircon, the reddish varieties of garnet (spessartite, almandine, rhodolite, and pyrope), spinel, topaz, red tourmaline (rubellite), beryl (bixbite), sunstone, glass, and of course rubies grown in the laboratory.

Although they will all produce a negative reading on a refractometer, the isotropic nature of sphalerite, cubic zirconia, YAG, and GGG can be confirmed using a polariscope. Garnet, spinel, and glass all have measurable refractive indices while the identification of smaller accent stones can be accomplished using either a polariscope or a dichroscope to confirm that they are singly refractive.

Sphene and zircon will both produce a negative reading on a refractometer, have appreciable birefringence, a lower hardness and in the case of sphene a biaxial optical character that can be confirmed using a polariscope.

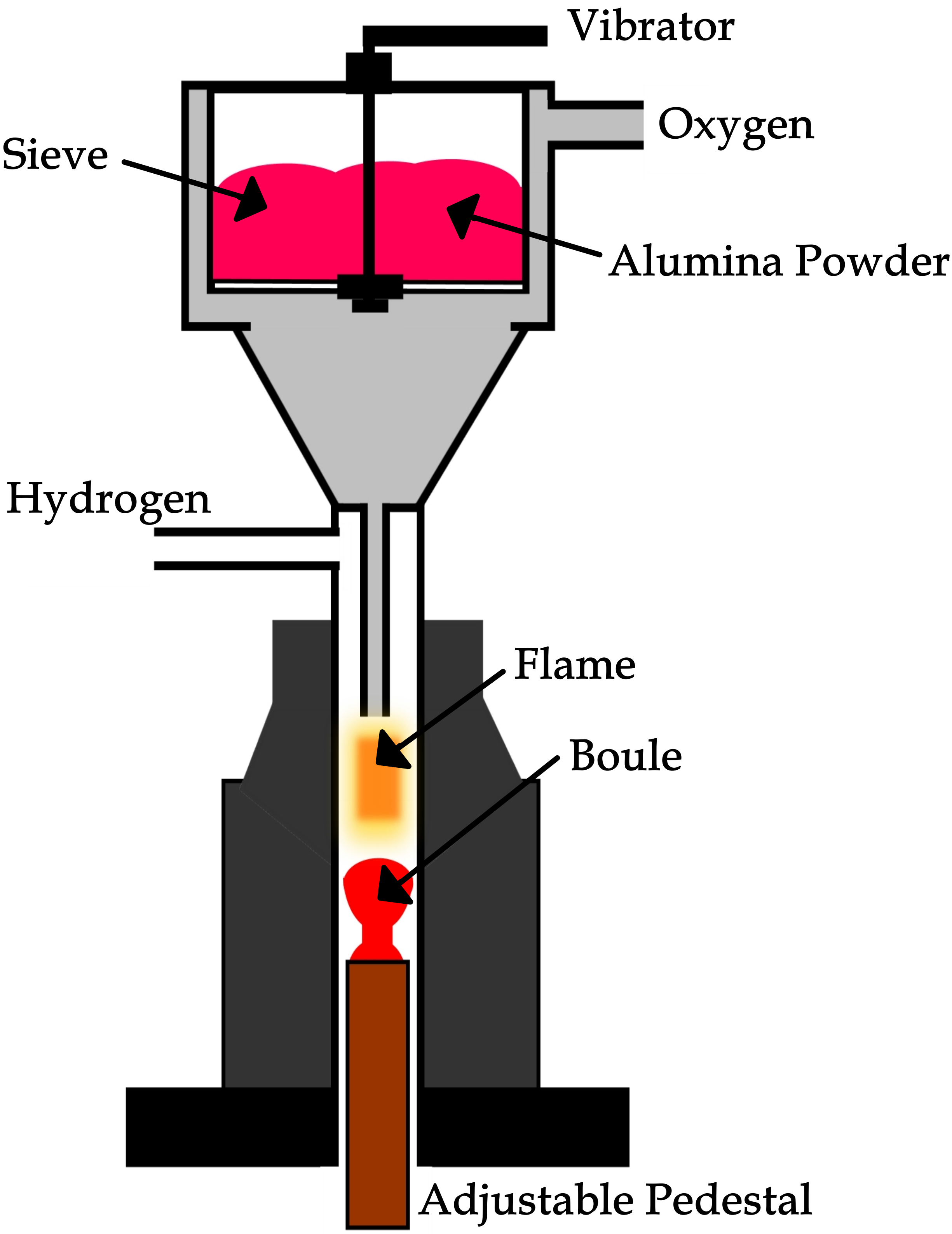
Reddish brown zircons are routinely subjected to heat in the 900 to 1000 degree Celsius range in a reducing (oxygen-free) environment. This produces a variety of colours including blue and colourless. Since the results are rather unpredictable, many of the less desirable colours produced by this method are re-heated in an oxidizing (oxygen-rich) environment at 900 degrees Celsius which turns them red, colourless or yellow. Like amethyst quartz and pink topaz, these colour changes are a result of misplaced electrons that return to their original positions when the stones are subjected to heat.

The separation of ruby from topaz is relatively straightforward with substantial differences in their refractive indices and the fact that ruby is uniaxial while topaz is

Natural Ruby (Photo by Tino Hammid)

Natural Ruby & Diamond Drop Earrings (Photo by Tino Hammid)

Ramaura Ruby Crystal and Cut Stone (Photo by Tino Hammid)



Verneuil Flame-Fusion Furnace

biaxial. This can be confirmed by carefully measuring the refractive indices to see which shadow edges move or by using a polariscope.

Ruby and tourmaline can be separated by the substantial differences in their refractive indices, the marked birefringence of tourmaline, and if unset, the fact that tourmaline with a mean S.G. of 3.05 will freely suspend in a heavy liquid of 3.05, while ruby will sink.

The absorption spectra of both stones are also quite different with ruby having prominent lines at 694nm, 693nm, 476nm, 465nm and 468nm, while tourmaline has two distinctive lines at 456nm and 451nm and lacks the fluorescent doublet at 694nm and 693nm.

Natural ruby will also fluoresce strongly under both short wave and long wave UV light, while red tourmaline will remain inert.

Under the Hanneman ruby filter, one can expect the following reactions:

Gemstone	Reaction
Ruby	Bright blue
Red Tourmaline	Grey/Purple

Enhanced pink and red tourmalines are produced by exposure to gamma rays which converts the Mn^{2+} to Mn^{3+} (*Manning 1973*). Unfortunately unless the stones are still radioactive, colour enhancement cannot be proven. This technique is used to not only intensify the colour in pink and red stones but also to convert less valuable light pink, green and even olive grey-green stones to more intensely coloured pinks and reds.

While red beryl (bixbite) is also uniaxial negative, unlike ruby it has a much lower refractive index (1.562 - 1.602), will float in a solution of undiluted di-iodomethane (S.G 3.33), and will exhibit strong paramagnetism when tested loose with an N-52 grade neodymium magnet.

Sunstones from Oregon are quite distinctive in appearance and exhibit a unique play of colour termed aventurescence (schiller) that is caused by the reflection of light from tiny native copper platelets. Like topaz, sunstone is also biaxial, has a lower refractive index than ruby, will float in a solution of diiodomethane and i-bromonaphthalene or toluol diluted to 3.05, and is considrably softer.

Lab-created Rubies

Verneuil Flame Fusion Rubies

Since great care is taken to ensure that no contaminants enter the process, Verneuil flame fusion rubies do not contain any natural mineral inclusions. They do however contain dark spots of undissolved alumina powder that can often be confused for natural inclusions. The practice of heating Verneuil fame-fusion rubies using an oxy-acetylene torch in order to produce internal fractures and then reheating them once they have cooled to partially heal these self-induced fractures also gives the stones a more natural appearance.

Two notable characteristics of flame fusion rubies are the profusion of small gas bubbles, almost certainly caused by the excess hydrogen gas used in the manufacturing process and the successive layering that forms as the pedestal is slowly lowered. This leads to very fine curved growth lines in flame fusion rubies that resemble gramophone lines and are referred to as curved striae.

Interestingly in natural rubies the tables are typically cut at right angles to the c-axis since this ensures that the resultant colour will not exhibit dichroism. In Verneuil flame fusion rubies, after the furnace has been turned off and the boule has been allowed to cool, it is split lengthwise to relieve the internal stresses that have built up during the formation of the boule. To maximize the yield, the stones are invariably cut with the table parallel to the c-axis and this results in dichroism when the stones are viewed through the table. Since the stones are cut at right angles to the growth of the crystal, we can therefore expect to see the curved striae when the stone is viewed at right angles to the table.

Differences also exist in their transparency under short wave UV light with Verneuil rubies showing a greater level of transparency. This can be determined, in a darkened room, by placing suspected rubies, along with known natural rubies, table down, on a sheet of photographic paper in an immersion cell covered by water. If they are then exposed to a few seconds of short wave UV light from a distance of approximately 18 inches and the film is developed, the natural rubies, due the presence of iron oxides, will appear white, indicating that the short wave UV rays did not penetrate the stones. On the other hand, the flame fusion rubies, due to the migration of the iron oxides towards the skin of the boule during its formation, will appear dark with a white rim around their edges.

Examination of the surface of a flame fusion ruby under incident light will reveal fire marks along the facet junctions, resembling small cracks. These are caused by local overheating of the stone during the polishing process and are indicative of lab-created stones since less attention is paid when they are being polished.

The 'Plato Method' can also help in the identification of stones that exhibit no obvious inclusions or curved striae by isolating and referencing the optic axis using the conoscope and then viewing the stone under 20 to 30X while immersed in methylene iodide between crossed polars. Verneuil flame fusion rubies will often exhibit two sets of bands intersecting at 60-degrees proving their 'synthetic' origin.

Most natural rubies are weakly to moderately magnetic due to the presence of iron and chromium, while Verneuil flame fusion rubies are coloured solely by chromium and therefore exhibit very weak to no magnetic attraction.

In the event X-ray technology is available, natural and lab-created rubies will both fluoresce when exposed to X-rays, but only the latter will phosphoresce.

Czochralski Rubies

Since this method is aimed at producing crystals with technological applications, including the laser industry, the optical purity of the crystals is of the utmost importance. Therefore, the mere fact that the resulting gemstones are exceptionally clean should immediately make one suspicious.

Microscopically, one can expect to see fine curved growth lines, similar to Verneuil flame fusion rubies, gas bubbles, whitish smoke or rain-like wisps and black prismatic crystals. Since pulled crystals are grown at a much slower rate, anywhere from 7 to 15 days, there is no internal strain. This allows cutters to cut the material in a similar orientation to their natural counterparts.

Flux Melt Rubies

Like flame fusion and Czochralski produced gemstones, flux melt rubies have the same physical and optical properties as their natural counterparts. For the most part, identification relies almost entirely on the presence or absence of certain key characteristic internal features.

Chatham rubies are often found with whitish fingerprint or liquid feather inclusions, a net-like inclusion with dense and narrow meshes, disseminated platinum platelets, very small exsolved needles in zoned clouds and rounded transparent crystals of low relief believed to be chrysoberyl. In some cases a Burmese ruby seed crystal nuclei may be visible, and this can often lead to an incorrect diagnosis since the inclusions tend to indicate that the stone is natural and of Burmese origin.

Originally Ramaura rubies were doped to fluoresce with a yellow-orange fluorescence to aid in their identification. However, this can no longer be relied upon since in many cases the dopant migrated towards the edges of the crystal and was lost during the cutting process. Stones may contain orange-yellow to whitish flux inclusions, comet-like inclusions with tails and a directional heat-wave effect similar to natural Burmese rubies. Under short wave and long wave UV light, chalky-white and bluish-white zones are present.

Kashan rubies tend to look like rubies from Thailand but with inclusions that are not typical of stones from this region. These may include veil-like whitish to slight brownish flux, fog or cloud-like inclusions, rain or dot-like inclusions or comet tails that also resemble paint-splash or footprint inclusions. Often, iron oxide has been added to suppress fluorescence, affecting their transparency to UV light and their reaction under the Chelsea filter.

Knischka rubies often contain negative crystals terminating in long crystalline tubes, black distorted hexagonal platelets of platinum or silver and two-phase inclusions. They also exhibit a strong carmine-red fluorescence under UV light with no traces of chalkiness.

Introduced in early 1993 and produced by J & A Douros Created Gems of Piraeus, Greece, Douros rubies are characterized by colour zoning, growth planes, primary and secondary flux inclusions similar to Ramaura rubies and intense red cores that gradually decrease in saturation to a near-colourless outermost layer.

Hydrothermal Rubies

In early hydrothermal rubies, one can expect to see the Verneuil seed crystal when they are immersed in methylene iodide along with inclusions typical of the flame fusion seed crystal including curved striae, gas bubbles, and surface crazing.

In more recent hydrothermal rubies, although the finished stone has been cut to exclude the seed plate, one can still expect to see strong irregular striated and heavily roiled growth features often referred to as chevron, mosaic or zigzag patterns.

Zone Melt Rubies

Characterized by their high purity, most Seiko rubies will contain clouds of gas bubbles and swirled growth features, due to the rotation of the crystal in counter-opposite directions. These are more evident when immersed in methylene iodide and often resemble the heat wave or treacly effect seen in Burmese rubies or hessonite garnets. Rectilinear parting and secondary lamellar glide twinning along the rhombohedron faces may also be present with the twin planes intersecting at 87 or 93-degrees. Long white needles, thought to be boehmite, may also be visible at the junctions of the intersecting twinning planes; these are best viewed between crossed polars while the stone is immersed.

Composite Rubies

Ruby doublets are also likely to be encountered and invariably consist of a natural ruby crown, often with characteristic inclusions and a lab-created ruby pavilion. This makes the identification of these clever doublets extremely challenging. Since both halves will show dichroism and the R.I. reading will be indicative of ruby, the gemmologist must now concentrate on the area around the girdle or the upper pavilion to see if there are any join lines.

While this is not difficult to do, stones that are bezel set can be extremely challenging and should raise one's suspicions especially if the stone is free of inclusions. In this case, the gemmologist must concentrate not only on the nature of the inclusions but also how they are oriented within the stone since inclusions are typically oriented randomly throughout the entire stone rather than being confined to a particular plane.

Since the manufacture of composite stones is often quite crude, one can expect to see gas bubbles in the epoxy used to join the two pieces together and if the pavilion is made from flame fusion ruby, gas bubbles, and curved striae.

UV light can also be particularly helpful since it will invariably reveal abnormalities in the fluorescence between the crown and the pavilion.

Treated & Enhanced Rubies

Heat Treatment

The primary objective of heat treating ruby is to remove the bluish component caused by the presence of ferrous oxide (Fe^{2+}) that gives the stones a purplish colouration. This requires temperatures in the 700 to 1200 degree Celsius range in an oxidizing environment that changes the ferrous oxide to ferric oxide (Fe^{3+})*(Hughes)*.

Rubies are also routinely heat treated to improve their overall clarity through the partial or complete dissolution of the rutile needles (silk). This generally involves temperatures in the 1200 to 1800 degree Celsius range. To avoid re-crystallization of the silk, the stones are allowed to cool slowly.

Since unehanced Burmese and Mozambique rubies command higher prices, it is important to not only confirm the country of origin but whether or not the rubies have been heat treated. While the appearance of certain inclusions, such as rutile (silk) can help to identify heat-treated material, laboratories today rely on UV-Vis-NIR spectroscopy, which is capable of detecting heat treatment and other enhancements.

The chart below, based on GemGuide January/February 2017, shows the % difference between unenhanced Burmese rubies and non-origin heat treated rubies.

Lead-Glass Fracture Filling

Rubies filled with lead glass often have very low-relief fractures, gas bubbles, voids (unfilled areas) in fractures, a blue or orange flash effect, and in surface reaching cavities, join lines that are often evident when the stone is tilted in reflected light. This produces marked differences between the lustre of the glass and the ruby.

Flux Assisted Partial Fissure Healing (FAPFH)

Detection of FAPFH relies on the presence of undissolved flux, gas bubbles surrounded by solidified glass, the partial resorption of the rutile silk leaving white silk skeletons when viewed perpendicular to the c-axis, and surface pitting caused by the high heat and the use of acids to remove residual flux.

Quench-Crackling

Verneuil flame fusion quench-crackled rubies tend to be characterized by curved striae, gas bubbles, an absence of any naturally occurring mineral inclusions, the presence of odd checkerboard patterned fractures, and pronounced fluorescence under UV light.

Oiling

Rubies are routinely oiled with a special red ruby oil that is introduced into surface reaching unhealed fractures. Detection is possible by gently heating the stone (under a halogen microscope lamp or by using a hotpoint), which causes the stone to 'sweat'. The presence of coloured oils can be confirmed using a cotton swab. Bubbles may also be evident, trapped as the oil was introduced into the cracks, and sometimes, the oils will fluoresce under long wave UV light. A drop of acetone applied to the surface of an oiled stone will dissolve the oil.

The identity of the actual substance used to infiltrate the stone requires the use of sophisticated equipment such as an infrared spectrophotometer or micro Raman spectrophotometry.

Weight	Commercial	Good	Fine	Extra Fine
1.00 - 1.99ct	+ 209%	+ 244%	+ 258%	+ 307%
2.00 - 2.99ct	+ 259%	+ 386%	+ 323%	+ 309%
3.00 - 3.99ct	+ 381%	+ 250%	+ 480%	+ 295%

The Spice of Life

Coloured Gemstones

LEONE LANGESLAG is the CEO of the Dutch Gem Academy and owner of SoleLeone. She received her European Gemmologist (E.G.) diploma from the Federation for European Education in Gemmology (FEEG) in 2006.

Peri - WHAT?

Peridot is the lovely transparent yellow-green gemstone and the birthstone for August. Most people know this ancient gemstone as since it has been used in jewelry worldwide for many many years. The larger intensively coloured examples are fabulous and the intense hue of these great green gemstones can easily concur with demantoid garnet, tourmaline and even some emeralds.

History

This olive green gemstone is one of the oldest gemstones known with records dating back to 1500 BC. Peridot was first mined on the volcanic island of Zabargad (St. John), in the Red Sea over 3500 years ago. This island was originally named Topazios and peridot therefore was also known as ‘topaz’. Peridot was already found in jewels dating all the way back to the Pharaohs in Egypt. According to legends this green gemstone was also the most favourite gemstone of Cleopatra (first being thought of as emeralds). In this ancient period peridot was considered a spiritual stone as the Egyptian priests used the ground peridot to make a strong beverage that was drank during important ceremonies. Understandably they called period the gem of the sun!

It is believed that the name ‘Peridot’ originated from the Arabic word ‘faridat’, meaning ‘gem’ and sometimes was also referred to as chrysolite, derived from the Greek word ‘goldstone’ which is the historical name used to refer to several green to yellow-green coloured gemstones.

The ancient Romans called it ‘evening emerald’ since its color did not darken at night, but could still be appreciated by candlelight and the light of a campfire.

Gem Deposits

St. Johns Island was the most important deposit, which was exploited for a very long time and delivered many large and beautiful peridot. Since the beginning of the 20th Century, St. Johns seems to have been re-discovered and is still producing nice stones.

The gem often occurs in volcanic rocks called basalts and are formed deep within the mantle of the earth and brought to the surface by volcanic activity. It can also be found as water-worn rolled pebbles in alluvial deposits.

Today, the finest qualities of peridot are coming from Mogok in Burma, Pakistan and Vietnam. Other deposits are found in Arizona, Brazil, Kenya, Mexico, Norway, South Africa, Sri Lanka, Tanzania and Hawaii with China also recently becoming a large producer of peridot.

Out of Space

Peridot has also been discovered in fallen meteors and it has been discovered on Mars and the moon in olivine form.

Characteristics

Peridot is an iron magnesium silicate $((Mg,Fe)_2SiO_4)$ and the gem variety of the mineral forsterite, which is one of the end members of olivine. Olivine itself is actually not a mineral. Peridot belongs to the orthorhombic crystal system but well-formed crystals are very rare.

Peridot Brooch (Photo by Tino Hammid)

Peridot, Sapat, Pakistan (Photo by Jeff Scovil)

Colour

Peridot is an idiochromatic gem, which means its colour comes from the basic chemical composition, of the mineral itself. In fact, peridot is one of the few gemstones only available in one colour being green. The colour shades of green may vary from a brownish-green colour to a yellowish-green to pure green. It's lovely green colour looks best under natural daylight and no change of colour will occur in artificial light.

Iron is responsible for its attractive yellowish green colours, while more intense green colours are achieved as the iron content increases. The finest coloured peridot has an iron percentage of less than 15 % and these deep intense green tones are considered to be the most valuable peridot. Trace elements of nickel and chromium can also contribute to the intense green colour of this gemstone. The spectrum of peridot contains, as one can expect three bands in the blue portion of the spectrum due to the ferrous iron.

Clarity and Inclusions

In general peridot can occur with excellent transparency but larger stones may look slight cloudy due to inclusions and impurities. The so-called 'Lily-Pads', caused by flat stress cracks around a chromite crystal, are typical inclusions for peridot and of course evidence of authenticity. Other inclusions, which can be found are rectangular biotite crystals, minute fluid drops, mica flakes and natural glass (Hawaii).

Cut

Peridot is typically faceted due to its excellent transparency. Table and step cuts are very popular but peridot can also be found in many shapes including fancies and traditional rounds, ovals, emeralds (octagons) and cushions.

The largest cut peridot olivine is a 311.8 carat specimen in the Smithsonian Institution in Washington D.C.

Other properties

Periodot is a relative softer stone, rating 6.5 to 7 on the Moh's scale. Since peridot exhibits strong double refraction, it is generally an easy gemstone to identify. In some cases the doubling of lower facet edges can easily be seen through the table facet. Peridot does not fluorescence under UV light or X-rays which is due to the presence of iron.

It can be challenging to distinguish between peridot, sinhalite or diopside since they all have similar physical and optical properties. This often requires the determination of the optic sign to confirm identity. This can be determined by carefully measuring the refractive indices in different directions (rotating the stone 360 degrees) and noting which shadow edges move and to what extent. Sinhalite is biaxial negative and does show an extra band in the blue portion of the spectrum at 463 nm on spectroscope, while Diopside is biaxial positive. The optical sign of peridot is typically positive but can also be negative when excessive amounts of iron are present which makes it even a more fascinating exercise to determine.

Peridot can exhibit a magnetic response (using a N52 magnet) when it contains excessive amounts of iron.

Physical & Optical Property	Value
Refractive Index	1.650 – 1.703
Birefringence	.036 – .038
Dispersion	.020
Optic Character	Biaxial
Optic Sign	Positive *
Specific Gravity	3.28 – 3.48
Hardness	6 ½ – 7
Cleavage	Indistinct to Poor
Fracture	Conchoidal, Brittle
Lustre	Vitreous
Transparency	Transparent
Colour Streak	White

* The optical sign of peridot can change to negative if excessive amounts of iron are present.

Treatments and imitations

Peridot is not typically treated or enhanced in any way. However, some stones may have been oiled, waxed or resin-filled. Some paler stones might have been coated with green foil to enhance colour and can be used also to increase stability but due to the fact that peridot is widely available it is not typically a concern.

Peridot can be imitated by synthetic spinel or sapphire. At this moment no commercial synthesis of peridot is available as a gemstone but using the Czochralski Method, forsterite has been produced to imitate tanzanite and larger productions of chromium-containing synthetic forsterite are being commercially manufactured for technical equipment.

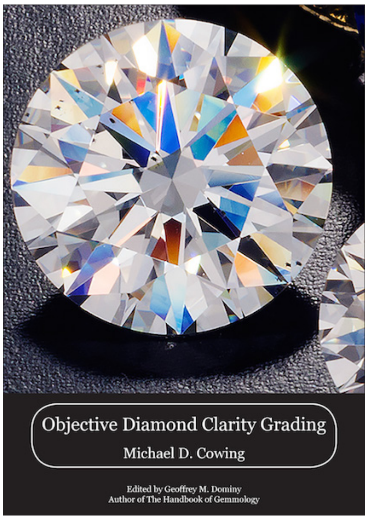
Overall natural peridot is one of the most appealing gemstones with a fabulous green colour and while some feel it is a 'summer' stone, it has the power to be a stone for all seasons.

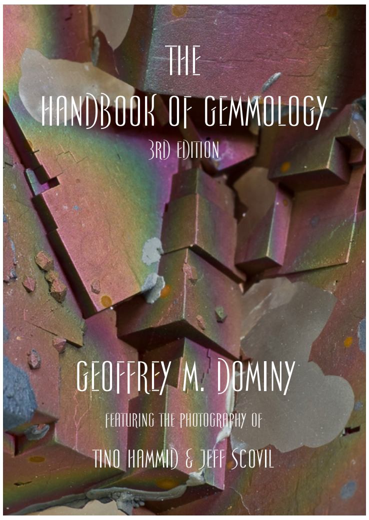
References

Handbook of Gemmology
Gemdat.org
Gemselect.com
Gem Testing Techniques
Gems & Gemmology

Burmese Peridot (Myanmar) (Photo by Tino Hammid)

Three Great Digital Publications





The main focus of Amazonas Gem Publications is to give authors of gemmological publications access to digital technology that allows them to market their work in new and innovative ways.

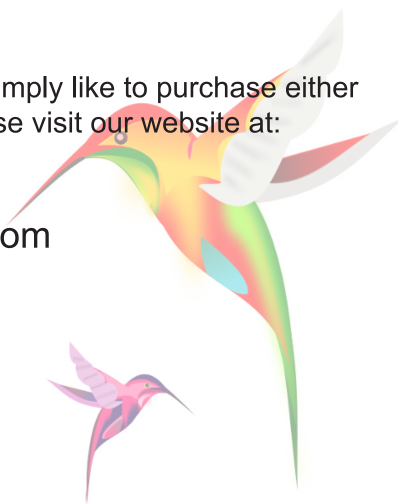
Unfortunately with traditional publishing houses, authors are often faced with restrictive policies that can in some cases cause them to lose control of the very product they created. Due to publishing economics, future editions are invariably decided not on the need to update important information but on profitability. This has, in the past and will undoubtedly in the future, prevent important works from being revised and essential information preserved in the pubic domain.

At Amazonas, we want to celebrate our authors, the creative process they have gone through, give them support and encouragement and most importantly create a viable platform that allows them to receive maximum exposure and maximum profitability.

Are we a traditional publishing house? Absolutely not! Why would we want to be? We are here to support our major stakeholders; our authors and those who support their work!

If you are an author and would like to learn more about us or you would simply like to purchase either Objective Diamond Clarity Grading or the Handbook of Gemmology, please visit our website at:

www.amazonasgempublications.com



Studying Gemmology with the World Gem Foundation

There's an expression 'different strokes for different folks' and this is certainly true in the case of gemmology. We are fortunate to work in an extremely diverse industry; one that provides unlimited opportunities in a broad range of disciplines.

Some people want to become a professional gemmologist; to forge a career for themselves working with gemstones. At the World Gem Foundation, gemmology is not just a job, it's a profession. This is why we opted for the 'Career Gemmologist' designation. We not only want to raise the level of consciousness with consumers but also within our industry. An awareness that gemmology is a science that demands a high level of theoretical knowledge and practical experience.

At the same token, we also understand that not everyone wants to become a fully fledged gemmologist. Many choose to specialise in a particular area, such as diamonds or coloured gemstones. Others decide to work in more defined areas such as the pearl, opal or jade sectors.

But what about gemmologists who may have completed their studies five, ten, fifteen or twenty years ago? Since gemmology is constantly evolving, it is important to continually upgrade your knowledge. You simply cannot afford to become complacent. One minute you may be 'up to speed', the next completely 'out of sync'. Each year brings new treatments and enhancements, new lab-created gemstones and new techniques to identify them. It is not the certificate that hangs on your wall that defines who you are as a gemmologist but the knowledge you possess. Our courses can be taken collectively or independent of each other, allowing our students to customise their own personal development programs based on their own specific needs.

Finally, there are many people who share a passion for gemstones but don't necessarily want to enrol in a gemmological program, they simply want to augment their existing knowledge and upgrade their level of understanding.

Regardless of your motivation to expand your knowledge, the World Gem Foundation has a variety of courses and programs that can help you reach your goal.

Career Gemmologist Program

For students wishing to pursue a career in gemmology, our 'Career Gemmologist' program has been especially designed to give you the knowledge and experience required to work as a professional gemmologist. The World Gem Foundation and our affiliated gem academies offer you two options to earn your Career Gemmologist Diploma with our Gemmology Seven/ Eleven programs.

Gemmology Seven

This option allows you to complete the entire theoretical requirements by enrolling in our Career Gemmology course (78 lessons) and completing the five practical workshops (Gem Identification #1, Gem Identification #2, Diamond Grading and Lab-created Diamonds, Coloured Gemstone Grading #1 and Lab-created and Treated Gems) and our 100 hour online Coloured Gemstone Grading course.

The theoretical component covers the chemical nature of gemstones, their physical and optical properties, basic crystallography, the absorption of light, the spectroscope, refraction and reflection, the refractometer, optical character and sign, dispersion, reflectivity meters, polarized light, the polariscope, pleochroism, the dichroscope, colour filters, specific gravity, luminescence, magnification and thermal conductivity.

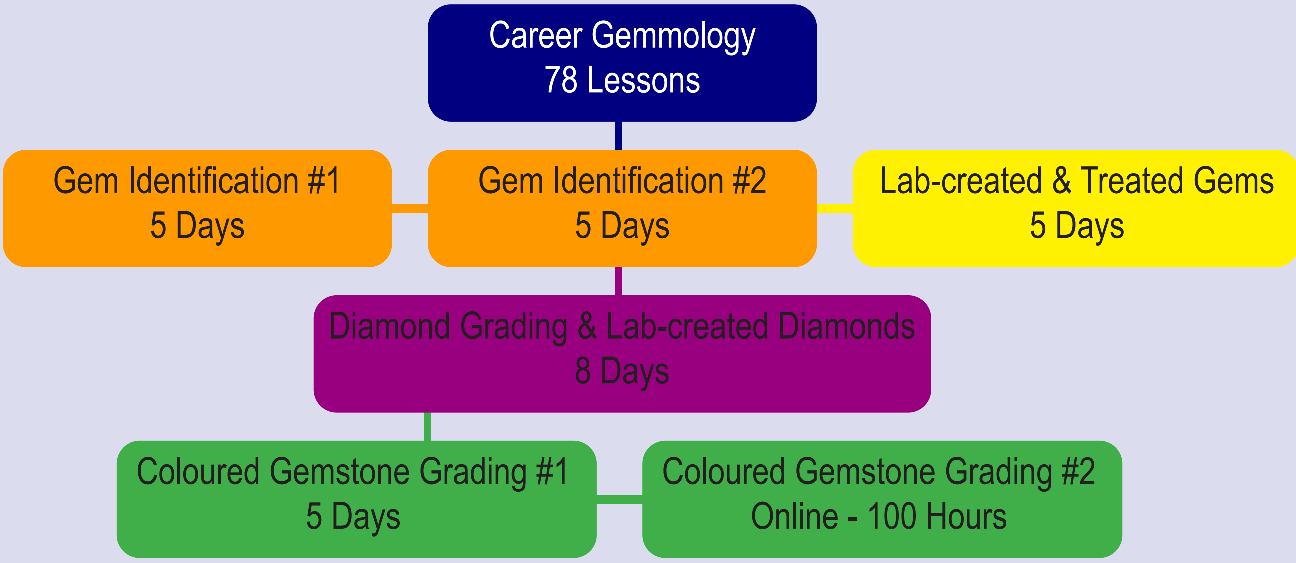
From there we move into the most challenging and fluid areas of gemmology; imitation and composite gemstones, lab-created gemstones and the treatment and enhancement of gems.

In the lessons pertaining to lab-created gemstones you will not only learn about the various methods used to manufacture lab-created gemstones (including Verneuil Flame-Fusion, Czochralski Pulling Method, Flux Melt Method, the Hydrothermal Method, Skull Crucible, Zone Melt, Horizontally Oriented Crystallization, the Sublimation Method, and the Modified Stober Method) but also the unique identifying features that allow us to separate them from their natural counterparts.

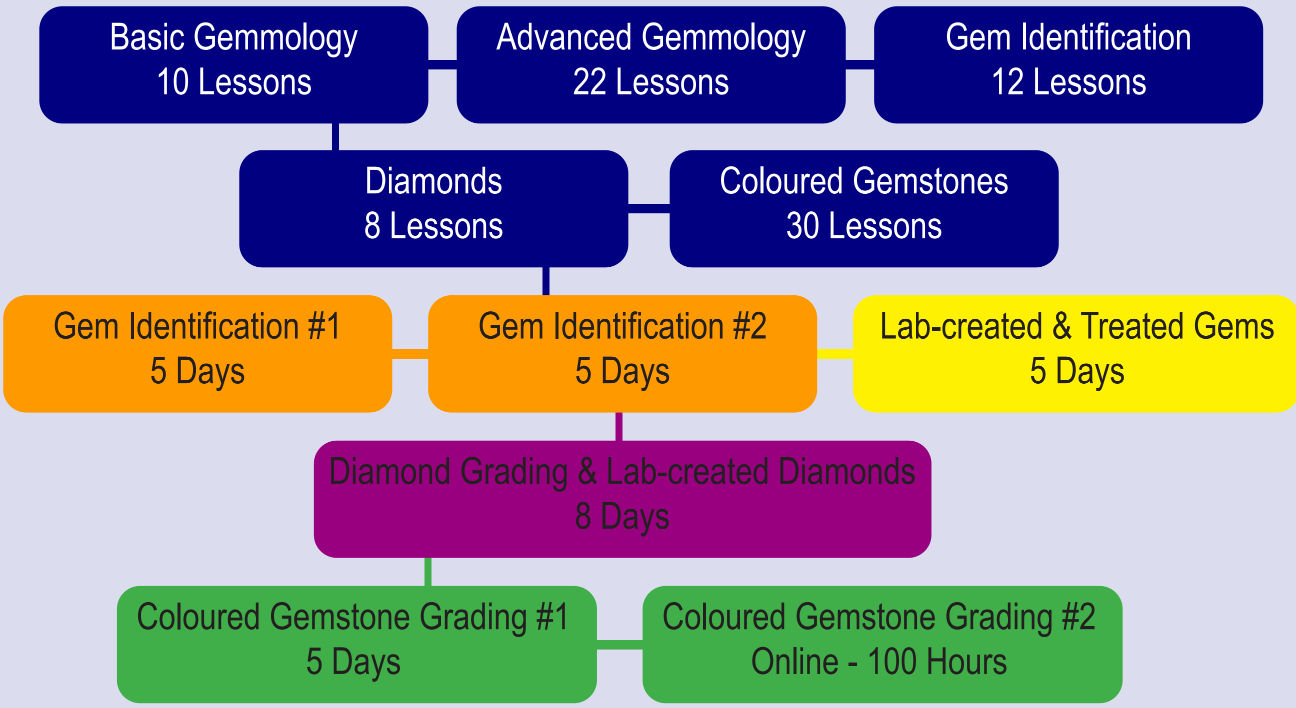
The use of treatments and enhancements is both demanding and depending on who you talk to, highly controversial. Here we look at not only the techniques used to treat and enhance gemstones (heat treatment, surface and sub-surface diffusion, lead glass fracture filling, flux assisted partial fissure healing, glass fracture filling, cobalt doped glass filled sapphires, clarity enhanced diamonds, HPHT, quench-crackling, surface modifications, coatings and foil backs, laser drilling and irradiation) but also how they can be detected. We also look at the advanced gem testing techniques that are often needed to identify many of these treatments.

The course then takes a slightly different direction, focusing on the identification of gemstones including the tests that are commonly used to identify them and an in-depth look at each of the ten gemstone groupings based on colour and transparency (colourless or white, red, pink, orange,

GEMMOLOGY SEVEN PROGRAM



GEMMOLOGY ELEVEN PROGRAM



yellow, blue, green, violet or purple, brown, black or grey). These lessons include the important varieties and species of gemstones that commonly occur within each colour grouping, how to distinguish gemstones that are commonly confused with each other (i.e. aquamarine and blue topaz, emerald and chrome green tourmaline, diamond and lab-created moissanite) or gemstones that have physical and optical properties that are similar (i.e amethyst quartz and purple scapolite) to each other. This section also includes gemstones that either exhibit optical phenomena (i.e. asterism or chatoyancy) or are unusual by nature.

The next section looks specifically at diamonds, their physical properties, geology, localities, principle mines, crystal system, chemical composition and classification. You will also find lessons dedicated to fancy coloured diamonds, the causes of colour, absorption spectra, inclusions, fluorescence, mining, gem identification, methods of synthesis (including HPHT, CVD, Detonation and Ultrasonic Cavitation), common treatments and enhancements and a comprehensive examination of the 4 C's (colour, clarity, cut and carat weight) and how they are measured and assessed. The lesson on 'Cut' compares some of the most important and recognized 'Cut' grading systems used today including those pioneered by the Gemological Institute of America (GIA), the American Gem Society (AGS), Hoge Raad voor Diamant (HRD), the International Gemological Institute (IGI), the European Gemological Laboratory (EGL) and the Accredited Gem Appraisers (AGA).

The final twenty-nine lessons (29) are devoted to coloured gemstones and covers their physical properties, geology, localities, crystal system, chemical composition and causes of colour, varieties, absorption spectra, pleochroism, inclusions, fluorescence, gem identification, synthesis, common treatments and enhancements, and care guidelines. Gemstones covered include corundum, beryl, chrysoberyl, spinel, zircon, topaz, tourmaline, peridot, quartz, garnet, tanzanite, lapis lazuli, turquoise, spodumene, feldspars, iolite, andalusite, diopside, apatite, and organic gems (pearls, coral, jet, ivory, and amber). You will also learn about the various colour grading systems currently used (GIA, Gemewizard, GemDialogue and the World of Color) including how to accurately describe colour based on hue, tone and saturation, the clarity classification of gemstones, how cut is assessed, opal, jadeite and pearl grading, and how weight is assessed in a 'mounted' stones.

The study of gemmology simply would not be complete without a comprehensive program of practical instruction. This involves five practical workshops (Gem Identification #1 & #2, Diamond Grading and Lab-created Diamonds, Lab-created and Treated Gems and Coloured Gemstone Grading #1) totalling twenty-eight days of in-class instruction and a 100 hour online Coloured Gemstone Grading course where you will work with the Gemewizard Colour Grading system.

Gemmology Eleven

While the information is the same, the theoretical portion of this program is divided into five free-standing courses (Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds and Coloured Gemstones). This option allows you to take each course separately giving you greater flexibility in terms of time and how you can pay for the courses.

Like the 'Gemmology Seven' program, there are five practical workshops and one 100 hour online course.

General Interest

For those interested in gemstones but not wishing to take either the Gemmology Seven or Eleven programs, all of our theory courses can be taken independently without prerequisites. In addition to the six courses (Career Gemmology, Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds and Coloured Gemstones), we also offer two other 'General Interest' courses (Opals and Jade and Organic Gems).

Opals and Jade

This course looks at two of the most fascinating and complex gemstones in the science of gemmology. The lessons on opal cover their physical and optical properties, their geology, localities, crystal system, chemical composition and classification, varieties, cause of colour, absorption spectra and pleochroism, inclusions, fluorescence, principal mines, opal mining in Australia, opal grading, synthesis of opal, gem identification, common treatments and enhancements, opal doublets and triplets, cleaning and care and pricing.

The section on jade follows a similar format with lessons covering their physical and optical properties, their geology, localities, crystal system, chemical composition, absorption spectra and pleochroism, inclusions, fluorescence, mining, principal mines, evaluating the rough, jadeite cutting, jadeite nomenclature, grading jadeite, synthesis of jadeite, gem identification, common treatments and enhancements, cleaning and care and pricing.

Organic Gems

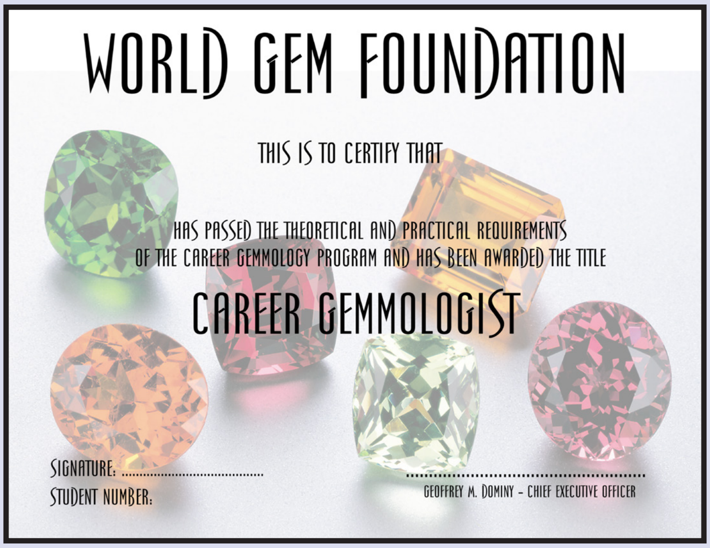
This course explores a very select group of gemstones (coral, jet, amber, ivory and pearls), formed through organic processes rather than through geological forces deep within the earth's surface. Lessons cover their physical and optical properties, geological formation, crystal systems, chemical composition, varieties and classification, causes of colour, common inclusions and internal characteristics, fluorescence, pearl grading criteria, methods of synthesis, gem identification, common treatments and enhancements, and cleaning and care instructions.

Individual Course Pricelist 2017

	Digital Option			Print Option		
Course Name	Euros	Pounds Sterling	USD	Euros	Pounds Sterling	USD
Basic Gemmology	200	150	225	235	180	265
Advanced Gemmology	400	300	450	430	325	485
Gem Identification	225	175	250	255	200	285
Diamonds	225	175	250	255	200	285
Coloured Gemstones	500	400	550	565	450	625
Career Gemmology	1400	1100	1600	1570	1235	1795
Opals and Jade	75	60	85	95	75	110
Organic Gems	50	40	55	65	50	75

Practical Workshops & Examination Fees

Course Name	Euros	Pounds Sterling	USD
Gem Identification #1 - Practical	500	400	550
Gem Identification #2 - Practical	500	400	550
Coloured Gemstone Grading #1 - Practical	500	400	550
Coloured Gemstone Grading #2 (Online)	1000	800	1150
Diamond Grading/Lab-created Diamonds - Practical	1750	1400	2000
Lab-created & Treated Gems - Practical	500	400	550
Examinations Fees (Gem Identification & Final Exam)	350	275	395



Fees charged by the individual gem academies are charged in the prevailing currency for that particular area (i.e. Euros in Europe, Pounds Sterling in Britain). Please note that shipping charges apply to any courses provided in print.

For more information please visit our website at www.worldgemfoundation.com

Career Gemmology
Practical Workshops

Diamond Grading & Lab-created Diamonds (8 Days)

This workshop includes practical instruction on how to clarity and colour grade diamonds, techniques to determine table percentage, crown angle, girdle thickness and pavilion depth percentage, how to access polish and symmetry and the identification of lab-created diamonds.

Coloured Gemstone Grading #1 (5 Days)

This workshop includes practical instruction on how to access the hue, tone and saturation of coloured gemstones and how to grade pearls, jadeite and opals. During this practical class three colour grading systems; GIA, GemDialogue and World of Color will be discussed.

Coloured Gemstone Grading #2 (100 Hours Online)

This online coloured gemstone course consists of a comprehensive overview of the GemeWizard Colour Grading System and includes practical exercises that are completed online and a six month subscription to their program.

Gemstone Identification #1 (5 Days)

This workshop covers the identification of red, pink, orange, yellow and green gemstones plus a section on crystallography.

Gemstone Identification #2 (5 Days)

This workshop covers the identification of blue, violet/purple, brown, black and phenomenal/unusual stones.

Lab-created and Treated Gemstones (5 Days)

This workshop focuses on coloured gemstones produced synthetically or treated to improve their appearance.

Sessions

Classes run from 9.00am to 12.30pm and 1.30pm to 4.30pm with scheduled coffee/tea breaks of 15 minutes. Students are required to supply their own 10X loupe and polishing cloth. All other equipment will be provided by the 'Host' Gem Academy.

Please Note: To complete the 'Career Gemmology' program and receive the diploma, students must complete the 'Career Gemmology' theory course or the five component theory courses (Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds and Coloured Gemstones) plus all of the aforementioned practical workshops, the online Coloured Gemstone Grading course and the applicable examinations.

The World Gem Foundation and the Instituto Gemológico Español (IGE) are delighted to present noted gemmologist Dr. Laurent Massi.

New major ruby sources from East-Africa: How those discoveries have deeply impacted the ruby industry?

Following the discovery of the first ruby deposit in Niassa province (Northern Mozambique) at the end of 2008, a second and even more promising deposit was discovered in the Cabo Delgado province, close to the city of Montepuez. These discoveries, which occurred within a short period of time, led to huge quantities of rubies of different qualities pouring into gem markets. As a result, and for the first time in 20 years, the most common rubies in the Thai market were not from Burma but rather from East Africa (Mozambique). During this presentation the nature of these rubies and the impact of these new discoveries on the ruby trade as a whole will be reviewed and discussed.

About the Speaker:

Dr. Laurent Massi had completed his PhD studies on “Atomic-scale Defects in Brown and Hydrogen-rich Diamonds” at Nantes University’s Department of Physics in France. During his studies in Nantes he also taught gemology in Paris at the French National Gemological Institute (ING). Dr. Massi subsequently taught gemology and gave presentations at conferences in numerous countries, including Canada, USA, Sri Lanka, France, Vietnam, Taiwan, Malaysia and Thailand. During his career he has also had the opportunity to publish a variety of scientific and educational articles on color-change corundum, hydrogen- and CO2-related optical centers in diamond, chameleon diamonds, clinohumite, color-change bastnäsite and on a new gem mineral: hibonite, one of the rarest gems on Earth. Dr. Massi was the Director of the Asian Institute of Gemological Sciences (AIGS) Gem Laboratory in Bangkok. He subsequently completed his Graduate Gemologist (GG) studies at the Gemological Institute of America (GIA) headquarters in Carlsbad, USA. He then became the Director of the new GIA Thailand Campus located in Bangkok. Dr. Massi is now a professional gemological consultant and lecturer at Laurent Massi Consulting (LMC).

Date: September 11th, 2017

Time: 7pm

Location: Instituto Gemológico Español,
C/ Alenza nº 1 28003 Madrid

WORLD GEM FOUNDATION

Admission is FREE but please contact us at:
information@worldgemfoundation.com
to reserve your place

INSTITUTO GEMOLÓGICO ESPAÑOL
I G E

WORLD GEM FOUNDATION WORKSHOPS

For 2017, The World Gem Foundation has developed four one-day workshops and one four-day workshop that are designed to appeal to not only those who are new to our industry but also to 'seasoned' professionals. These fast-paced sessions cover a wide range of topics ranging from the complexities of grading both diamonds and coloured gemstones, to three coloured gemstones (rubies, sapphires and emeralds) that individually and collectively are the cornerstones of the coloured gemstone trade, to an area that is perhaps the most fluid and challenging (gemstone enhancements and treatments) and finally to a complete overview of the twelve primary gemstones that are typically sold in the trade.

Where and When?

The workshops will be offered in the United Kingdom, Holland, Spain, France, Germany & Sweden. The cost of each workshop is £ 100 (United Kingdom) or € 125 (Holland, Spain, Sweden, France or Germany).

Join our 'Gemnastics' four-day gemmological workout in Mallorca (September 28th to October 1st, 2017) or in London (November 6th to 9th, 2017). The cost is € 500 (Mallorca) or £ 400 (London).

For more information, please see the individual course profiles on the opposite page.

World Gem Foundation Tuition Credits

If you would like to learn more about gemstones and the science of gemmology, we would like to help. If you enrol in any of these one-day workshops or our four-day gemnastics program, you will receive a 'tuition credit' equal to the value of the workshop towards the cost of any of our 'Career Gemmology' theory component courses (Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds, Coloured Gemstones) or our complete 'Career Gemmology' program.

There has never been a better time to explore gemmology......

DIAMOND & COLOURED GEMSTONE GRADING

This one day workshop will give you a thorough understanding of the grading techniques used to assess the quality of both diamonds and coloured gemstones. Topics covered include the 4 C's (colour, clarity, cut and carat weight), how they are measured and assessed, how to describe the colour of a coloured gemstone, the various colour grading systems currently used by professionals, the clarity classification of coloured gemstones based on their geological environments, and how cut is assessed.

Designed for those with some previous jewellery or gemmological knowledge, such as jewellers, goldsmiths, gemmological students and those who are engaged in the wholesale trade.

Upcoming Dates for 2018
To Be Announced

RUBIES, SAPPHIRES & EMERALDS

This one-day course covers three of the most important coloured stones; ruby, sapphire and emerald. Topics covered include an overview of their physical and optical properties, principal sources, basic testing methods, how they are produced synthetically, common treatments and enhancements, care guidelines, how they are valued and helpful buying tips.

Designed for those with some previous jewellery or gemmological knowledge, such as jewellers, goldsmiths, gemmological students and those who are engaged in the wholesale trade.

Sept 1st, 2017 London, England
Oct 25th, 2017 Munich, Germany

GEMSTONE ENHANCEMENTS & TREATMENTS

This one-day course covers one of the most fluid and challenging areas of gemmology; the enhancement and treatment of gemstones. Topics covered include heat treatment, surface and sub-surface diffusion, lead glass fracture filling, flux assisted partial fissure healing, glass fracture filling, cobalt doped glass filled sapphires, clarity enhanced diamonds, HPHT, quench-crackling, surface modifications, coatings and foil backs, laser drilling, and irradiation.

Designed for those with advanced gemmological knowledge who deal on a day to day basis with gemstones either at the wholesale or retail level or in the manufacturing process.

Sept 2nd, 2017 London, England
Sept 11th, 2017 Laren, Holland
Oct 26th, 2017 Munich, Germany

BIRTHSTONES OF THE MONTH

This fast paced workshop covers the twelve primary 'Birthstones' (garnet, amethyst quartz, aquamarine, diamond, emerald, pearl, ruby, peridot, sapphire, opal, topaz and zircon) and gives a general overview of their primary sources, how they are valued, helpful buying tips, how to care for them, common treatments and enhancements and basic testing methods.

An entry level course but will also appeal to jewellers and goldsmiths who would like to know more about the stones they are selling or using in the manufacturing process.

Nov 6th, 2017 Laren, Holland

The cost of our one-day workshops is £ 100 (United Kingdom) or € 125 (Holland, Spain, Sweden, France or Germany).

Upon registration, you will receive a tuition credit equal to the cost of the workshop that you can apply to the cost of any of our theory courses.

To register, please click here

ALLORCA

Sea, Sun, Sand and Gemmology

To Reserve Your Place

Click Here

GEMnastics

A four day gemmological workout

The Spanish Gem Academy is pleased to offer our four-day workshop in Mallorca on September 28th, 29th, 30th & October 1st, 2017.

This four-day workshop covers a variety of subjects ranging from how diamonds and coloured gemstones are graded, the twelve primary gemstones used in the trade to the fluid and challenging area of gemstone enhancements and treatments.

The workshop starts with the grading techniques used to assess the quality of both diamonds and coloured gemstones. Topics covered include the 4 C's (colour, clarity, cut and carat weight), how they are measured and assessed, how to describe the colour of a coloured gemstone, the various colour grading systems currently used by professionals, the clarity classification of coloured gemstones based on their geological environments, and how cut is assessed.

From there, we move onto the twelve primary 'Birthstones' (garnet, amethyst quartz, aquamarine, diamond, emerald, pearl, ruby, peridot, sapphire, opal, topaz and zircon) giving an overview of their physical and optical properties, principal sources, how they are produced synthetically, how they are valued, helpful buying tips and basic testing methods.

The workshop concludes with a complete overview of the enhancement and treatment of gemstones. Topics covered include heat treatment, surface and sub-surface diffusion, lead glass fracture filling, flux assisted partial fissure healing, glass fracture filling, cobalt doped glass filled sapphires, clarity enhanced diamonds, HPHT, quench-crackling, surface modifications, coatings and foil backs, laser drilling, and irradiation.

The total cost is € 500 (including lunch)

TUITION CREDIT

All participants will receive a € 500 tuition credit towards the World Gem Foundation's Career Gemmology Course or any of the five component courses (Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds or Coloured Gemstones)

A wealth of knowledge for a fraction of the price......

LONDON CALLING

To Reserve Your Place

Click Here

GEMnastics

A four day gemmological workout

The British Gem Academy is pleased to offer our four-day workshop in London on November 6th to November 9th, 2017.

This four-day workshop covers a variety of subjects ranging from how diamonds and coloured gemstones are graded, the twelve primary gemstones used in the trade to the fluid and challenging area of gemstone enhancements and treatments.

The workshop starts with the grading techniques used to assess the quality of both diamonds and coloured gemstones. Topics covered include the 4 C's (colour, clarity, cut and carat weight), how they are measured and assessed, how to describe the colour of a coloured gemstone, the various colour grading systems currently used by professionals, the clarity classification of coloured gemstones based on their geological environments, and how cut is assessed.

From there, we move onto the twelve primary 'Birthstones' (garnet, amethyst quartz, aquamarine, diamond, emerald, pearl, ruby, peridot, sapphire, opal, topaz and zircon) giving an overview of their physical and optical properties, principal sources, how they are produced synthetically, how they are valued, helpful buying tips and basic testing methods.

The workshop concludes with a complete overview of the enhancement and treatment of gemstones. Topics covered include heat treatment, surface and sub-surface diffusion, lead glass fracture filling, flux assisted partial fissure healing, glass fracture filling, cobalt doped glass filled sapphires, clarity enhanced diamonds, HPHT, quench-crackling, surface modifications, coatings and foil backs, laser drilling, and irradiation.

TUITION CREDIT

The total cost is £ 400 (including lunch)

All participants will receive a £ 400 tuition credit towards the World Gem Foundation's Career Gemmology Course or any of the five component courses (Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds or Coloured Gemstones)

A wealth of knowledge for a fraction of the price......

DEBORAH MAZZA studied gemmology at the DGemG (Germany), completed her FGA, and later her Diamond Diploma also through the DGemG and the Certificate of Appraisal Theory through the National Association of Jewellers

Any Old Iron....

Dauvit Alexander (Photo by Simon Murphy)

'What we call disorder and ruin, others, younger than us, experience as natural, and perhaps they will have the ingenuity to dominate it precisely because they are no longer seeking their points of reference where we took ours.'

Maurice Merleau-Ponty

Dauvit Alexander, or as he calls himself 'The Justified Sinner', trained as a gardener and taught himself to be first a jeweller, and more recently a metalsmith, establishing a new understanding of jewellery as ornament, and is transforming the way we regard jewellery today. He collects old pieces of metal and scrap from abandoned industrial buildings, rusted bolts or corroded washers, old unused sewing machine needles, and uses them combined with precious metals and gemstones for his pieces. The items he finds are all ready-made items, or found items as he calls them, discarded by our consumerist society where obsolescence rules and newer shinier models replace the old.

He says of himself: *'Rusty bolts lie by the side of the road. A coffee jar filled with corroded spring washers sits on the windowsill of a disused engineering works. Someone throws a cast-iron fencing spike into a skip. A piece of pitted steel washes up on the beach. These are not the images normally associated with the worlds of either commercial or art jewellery but they are the sources of the material for most of my work. Combining these materials especially corroded steel and iron with precious metals and gemstones, using the skills of the traditional fine jeweller, I aim to make pieces which are aesthetically pleasing, technically interesting and, if possible, humorous: if they happen to be not just a little unsettling or disturbing, so much the better.'*

The finished pieces of jewellery hark back to the Renaissance period, they are allegorical and worthy of an alchemist, a combination of skill and material where he combines precious with worthless in a celebration of colour and shape, they seem paradoxically quite un-wearable, reminiscent of medieval torture devices, sacrificing the comfort but supporting his ethos. Dauvit Alexander creates men's jewellery in a contemporary society that prefers delicate and fine objects with brand names, such as those flaunted by celebrities; jewellery that wouldn't have been out of place on men in the Renaissance.

The materiality of his creations and his love of iron, especially when corroded and rusty, reminds one of the constant changes in life and nature. The challenges he faces working iron, (iron is a cast metal and thereby not malleable as precious metals are), into the desired object when combined with precious metal and gemstones reflects the constant entropy found in natural environments; the temporal perception is then affected by the signs of the making processes between the hand-made and the ready-made, such as degrees of refinement and the inherent limitations found in different materials. Materials are transformed into an aesthetic experience, first expressed by Dauvit as the artist in the creation process, and then received by the viewer/wearer of his objects via thoughts and feelings inspired by the artwork.

Dauvit Alexander states that his work is rooted in the past, but he creates pieces that last into the future as it is important to him that the work is well made and durable; craftsmanship is quite often disregarded from discourses on contemporary jewellery and some art in general and: *'My work is about memory and place and it is really important that the work I make is worn with significance for the wearer: that is part of the reason that I make work which is impossible to ignore. The work gains significance and becomes a bridge between the past, present and future and the jewellery is a tool for memory and feelings.'*

Many of his pieces have an allegorical meaning, or a special narrative, either in the materials used or in their name, which evoke special feelings, associations and memories in the wearer. The narrative is then generated either in the process of finding the separate items and creating the piece, or Dauvit is inspired by something that triggers a need from within him to tell a story about the piece.

The piece called 'The Mysterious Adventure of Lady Stevens', - formed by found and corroded steel objects, silver, porcelain, glass, a found lens, titanium, brass, garnets, gold, included quartz, cubic zirconia and acrylic enamels – and was inspired by a 'faux-coral' from his associate Lisa Stevens, which suggested undersea exploration. The Jules Verne style bathysphere is a locket, which can be opened, allowing the coral to be worn as a ring. Additionally the chain element can be removed and worn as a brooch, or the brooch can replace the ring in the inside of the locket. This piece inspired the artist to write a short story about it.

The 'Three Post-Apocalyptic Cocktail Rings', - found rusted steel conduit, silver, citrine, garnets, topaz tourmaline, peridot and amethyst -, were the artist's first work in corroded steel and the first experiments with this material, and they became a set. The story behind the pieces title originates from where he found the conduit, in a derelict garage in Dennistoun, lying next to broken glass, a discarded champagne bottle and a muddy feather boa, he says 'the post-apocalyptic cocktail party to which I had not been invited…'

After this, the inspiration came to create The Four Cocktail Rings of the Apocalypse, each one dedicated to the biblical riders.

In his search for new materials, he was also inspired to create a watch, called 'Alice Watch', made from the petrol cap of a 1950's tow-truck, a large steel washer, a corroded door key, silver, 9 ct gold, copper, a corroded ball bearing, gemstones and engraved with quotations and images from the book Alice in Wonderland by Lewis Carroll. It can be worn on the wrist with a leather strap or can be transformed into a pocket watch, cleverly reminding one of the White Rabbit character who always looked at his watch, afraid of the time fleeting by him as he is engrossed in other aspects of his life.

Dauvit says:

'Decay is part of a natural process. I have no problem with the fact that the work will wear away as it is worn, that the iron elements - already partially corroded - will corrode more. That is the history of the piece. I enjoy seeing work that has been repaired and I like the idea that some of the construction of my work has the sort of ad-hoc quality of much-repaired (thus much-worn and much-loved) jewellery.

In terms of new technologies, I am fascinated by blurring the distinction between super-high-tech objects and hand-made and found objects, by combining them to create something in which the role of the machine is visible but it is unclear where it begins and ends. This can be achieved by a variety of processes, including working into the objects, deliberately patinating and corroding the materials and combining the high-tech objects with hand-made facsimiles.'

Dauvit Alexander creates contemporary jewellery that reminds one of the past, but is avant-garde in its making and style, reflecting all the problems of our modern society. One could argue that he uses ready-mades like Duchamp's 'Fountain' (1917), but in reality he calls them found materials and they aren't different to various findings purchasable from any bullion merchant for jewellery making, the difference is in the way they are used. He says the 'object-ness' is important to him but not a priority, because the history of the material, the colour, the texture and the materiality are as important as the form they gain in in the whole finished composition. He might change the form of the found object a little but never the surface, beyond maybe removing any loose material for practical reasons.

Jewellery is for many a commodity, and many expect it to be perfect with beautiful flawless surfaces, unblemished components that can be gemstones or metals, like an expensive car both are symbols of wealth and success. Jewellery is one of the earliest known man made objects; it has always fulfilled a particular psychological, talismanic and symbolic need within us. Jewellery should be worn as an

Atavism

The Mysterious Adventure of Lady Stevens

Three Post-Apocalyptic Cocktail Rings

Alice Watch

Alice Watch

The Four Cocktail Rings of the Apocalypse

Ko Si Iruufen

Fashion: Victim - In Memoriam Alexander McQueen 2

Iron Filings

Blue Sunset on The Grey Lagoon

expression of one's self, not kept hidden away for fear of losing it; it is alive and not dead, and the textures found in Dauvit Alexander's pieces exemplify this through an almost organic and living surface. He says that his work has significance to the wearer, not exploited or corrupted by commercial capitalistic pressures, 'People have been sold the idea of need and over time this has overwritten the actual need but has not removed it. I hope that my work helps reconnect people with their psychological need to decorate themselves in a significant manner.'

Dauvit has only recently started exploring the possibilities with these found materials at his disposal, and how he can express his ideas. Lenses fascinate him, they can magnify, and possibly distort reality, they bend light and we see a different world through them that is usually never seen. When he finds old disused lenses he incorporates them into his work wherever the inspiration leads him; they can be found in some pieces such as 'The Mysterious Adventure of Lady Stevens'.

'Ko Si Iruufen' is formed of porcelain pipe-stems found on the shores of the river Thames in London, silver, sapphires, spinels and garnets. The artist went 'mudlarking' some years back at London's Docklands, and was drawn to the many pipe stems he found, just like the 'fag-ends' of the day. These stems were the tobacco pipes of the late 17th to 19th century and were sold ready filled with a plug of tobacco. They could have been re-used but this was the birth of industrialisation and of our modern 'throw-away' society, and it was easier to buy a new one for pennies. What fascinates him is the real connection to the past these pipes have, that someone has actually drawn a breath through them; Dauvit Alexander was determined not to use them like beads like many other jewellers did before, but wanted to use their hollow form, the colour and the sound they make when clashing against each other like some 'demented wind chime'. The name of the piece derives from some African tribal heads as seen in the Museum of London.

Dauvit Alexander creates for personal adornment and use; he picks up things from another time and aims to freeze time in order to catch a particular moment, he repairs objects trying to hold back time.

In the future Dauvit plans to collaborate with musicians creating works of a musical nature; using improvisation like some jazz musicians, taking the object and working outwards from it, as it grows adding metal elements in response to the object's demands without any intermediate drawings or planning, going where his inspiration leads him. The final piece will be a harmonic and structural whole, further exploring his unique style and love of metal.

Author's Note: I would like to thank Dauvit Alexander for his help and patience in answering my questions for this article.

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Photographic Credits: Dauvit Alexander & Simon Murphy

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Diamond Design and Light Performance

Figure 1. Ideally proportioned round brilliant with hearts and arrows optical symmetry displaying its superior brilliance and fire.

Figure 2. Another example of a beautiful round brilliant possessing hearts and arrows optical symmetry and displaying brilliance and fire in different lighting.

Introduction

The brilliant cut diamond evolved over several hundred years of diamond cutting. This style of cut stands above all others in popularity for one principal reason. When fashioned with the best angles and proportions, the round brilliant displays the finest of the attributes of diamond beauty, brilliance (aspects of brightness and contrast), fire (rainbow colours of dispersion) and scintillation (sparkle with movement). See Figures 1 and 2.

A brilliant cut diamond's appearance is a kaleidoscopic pattern of internal reflections of surrounding light sources mirrored from the diamonds pavilion facets. Light is broken up upon refracting into the diamond's crown facets (Figure 3a). Light is further divided as it reflects twice from pavilion facets (Figures 3b and 3c), and it then refracts back through the crown facets (Figure 3d) to the observer's eyes. In the best cut round brilliant about 90% or more of the diamond's brilliance comes to our eyes having followed this path of refraction and double reflection from light source, into, through and out of the diamond to the observer.

Shown in the face-up position and tilted in Figure 4a is a wire frame model of the arrangement of the 57 facets making up the round brilliant cut diamond. Shown in Figure 4b is a wire-frame pattern of 'virtual facets' resulting from the breakup and division of light by double internal reflection from the pavilion facets. The pattern of virtual facets was so named, because they give a gemstone the appearance of having a lot more facets than are actually present. Figure 4c is a photorealistic computer rendering of round brilliant light performance displaying brilliance and fire emanating from these virtual facets. Each virtual facet exhibits bright to dark brilliance or spectral fire dependent on its orientation to surrounding sources of light, and the properties of those light sources.

The pattern of virtual facets changes with each movement of the diamond or the observer. At any moment in time the arrangement of diamond and viewer results in a unique reflection pattern such as the one seen in Figures 3b and 3c where the view is looking at the diamond face-up, perpendicular to the table.

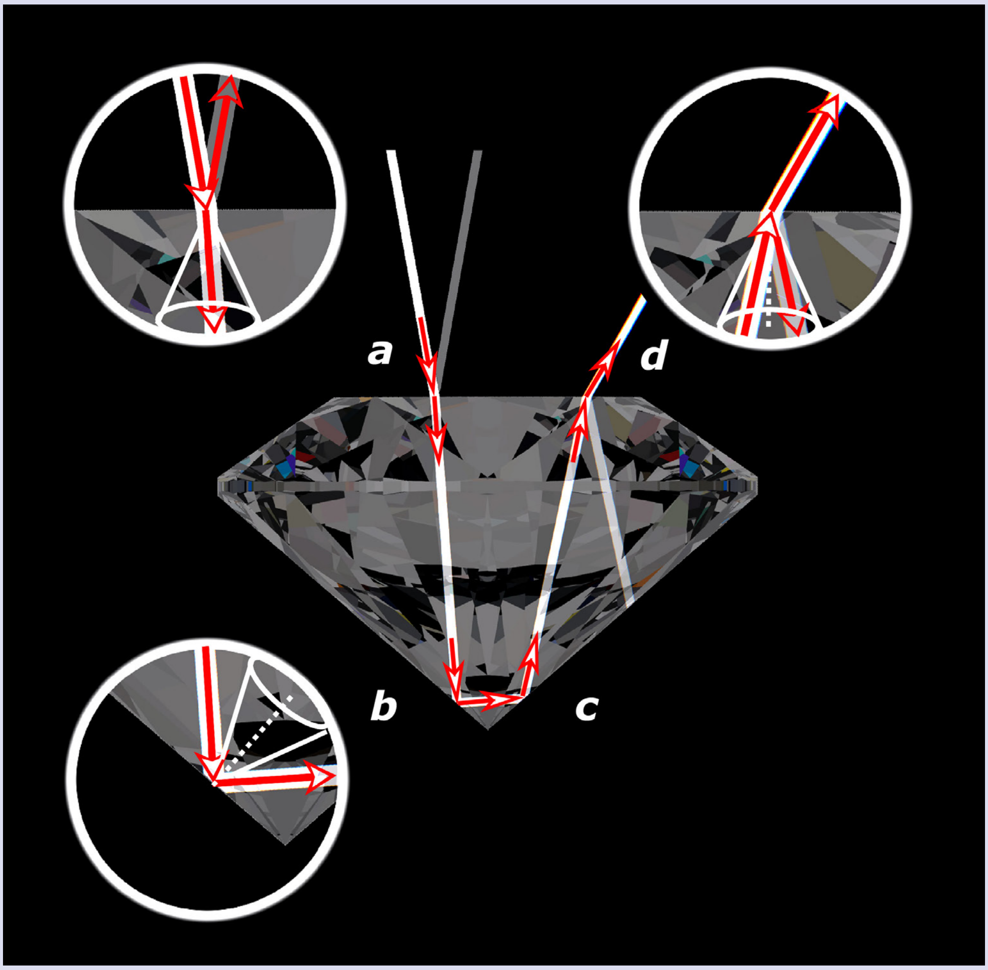

Figure 3. Typical light ray interaction in a round brilliant cut diamond.

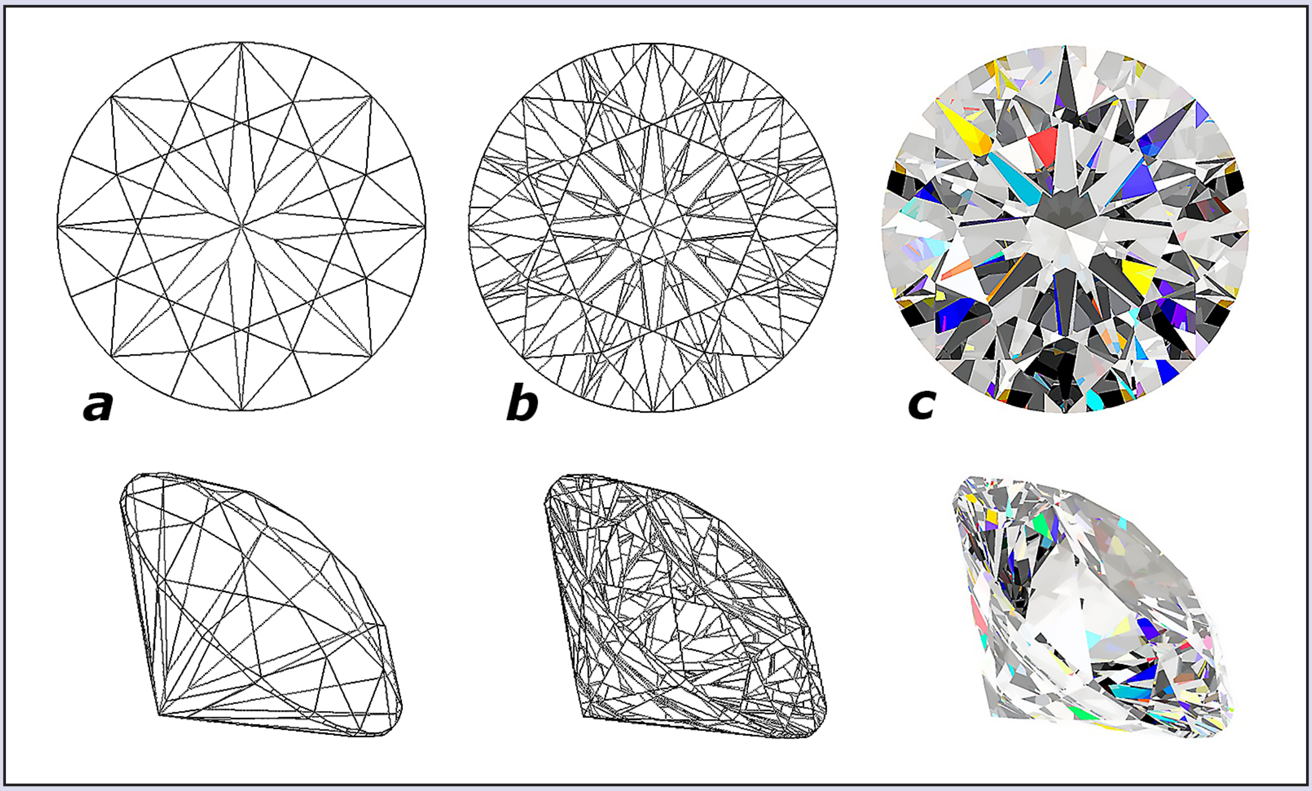

Figure 4. Face-up and tilted views of round brilliant. a. Wire frame of the diamonds 57 facets.
b. Wire frame of 'virtual facets' resulting from double reflection from the pavilion.
c. Photo realistic computer rendering of round brilliant displaying brilliance and fire.

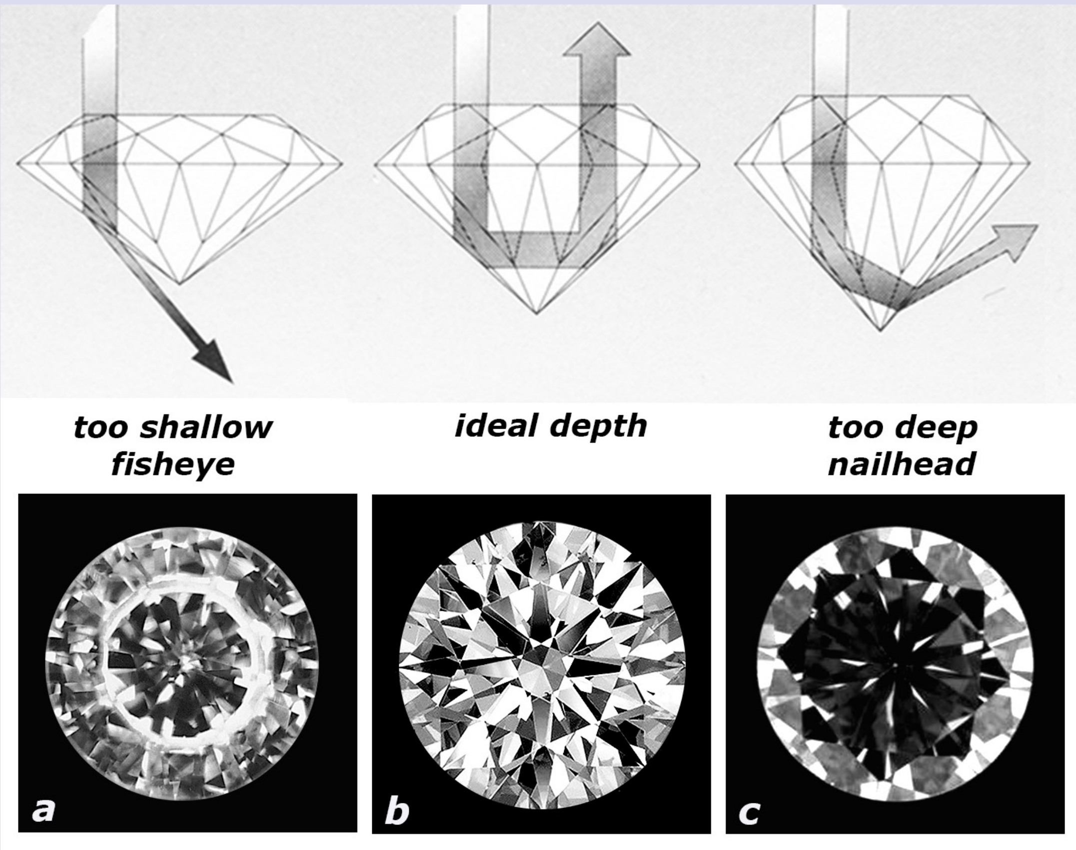

Figure 5. Typical ray trace diagrams to explain the appearance of a. Fish-eye diamond displaying the fish-eye like whitish ring just inside the diamond's table. b. Ideal cut diamond displaying an even distribution of brilliance (both brightness and contrast.) c. Nail head diamond displaying dark star facets and a characteristically dark table.

What we discover through ray tracing is that each virtual facet reflects light to the observer's eye primarily from one point in the diamond's surroundings. If bright light exists at that point and direction, that virtual facet will be bright, if not it will be dark. There can be light all around that point but that virtual facet will remain dark until the diamond is moved and that point moves to coincide with a source of light.

Diamond Light Performance Analysis Through Ray Tracing

For more than a century ray tracing has been an important method used to analyze diamond optics and to explain diamond light performance. Today, computer software systems like Octonus's DiamCalc not only automate ray tracing, they also provide photorealistic renderings of a diamond's light performance. Diamond photography is another valuable tool for studying diamond optics. Both DiamCalc and photography are the essential tools used throughout this work.

Ray tracing is a technique used in the field of optics to analyze paths of light in any optical system. To analyze a diamond's light performance, rays of light are traced into, through and out of a model of the diamond, as in Figure 3, using its properties of reflection and refraction.

Most everyone learning about diamonds and their cutting has seen ray tracing like that shown in Figure 5. For more than 80 years these ray trace diagrams have been used to graphically explain to the consumer the superior light performance of the ideal round brilliant cut and the two examples of poor diamond cutting, the fish-eye and nail head.

It will surprise many to learn that the ray trace diagrams in Figure 5, which explain some aspects of light performance in gemstones with refractive indexes much lower than diamond, are inadequate, and do not explain the light performance in all three of these diamond cut examples. Shown in the work that follows is a unique way to use 3-dimensional ray tracing to test these conventional explanations.

The unique method used is 'reverse ray tracing'. Employing this analytical technique will show that the ray tracing diagrams in Figure 6 are the explanations for the light performance resulting in the appearance of these three diamond cut examples. Note that the directional arrows indicate light traveling from its source to the viewer's eye. To discover these ray paths we will reverse these directions and trace rays starting from the viewer's eye through the virtual facet locations being analyzed.

Light rays originate from each source of light, and enter everywhere through the facets of the diamond that face those sources. Reverse ray tracing is used to discover which of these rays reach the viewer's eye from any particular virtual facet.

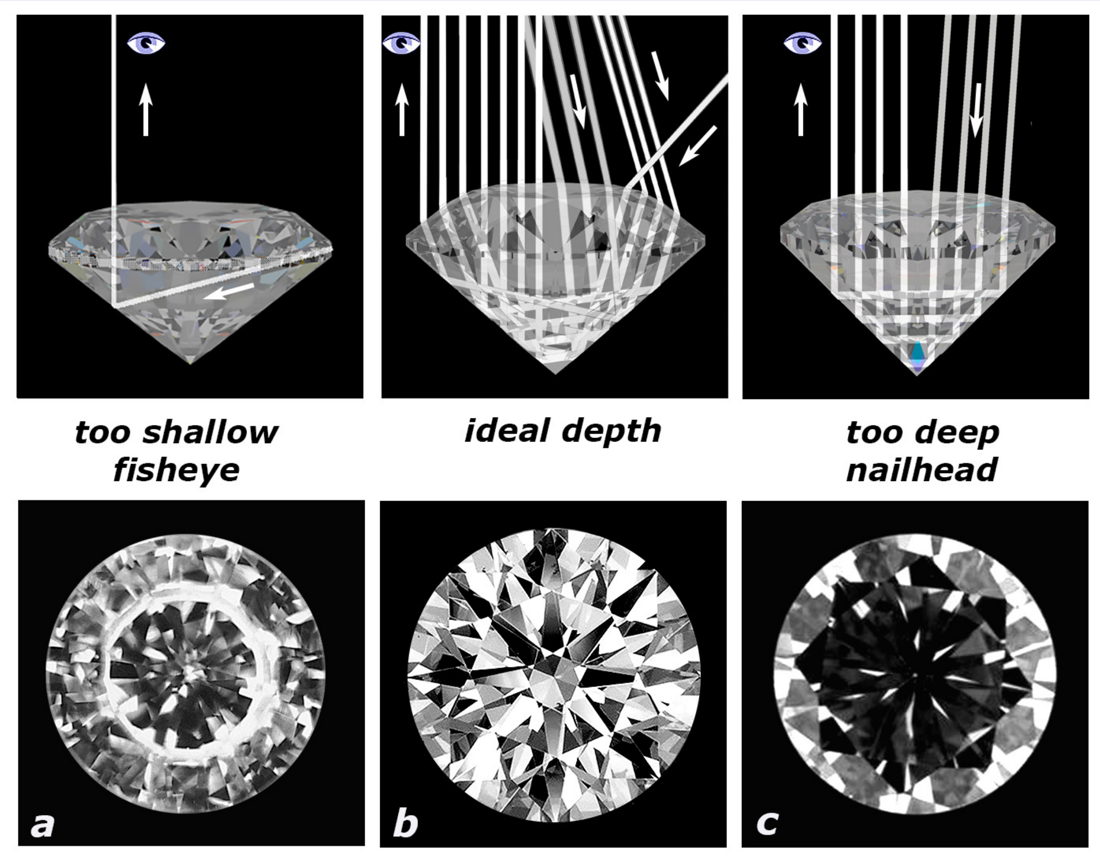

Figure 6. Optically accurate ray trace diagrams to explain the appearance of a. Fish-eye diamond displaying the fish-eye like whitish ring just inside the diamond's table. b. Ideal cut diamond displaying an even distribution of brilliance (both brightness and contrast.) c. Nail head diamond displaying dark star facets and a characteristically dark table.

Each ray starts at the eye, and enters perpendicularly through a virtual facet location in the crown. By following that ray into, through and out of the diamond, we discover the direction it takes upon exiting. That direction must be a source of bright light for the analyzed virtual facet location to be bright. In other words, for a particular configuration of diamond and observer that virtual facet is 'looking for light' in the direction of that exiting ray. In this way reverse ray tracing discovers what the eye is seeing mirrored to the viewer from each virtual facet.

The Fish-eye Diamond

As a first example of reverse ray tracing analysis, let us explore the appearance of the shallow pavilion fish-eye diamond. From Figure 7 we see the conventional ray tracing diagram used to explain the fish-eye appearance. It shows a ray entering perpendicular into the stone's table that refracts out upon first contact with a pavilion facet.

Gemstones with lower refractive indices, such as aquamarine or topaz, often exhibit this phenomenon called 'light leakage' occurring at the rays first encounter with the pavilion. This leakage is also described as 'windowing' and occurs when pavilion facets are cut below the gem's critical angle. The central area of these shallow-cut gems appears to have a 'window' that the observer can see through. Notice the window in the table area of the pink sapphire in Figure 11 where the background is visible through the gem.

However, diamond's critical angle is 24.4°. The fish-eye appearance in shallow cut diamonds occurs at pavilion angles around 37°, so light leakage is not the cause of the fish-eye diamond appearance. That appearance of a dead fishes eye is due to the whitish ring apparent just inside the table.

The cause of this appearance is discovered with reverse ray tracing starting from the viewer's eye and entering perpendicularly through one of the whitish ring's virtual facets (Figure 8). That ray enters through the ring inside the table and internally reflects off the pavilion to the diamond's girdle.

In this instance of the shallow pavilion fish-eye, the ray tracing reveals that the whitish ring is an internal reflection from the pavilion, mirroring the whitish unpolished girdle. Besides the fish-eye like ring, this diamond cut has a poor general appearance described in the GIA Diamond Dictionary as 'a glassy appearance and a noticeable dearth of brilliancy'. (Analysis of more virtual facets in the fish-eye show no windowing. For simplicity and to maintain clarity these additional reverse rays were not included.)

The Nail head Diamond

Although it has since been corrected, the GIA Diamond Grading Course (1993) reflected conventional wisdom at the

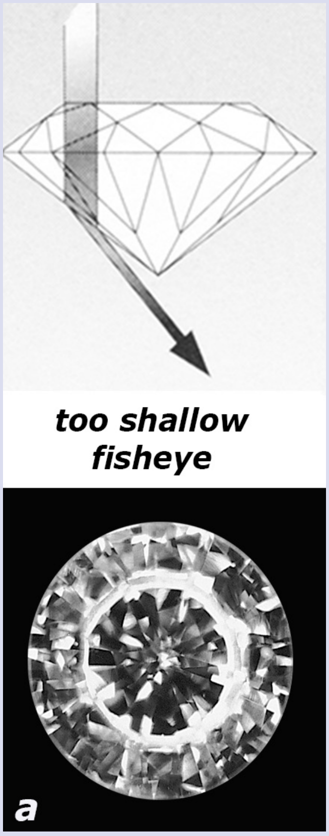

Figure 7. Conventional ray tracing explaining the too shallow fish-eye diamond's appearance.

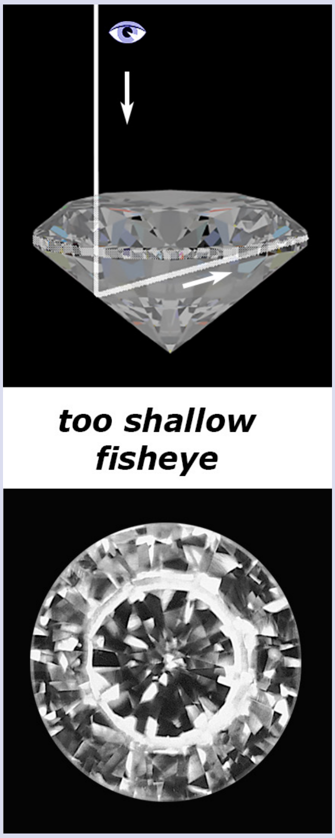

Figure 8. Optically accurate reverse ray tracing explaining the too shallow fish-eye diamond's appearance.

time when they said, 'If the pavilion is very deep, much of the light is leaking out. Then the table reflection and star facets look almost black, and the stone is called a 'nail head'.' The nail head diamond is the second often used example of poor diamond cutting. The distinctive dark table, Figure 9, is the characteristic feature of its appearance.

As was the case with the first example of the shallow pavilion fish-eye, conventional ray trace diagrams like that in Figure 9, attribute the dark table to light leakage. However, this time the leakage is shown to occur at the ray's second encounter with pavilion facets after total internal reflection from the first point of internal contact. This form of leakage can occur in very deep pavilions. However, in the case of diamond it would require a pavilion angle greater than 52.5°. Since the nail head phenomenon occurs at pavilion angles approaching 45°, this form of light leakage is not an explanation for the dark table appearance of this type of poor cutting.

As is discovered through reverse ray tracing, it is also not the explanation for the dark table nail head appearance in gems with much lower refractive indexes than diamond such as the peridot photographed in Figure 12.

To discover the cause of this table darkening four representative rays are traced in reverse through virtual facet locations in the diamond's table. These rays are traced from the viewer's eye perpendicularly through the table into the diamond where they totally internally reflect twice from the pavilion, Figure 10.

Rather than leaking, these rays are seen to return through the table directly back toward the viewer. Rather than light leakage, the darkness seen in the table of the nail head is thus a reflection from and of the viewer or in the case of photography, the lens and camera. The area of the viewer's head or the camera lens is dark relative to surrounding illumination, which is the explanation for the dark appearing table of the nail head.

The nail head diamond is acting in the table as a retroreflector when its pavilion is cut at angles close to 45°. (Definition of a retroreflector: a device which serves to reflect incident light, back in the direction it came from so that the paths of the reflected rays are parallel to those of the incident rays.)

There can be light all around, but the table of the nail head diamond or other gem cut with pavilion close to 45°, like the peridot in Figure 12, is reflecting the viewer who is obstructing light from his or her direction thus leaving the table dark.

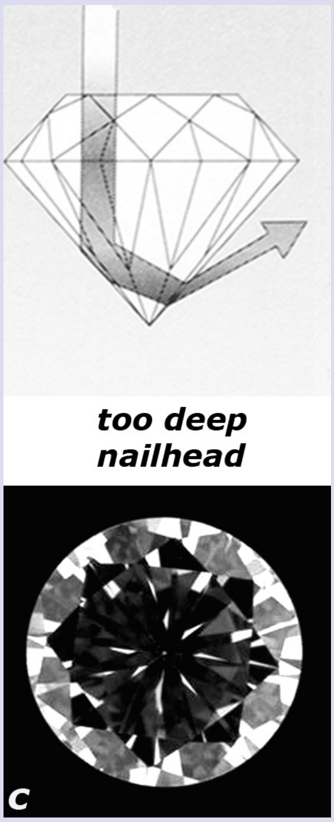

Figure 9. Conventional ray tracing explaining the too deep nail head diamond's appearance.

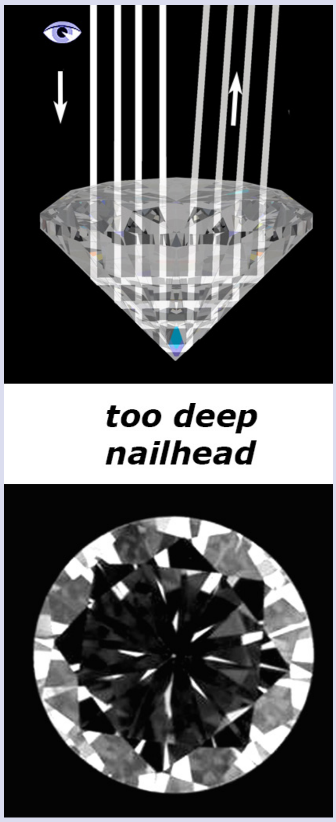

Figure 10. Optically accurate reverse ray tracing explaining the too deep nail head diamond's appearance.

Figure 11. Example of 'windowing' in an oval, pink sapphire gemstone.

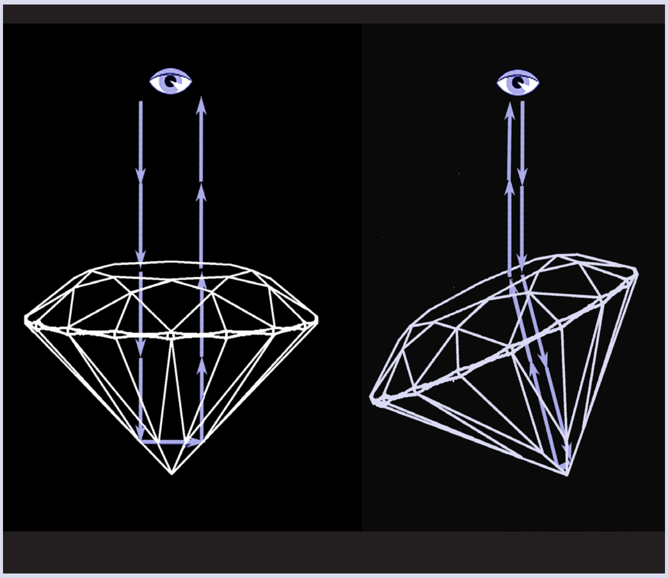

Figure 13. The nail head's retroreflection property results in the dark table appearance even when the diamond is tilted away from the viewer's direction.

The ray tracing in Figure 13 reveals that this retroreflection property maintains the dark table appearance even when the diamond is tilted away from the viewer's direction to the extent shown.

The Ideal Cut Diamond

The conventional ray trace diagram used to explain the superior light performance of the ideal cut diamond is illustrated in Figure 14. The diagram is of a ray entering the diamond vertically that doubly reflects from the pavilion and returns back vertically to the observer. At first glance, this appears to be a good thing. Many early experts in diamond cut, including GIA's founder Robert Shipley, at one time believed that the best cuts returned light that entered vertically directly back vertically to the observer. In his 1931 GIA course notes, Shipley discussed the European version of what he called 'ideal cut': 'These proportions actually return to an observer, directly in front of the stone, a maximum number of rays which enter vertically from the front.'

Figure 12. Round brilliant cut peridot with 45° pavilion retroreflecting the dark camera lens causing its dark table nail head appearance.

Through the insight obtained with reverse ray tracing we now recognize the ray trace diagram of Figure 14 to be that of the dark table, nail head diamond. If diamond proportions cause the 'return to an observer, who is directly in front of the stone, a maximum number of rays which enter vertically from the front', the table will reflect the observer's head and appear dark. Reverse ray tracing shows us that rather than coming from the vertical, the bright light that reaches our eyes from a diamond held face-up must come from an angle sufficiently off the vertical to avoid obstruction by our head.

We can see that this is the case with the ideal cut diamond by reverse ray tracing as shown in Figure 15 where there are seven probes of virtual facets across the ideal.

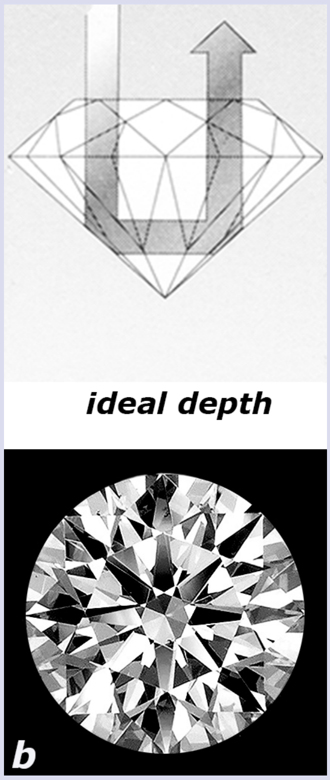

Figure 14. Conventional ray tracing showing a ray entering vertically and returning vertically to an observer directly in front of the stone.

Looking at the ray tracing in the ideal cut of Figure 15, we see that its sources of brilliance originate from medium angles and from high angles that are close, but not too close to the viewer's line-of-sight and head. This is the best optical circumstance for a number of reasons. For one, bright light is often located overhead at high angles. The ideal cut reflects this bright light to our eyes from these high angles, but not at angles so high as to reflect from the area where there is constant obstruction from the viewer's head. In addition, ideal cutting takes maximum advantage of usual diamond lighting and viewing circumstances. The ideal's superior light performance is maintained, not only when viewed face-up, but also when tilted to a greater degree than is possible in poorer cutting. Figure 16 is a good example.

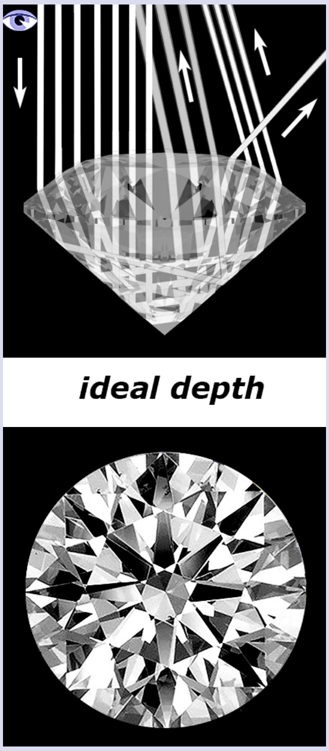

Figure 15. Optically correct reverse ray tracing of the Ideal showing reflection from high angles that are close, but not too close to the viewer's head.

Conclusions:

Let us review what has been learned through an understanding of diamond optics and light performance gained by means of concepts like virtual facets and their analysis by the technique of reverse ray tracing.

1. The fish-eye diamond's traditional ray trace diagram, Figure 7, attributes its poor light performance to light leakage. Reverse ray trace analysis, Figure 8, has shown this is not the cause of the dead fish-eye appearance. In this instance of the shallow pavilion fish-eye, the ray tracing reveals that the whitish ring is an internal reflection from the pavilion, mirroring the whitish unpolished girdle.

2. As is the case of the fish-eye, the nail head diamond's traditional ray trace diagram, Figure 9, also attributes to light leakage the nail head's dark table poor appearance. This also was the conventional belief expressed in the GIA Diamond Grading Course as late as 1993 when it stated: 'If the pavilion is very deep, much of the light is leaking out. Then the table reflection and star facets look almost black, and the stone is called a 'nail head'.'

In this instance of the deep pavilion nail head, reverse ray trace analysis, Figure 10, has shown that leakage is not what is causing the dark table appearance. Light leakage is also not the explanation for the dark table nail head appearance in gems with refractive indexes much lower than diamond such as the peridot photographed in Figure 12. Rather than leaking, the nail head diamond is acting in the table as a retroreflector when its pavilion is cut at angles approaching 45°. (Definition of a retroreflector: a device which serves to reflect incident light, back in the direction it came from so that the paths of the reflected rays are parallel to those of the incident rays.)

There can be light all around, but the table of the nail head diamond or other gem like the peridot, Figure 12, that is cut with pavilion close to 45° is reflecting the viewer who is obstructing light from his or her direction thus leaving the table dark.

3. In an ironic twist we observe the correct ray trace diagram, Figure 10, for the dark table nail head is employed in conventional ray trace diagrams, Figure 14, to explain the superior light performance of the ideal cut diamond. This misunderstanding, which continues to be perpetuated by this traditional diagram, is due to the early belief that the best cuts returned light that entered vertically directly back vertically to the observer.

Reverse ray tracing, Figure 15, shows us that rather than coming from the vertical, the bright light that reaches our eyes from an ideal cut diamond held face-up must come from an angle sufficiently off the vertical to avoid obstruction by our head. We see that the ideal's sources of brilliance originate from medium angles and from high angles that are close, but not too close to the viewer's line-of-sight and head.

Figure 16. 1.83ct ideal round brilliant with hearts and arrows optical symmetry displaying its superior 'tilt brilliance and fire'

The ideal's superior optics and light performance takes maximum advantage of usual diamond viewing and lighting circumstances. Slight rocking or movement results in virtual facets flashing from bright to dark as they move in and out of the light and head obstruction contributing to the ideal cuts scintillation and fire.

There is more to learn and discuss about the light performance properties of the ideal cut diamond especially its fire that is enabled through the technique of reverse ray tracing. They will be addressed in a follow-on second part to this article. Cutting to ideal angles and proportions results in the best combination of the attributes of diamond beauty – brilliance, fire, and sparkle.

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Tools of the TRADE

Kirk Feral is a man who is passionate about gemmology but particularly about how to use magnetism to identify gemstones. In a world of high-tech instrumentation, Captain Kirk brings us down to earth.

A Man, A Magnet and an Idea....

GEM IDENTIFICATION WITH MAGNETISM

Every gemstone species and variety shows a characteristic range of responses to the magnetic field of a strong magnet. Every individual gem is either repelled by the magnet (a diamagnetic response), or attracted to the magnet to some measurable degree (a paramagnetic response in most cases).

The response we observe when we apply a magnetic wand to a gem serves as an aid to gem identification. The magnetic response ranges for most types of gemstones are found on the Magnetic Susceptibility Index for Gemstones at gemstonemagnetism.com.

As with other gemology tools, we use a magnetic wand to separate one gem type from another in a process of elimination. Additional testing with other instruments is usually necessary to narrow the possibilities until final identification is achieved. However, in a few instances magnetic testing is all we need to positively identify a gem.

HOW TO MAKE A MAGNETIC WAND

A magnetic wand is made with the strongest permanent magnet available today: an N52 grade magnet containing the rare earth metal neodymium. Neodymium magnets are much stronger than traditional magnets such as horseshoe magnets and refrigerator magnets.

To make your own magnetic wand, begin by ordering a neodymium magnet online. The optimal size and shape is a 1/2" diameter by 1/2" deep cylinder, and the desired strength is grade N52. Important: This exact size and strength is recommended to obtain the maximum degree of response equivalent to responses listed on the Magnetic Susceptibility Index.

For a handle, the magnet can be attached to a metal hex bolt from the hardware store. A good bolt size to fit the magnet is a 2" long bolt with a ½" wide head. No glue required!

Finally, to safely store your magnetic wand, use and empty 3" tall pill bottle with a child-safe cap. A piece of gem-jar foam can be placed at the bottom of the pill bottle to buffer the strong magnetic field emitted by the bottom pole of the magnet.

SAFETY PRECAUTIONS

The magnetic wand has a strong pull-force and should be handled with care. Keep it out of the reach of small children. Never put your finger between the magnet and a metal surface or your finger could be injured. During magnetic testing, use only non-metallic surfaces such as glass or wood for your workspace.

Keep your wand away from all electronic devices such as watches, digital gem scales, cell phones, laptop computers and tablets, as these could be damaged. The wand will also erase data stored on credit cards. If you have a pacemaker, never place a magnetic wand near your chest or in your shirt pocket.

TESTING METHODS

Two testing methods are used with a magnetic wand: the Direct Method and the Floatation Method. The 'Direct Method' enables us to make a number of quick and easy gem separations such as distinguishing rubies from red garnets, orange hessonite garnets from orange spessartine garnets, and chrome tourmalines from other green tourmalines. The 'Floatation Method' is useful for separating many types of gems such as aquamarine from blue topaz, iolite from tanzanite, and natural blue spinel from synthetic blue Spinel.

THE DIRECT METHOD

The Direct Method of testing simply involves touching the magnet directly to the surface of a gem while the gem rests on a smooth flat dry surface. We can use this method to first check an unidentified gemstone for magnetism. Direct testing works only with gems that are highly magnetic. Such gems will either drag across the surface, or will be picked up by the magnet.

All Direct responses are affected by the weight of the gem being tested. Large gems that typically show a 'Pick-up' response can at times be too heavy to pick up, but they may drag. When gems are very small and light (under 0.5ct), those which typically show a 'Drag' response may be picked up. The 'Direct' response ranges listed on the Magnetic Susceptibility Index are based on gems of average weight, between one and four carats.

DRAG RESPONSES

Only six common transparent gemstones show a 'Drag' response to a magnet:

1. Peridot
2. Blue Indicolite Tourmaline
3. Green Verdelite Tourmaline
4. Yellow Manganous Tourmaline
5. Mali Garnet (any color)
6. Man-made Pink Cubic Zirconia

The only natural blue gem of any kind that shows a 'Drag' response is indicolite tourmaline, and no other test is needed to positively identify indicolite.

PICK-UP RESPONSES

Only one common transparent gemstone shows a 'Pick-up' response to a magnet: Garnet. If a gem of average size picks up during magnetic testing, you can be sure it is garnet unless you are working with rare stones. Some rare gems such as transparent rhodochrosite and transparent rhodonite also pick up.

The only natural transparent green gem of any kind that picks up is demantoid garnet, and this is the only test needed to positively identify demantoid.

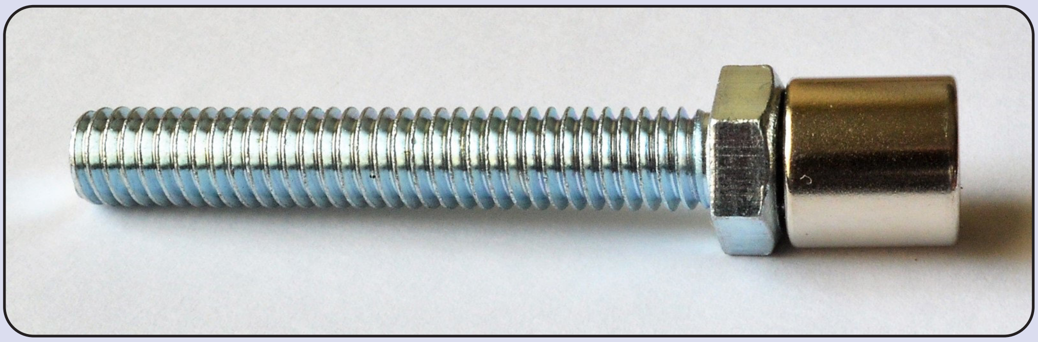
The only common orange transparent gem that picks up is spessartine garnet. A few rare orange transparent gems also pick up, such as triplite and orange rhodochrosite.

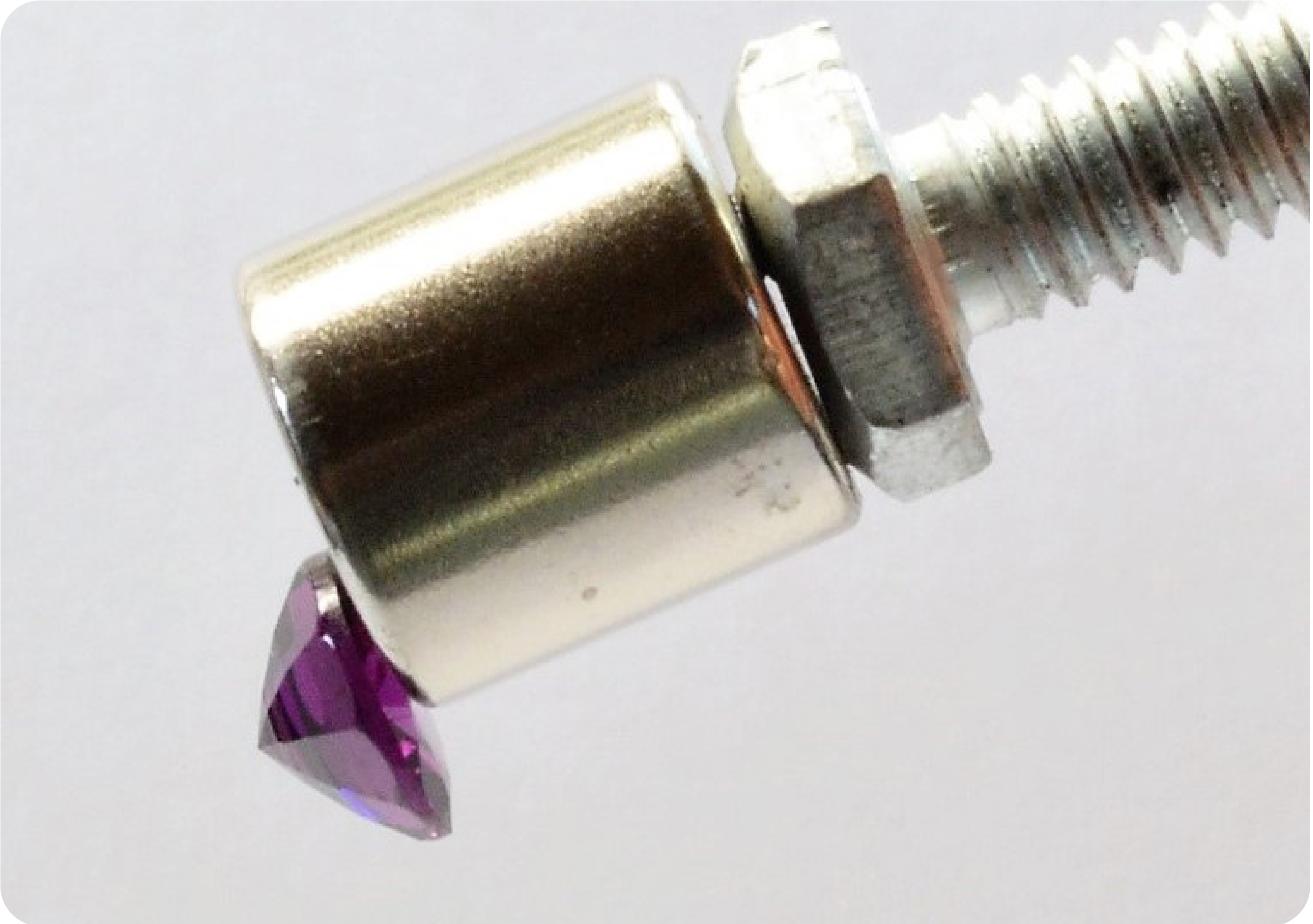
Most garnet gems pick up, but grossular garnets do not. Grossular garnet varieties other than Mali garnet typically show no 'Direct' responses. Mali garnets show only 'Drag' responses. Two unusual varieties of pyrope garnet - chrome pyrope and pastel pyrope - also typically show only 'Drag' responses.

THE FLOATATION METHOD

Because magnetic susceptibility is so low in most transparent gems, direct responses to a magnet are uncommon. In most instances, we must use the 'Floatation Method'. This method allows us to see weak paramagnetic and diamagnetic responses.

Floatation simply involves setting a gem onto a foam raft that floats on water. This method mostly eliminates friction and gravity, two factors that prevent a gem from moving toward or away from a magnet. Unlike the 'Direct Method', the weight of a gem does not affect floatation responses.





Almandine Garnet Picks Up (Photo by Kirk Feral)

Testing a parcel of rubies for garnet substitutions (Photo by Kirk Feral)

HOW TO USE THE FLOATATION METHOD

If a gem is faceted, position the gem face-up, and hold the magnetic wand about a half inch away from the facet table or body of the gem. Maintain the half inch testing distance as the gem and raft are pulled across the surface of the water toward or away from the magnet.

If the raft moves away from the magnet, the gem response is Inert (Diamagnetic). If the raft follows the magnet slowly as you pull the magnet away, you have a 'Weak' response. If the raft glides easily toward the magnet, you have a 'Moderate' response. Rapid movement toward the magnet indicates a 'Strong' response. Deciding which response you are seeing is somewhat subjective. 'Moderate' responses are the trickiest, as these can overlap with either 'Weak' or 'Strong' responses.

MAGNETIC RESPONSES

Direct Method: Drag or Pick-up

Floatation: Inert (Diamagnetic), Weak, Moderate or Strong

PRACTICAL APPLICATIONS

1. In addition to faceted gems and cabochons, mineral specimens, rough stones and tumbled stones can be tested for magnetic response. A polished facet is not required, and lack of transparency does not affect magnetic testing.

2. Parcels of rough stones or cut stones can be scanned with a magnetic wand to separate stones that show a 'Direct' response. A 'Pick-up' response is particularly useful for quickly separating garnets from all other stones of similar appearance that may be mixed within a parcel.

3. Gems mounted in jewelry can be tested for magnetic response when the 'Floatation Method' is used. Metal settings used in most jewelry are not magnetic and do not interfere with magnetic testing.

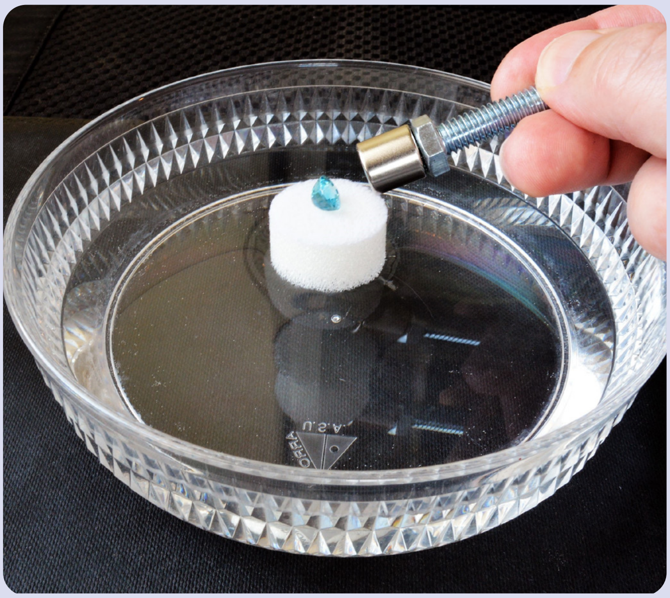
4. Gems whose refractive index is too high be measured on a standard refractometer (> RI 1.81) can be tested for magnetic response using a magnetic wand.

5. One of the most important uses of a magnetic wand is separating gems that look alike. Two different gem types that appear identical to the naked eye can often easily be separated by differences in magnetic response.

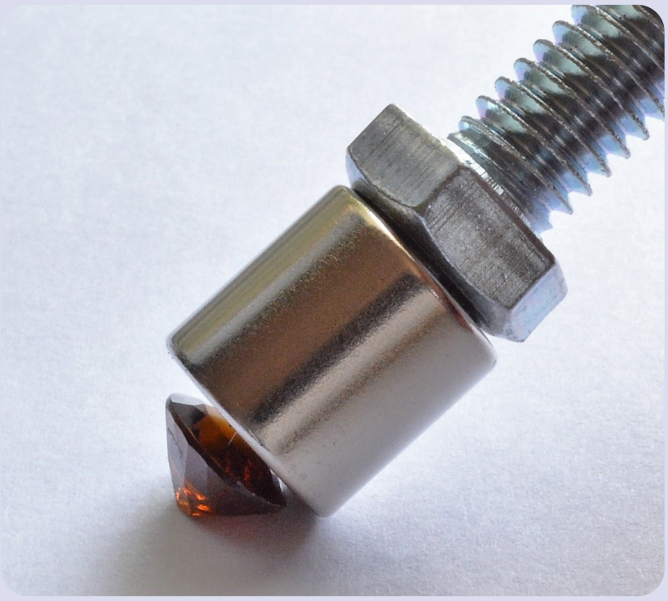
6. Separating natural gems from synthetic gems is often possible using a magnetic wand. Most other gem identification tools are not suited for this purpose.

To learn more about magetism in gemstones, visit:
www.gemstonemagnetism.com

The Floatation Method (Photo by Kirk Feral)



Testing Blue Zircon (Photo by Kirk Feral)



Drag response from a Mali Garnet (Photo by Kirk Feral)

Meet our team of dedicated professionals who all share a common philosophy, a common goal and a passion and commitment to gemmology and education.

Geoffrey M. Dominy
WGF Founder

Geoffrey Dominy is an author, independent gemmologist and former jewellery appraiser who appeared on the Canadian Antiques Roadshow for four seasons. He received his F.G.A through the Gemmological Association of Great Britain (Gem-A) in 1987 passing the diploma examinations with distinction.

Throughout the 1990's, Geoff developed and taught the 'Gemmology' program at Red River Community College and The University of Manitoba in Winnipeg, Canada, worked for the Canadian Institute of Gemmology, was President and Founder of the Jewellery Appraisers Association of Canada and was a contributing author for the 5th & 6th Editions of Robert Webster's 'Gems' which even today is considered one of the most authoritative textbooks in Gemmology.

In 2013, he released the first digital gemmological textbook entitled 'The Handbook of Gemmology' in collaboration with world famous gem photographer Tino Hammid. Now in its third edition, the handbook has been sold or downloaded in forty-seven countries, is used by fourteen schools, colleges, universities and gemmological organizations as their recommended textbook and now features photographic contributions by another award winning photographer Jeff Scovil.

Geoff currently lives in Palma de Mallorca, Spain and in addition to lecturing and promoting his book, is the founder of the World Gem Foundation and Mi Isla También.

Leone Langeslag
Dutch Gem Academy

Leone Langeslag is a graduate of the Federation for European Education in Gemmology (FEEG) (2006), an independent gemmological consultant and is actively involved with the Gemma Association in Holland offering lectures and workshops. Her desire to provide accessible gemmological training in the Netherlands has lead to the formation of the Dutch Gem Academy.

Leone is a frequent visitor to international symposiums, exhibitions and trade shows where she continues her own gemmological education and passion for collecting gemstones and minerals.

Deborah Mazza
British Gem Academy

Deborah Mazza is half Italian and half British, and started her journey through the world of gemstones in Germany in 1984, where she studied at the Deutsche Gemmologische Gesellschaft attaining her gemmology and diamond diploma; she subsequently gained her FGA in 1986.

Deborah then went to work for the trade in Idar-Oberstein, buying and selling wholesale gems and diamonds, working as a gemmologist and teaching gemmology at the DGemG, this lead on to carrying out jewellery valuations for an insurance company in Germany. She later got a Bachelor in Business in Germany, and returned to the UK in 2010, where she became a tutor for the Gem-A's online courses. Deborah, keen to add to her knowledge, started to study again and passed the NAJ/IRV's CAT jewellery valuation diploma, and is now studying History of Art at Goldsmiths University. Deborah has her own valuation business and works part-time for an online auction house. She contributed several written pieces for Yavorskyy's new book, Terra Connoisseur: Gemstones. She is currently the Director of Education for the British Gem Academy.

Conny Forsberg
Scandinavian Gem Academy

Conny Forsberg has over thirty years experience as a gemmologist and precision gem cutter. He received his FGA in 1986 through Gem-A, his diamond grading diploma through Hoge Raad voor Diamant (HRD) in 1994 and is an Accredited Senior Gemologist with the Accredited Gemologist Association (AGA).

He is currently the owner of the Swedish Gem AB, a modern and accomplished gem lab as well as a precision cutting facility. He has twice received 'Honourable' mention in the Gem-A photo competition for his photomicrography (2011 & 2013) and is a valued contributor to the Handbook of Gemmology, with a large collection of his photomicrographies planned for the upcoming 4th Edition. Conny is also an Accredited PRINCE2 Practitioner (Project Management), experienced in public procurement and contracting (EU law) and the initiator and organizer of the Scandinavian Gem Symposium. He is currently the auditor for the Swedish Gemmological Association.

Jan Asplund
Scandinavian Gem Academy

Jan Asplund is a gemmological consultant specializing primarily in the identification and valuation of diamonds, both cut and rough, as well as coloured gemstones and jewellery.

He received his FGA & DGA (Gem Diamond Diploma) through Gem-A in 2011, his BA in History from the Mälardalens University in 2000 and studied geology and gemmology at Luleå Technical University (2005 – 2007), cultural and industrial history at the Uppsala University (1998 – 2000), and archival science at Karlstads University (1998 – 1999). Jan also took his Accredited Jewelry Professional – AJP (Gemological Institute of America 2011), Introduction to Watches (International School of Gemology 2012), Jewellers Education Foundation – Graduate Sales Associate (American Gem Society 2011), Blacksmithing (Sätergläntan 2002) and Silversmithing (Tärna Folkhögskola 1996).

He is a board member of the Swedish Gemmological Association, fellow and diamond member of Gem-A and initiator and organizer of the Scandinavian Gem Symposium.

Leroy Bakelmun
Pacific Northwest Gem Academy

Leroy Bakelmun started his gemmological career after receiving his certificate in gem cutting and polishing at the Lapidary Training Centre Sri Lanka in 1995. In the same year he also received his certificate in Gem Identification, through the A.K. Institute of Gemmology in Sri Lanka.

In 2006 he received his 'Gemmologist' certificate through the Canadian Institute of Gemmology (C.I.G.)

Leroy has extensive experience buying and selling gemstones. From 1997 to 2014, he owned and operated GeoGem Jewellers in Langley, British Columbia, Canada and from 2012 to 2014, he also owned the 925 House of Silver in Fort Langley, British Columbia, Canada.

Rahul Desai
SRDC WorldGem

Rahul Desai began his career taking forward his father's creation Shreeji Rajendra Diamond Classes (SRDC-INDIA), a pioneer in diamonds, gems and jewellery education throughout India that has graduated more than 50,000 jewellers, gemmologists, diamond traders and jewellery designers through their educational programs.

One of the first and foremost private institutions in gems and jewellery education, SRDC – INDIA received world recognition through its corporate education program in various countries including Turkey, Hong Kong, Bangkok, Myanmar (Burma), Dubai and Bostwana.

Renuka Punjani
SRDC WorldGem

Renuka Punjani has worked within the jewellery industry for nearly 25 years with a tremendous inclination towards designing and fine jewellery and has worked closely with some of the industry leaders, designing personal family fine jewellery.

Cristina Rzepka de Lombas
Spanish, South American, Central American and Caribbean Gem Academies

Cristina Rzepka de Lombas is a geologist, gemmologist, appraiser of gemstones and jewellery and an expert in diamond and coloured gemstone grading.

Currently Cristine serves on the Board of Directors of the Instituto Gemológico Español (IGE) in Madrid, Spain where she also teaches their 'Gems of Organic Origin' course.

She is also the Director of Education for the Spanish, South American, Central American and Caribbean Gem Academies.

World Gem Foundation Gem Academies

To contact the individual gem academies, please click here

EGOR GAVRILENKO is the current Director of the Gem Testing and Certification Laboratory of the Spanish Gemological Institute, holds a PhD in Geology and is a qualified and highly respected gemmologist. He is also an avid gem cutter and photomicrography enthusiast.

Rock with a Little Heavy Metal (Part Three)

In this final installment we look at magnetism and anomalous birefringence and how they can provide vital clues as to the origin of a diamond.

High Pressure, High Temperature (HPHT) Synthetic Diamonds

Magnetism

Metal solvents used as a growth medium for HPHT synthetic diamonds often produce metallic inclusions - from submicroscopic particles to inclusions visible to the naked eye. Since these inclusions are magnetic, diamonds that contain them will react to a strong magnet (Figure 1). Ideally the magnet should be a neodymium magnet, which is stronger than a traditional ferrite magnet. To detect weak magnetism, the floatation method can be used which involves placing the diamond on a small floating object (such as foam) in water to reduce friction and noting any magnetic attraction. If the diamond exhibits magnetism, this is proof that it is synthetic, however not all synthetic HPHT diamonds have metallic inclusions so a negative reaction is not conclusive proof that the diamond is natural.

The magnetism test can also be applied to parcels of melee diamonds. In a parcel of small, medium-low clarity HPHT synthetic diamonds, placed in a transparent plastic bag and oriented horizontally, there will always be some stones with metallic inclusions of sufficient size to move the diamonds inside the bag when a strong magnet is applied.

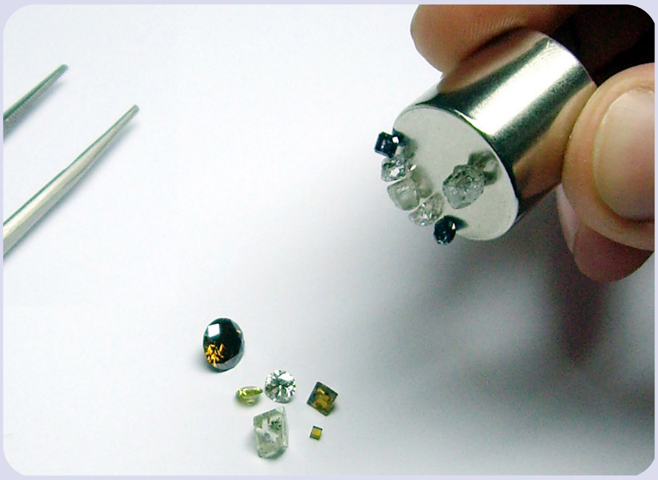


Figure 1: HPHT synthetic diamonds with metallic inclusions are attracted by a strong magnet, while natural diamonds and synthetics free of inclusions do not exhibit magnetism (IGE).

Anomalous Birefringence

Anomalous birefringence in diamonds is a characteristic that is not frequently used by gemologists, but it is well known by diamond cutters. This way they can analyze internal strains in diamonds before cutting.

Figure 2a: Observation of anomalous birefringence in a diamond in a compact polariscope. The stone is held between its table and culet in tweezers and placed between cross polarizers, where it is observed with the 10x loupe, rotating the stone to see the interference figures in different directions (IGE).

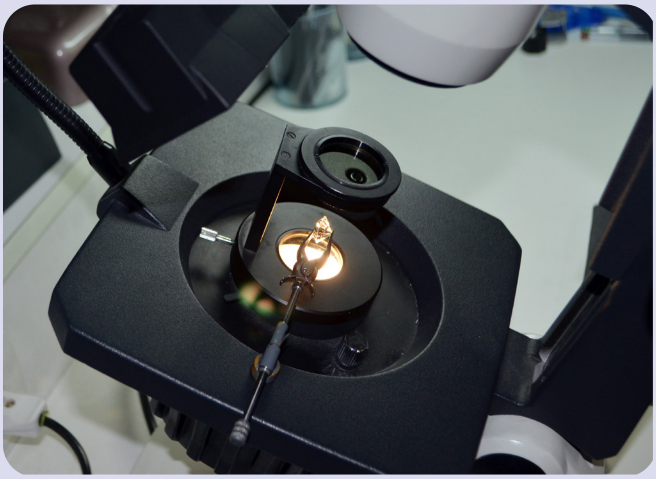


Figure 2b: The same test is performed much better on a gemological microscope with cross polarizers (IGE).

It can be observed by holding the diamond between the table and the culet in the polariscope (Figure 2a) or cross polarizing filters adapted to the microscope (Figure 2b). Although diamond crystallizes in the cubic system and should therefore be optically isotropic, natural diamonds are rarely found without anomalous birefringence. A property that reflects the structural deformations produced during its growth and subsequent geological history.

It is an easy test that can be performed on both loose diamonds and larger set diamonds that allow full access to the stone. Virtually all natural diamonds exhibit anomalous birefringence of varying degrees. In Type I diamonds it can range from subtle to very sharp, often exhibiting live interference colors. The patterns of distribution of anomalous birefringence in natural diamonds can be varied, with mottling frequently seen, in the form of colored patches or banding, forming parallel lines (Figure 2c-2e). Observation of such clear patterns of anomalous birefringence would rule out the possibility of synthetics.

In natural type II diamonds, an anomalous birefringence pattern known as 'tatami', consisting of parallel fine lines in two crossing directions, is usually observed. The most typical interference colors in this case are usually white and gray, with no vivid colors (Figure 2f).

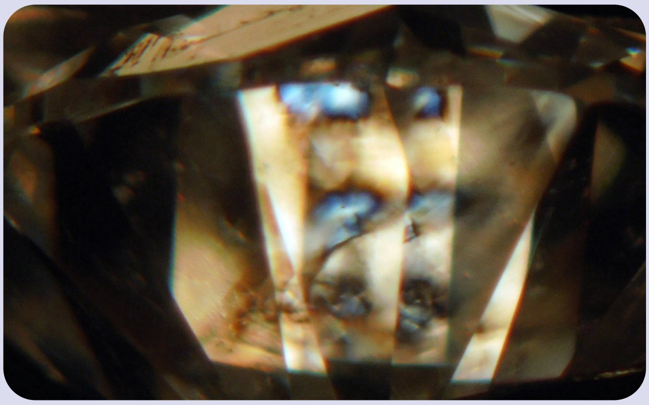


Figure 2c: Typical interference figures for a natural type Ia diamond, anomalous birefringence pattern mottled with second order interference colors. This pattern rules out the possibility that the diamond is synthetic HPHT or CVD (IGE).

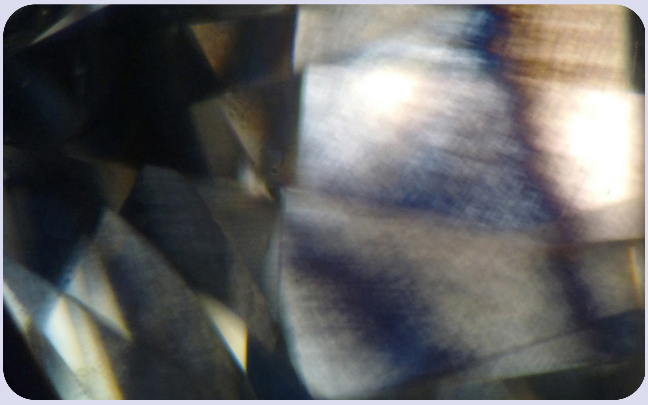


Figure 2f: The pattern composed of interlaced fine lines is known as 'tatami' and is characteristic of natural type II diamonds, although it can also be observed in CVD synthetic diamonds. (IGE).

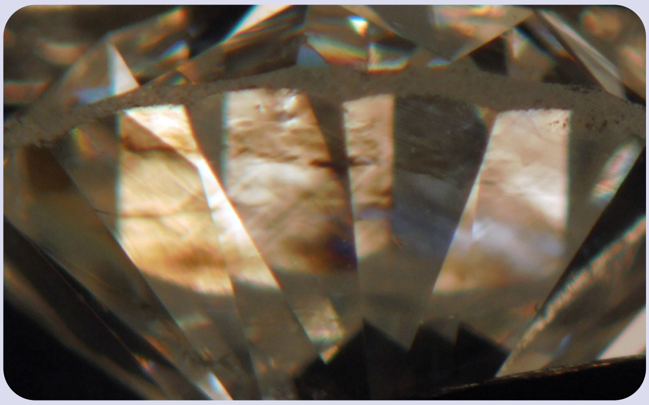


Figure 2d: A pattern similar to the previous one but somewhat more subtle, in another type Ia natural diamond (IGE).

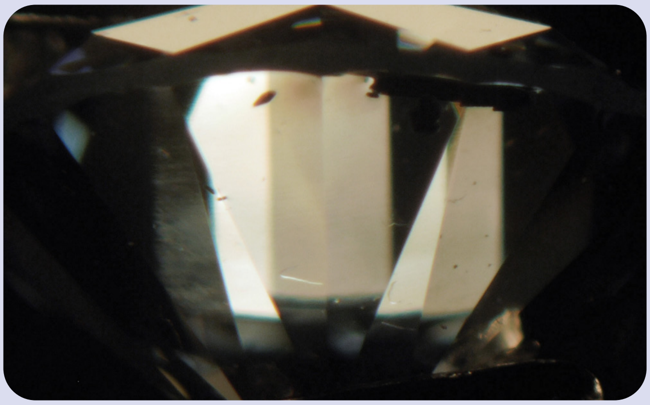


Figure 2g: Absence of anomalous birefringence in colorless HPHT synthetic diamond (IGE).

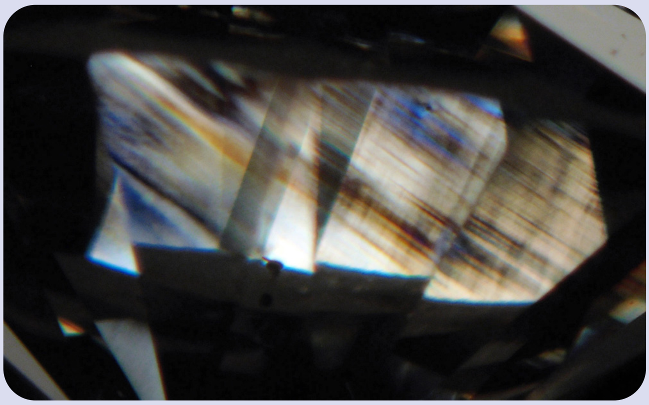


Figure 2e: Another pattern of anomalous birefringence, in bands, also frequently seen in natural type Ia diamonds (IGE).

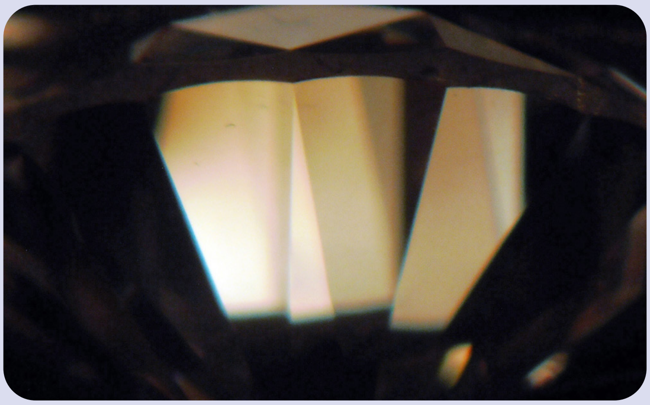


Figure 2h: Another colorless HPHT synthetic diamond with hardly any anomalous birefringence pattern (IGE).

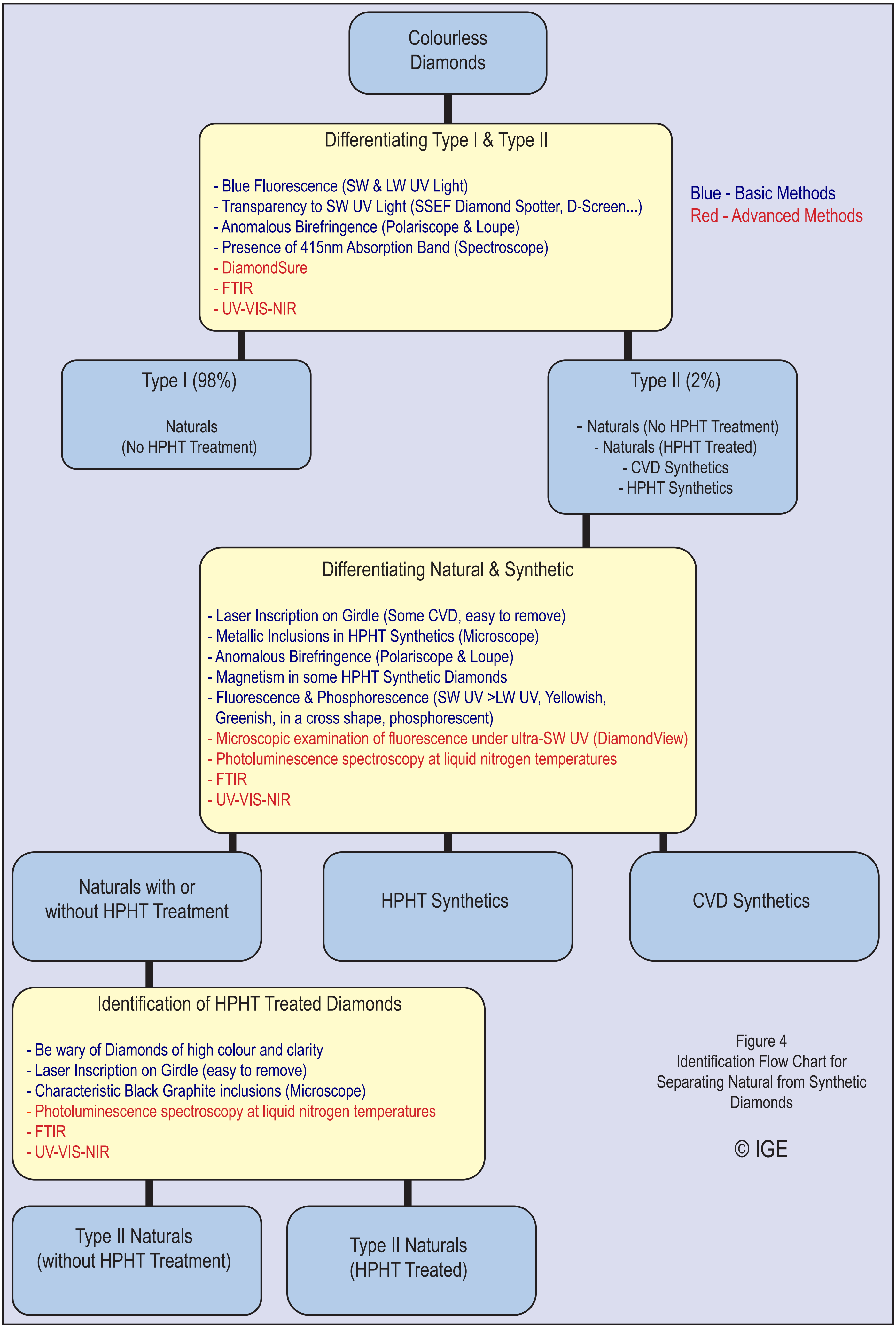


Figure 4
Identification Flow Chart for Separating Natural from Synthetic Diamonds

HPHT synthetic diamonds are formed under much more stable conditions than any natural diamond. Therefore they exhibit far less crystal lattice deformations and generally do not have anomalous birefringence, observed under a microscope between cross polarizers (Figure 2g and 2h). They are usually isotropic, although they may have areas of slight anomalous birefringence associated with inclusions.

Chemical Vapour Deposition (CVD) Synthetic Diamonds

Anomalous Birefringence

As we have seen with synthetic HPHT diamonds, birefringence is also a very useful method for the differentiation of synthetic CVD diamonds from natural diamonds. Similar to natural type II diamonds, synthetic CVDs have the characteristic “tatami” pattern (Fig. 3a), although the interference colors tend to be more lively. In addition, by rotating the stone, a position can be found where a characteristic “column” pattern is observed produced by the layered deposition of this type of synthetic diamond (Fig. 3b). However, not all CVD diamonds present this pattern, while some natural type II diamonds can also give a similar image in some directions.

Advanced Analytical Techniques for the Identification of Synthetic Diamonds

The basic gemological techniques described above can lead to the positive identification of synthetic diamonds in many cases, but in others it would be advisable to go to a specialized gemological laboratory for the definitive identification of suspect diamonds (see Figure 4 on next previous).

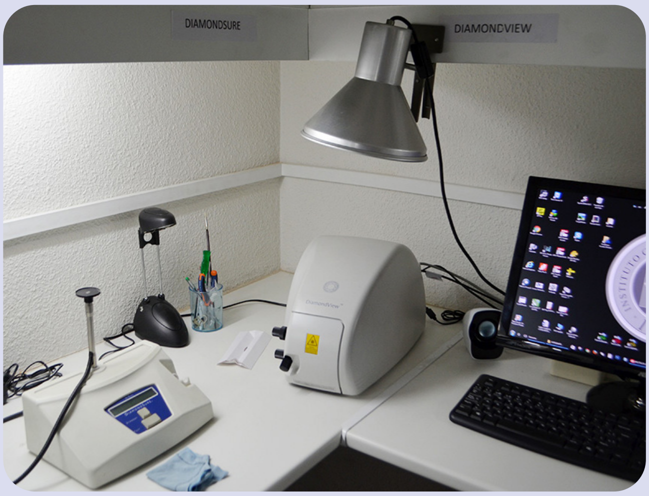


Figure 5a: The DiamondSure (left) and DiamondView (right) by De Beers at the IGE Laboratory (IGE).

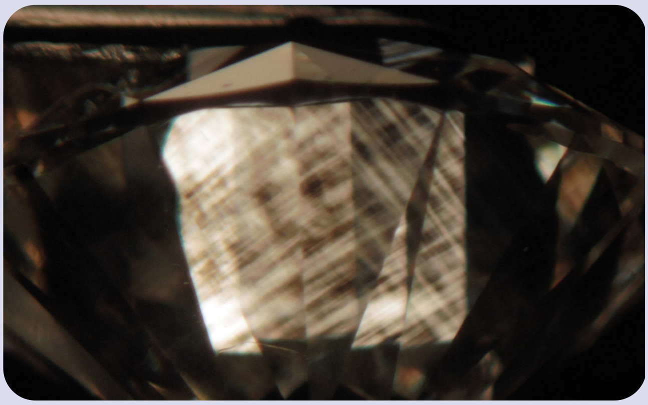


Figure 3a: Anomalous birefringence pattern ‘tatami’, typical for CVD synthetic diamonds and also for natural type II (IGE).

Figure 5b: The DiamondView also allows you to analyze diamonds mounted in jewelry (IGE).

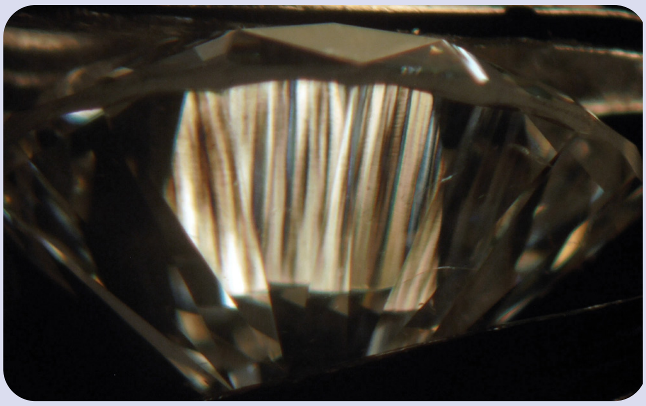


Figure 3b: Anomalous ‘columnar’ birefringence pattern, observed in some directions on CVD synthetic diamonds. In other directions the same diamond has the ‘tatami’ pattern (IGE).

Figure 5c: The FTIR, UV-Vis-NIR and Raman-PL spectrometers from M & A Gemmological Instruments at the IGE Laboratory (IGE).

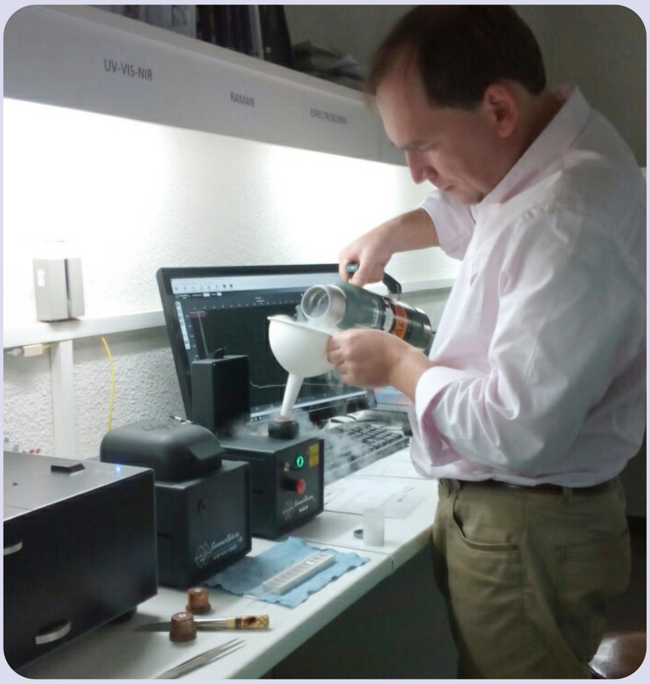


Figure 5d: For better observation of photoluminescence spectra in diamonds, liquid nitrogen is used to cool the sample (IGE).

The main techniques used for the detection of colorless synthetic diamonds in laboratories include infrared spectroscopy (FTIR), ultra-short UV light fluorescence and phosphorescence (DiamondView) and liquid nitrogen photoluminescence, available from the Laboratory of Analysis and Certification (Figure 5a-5d). The use of these techniques is described in detail in numerous specialized gemological articles.

Overall Conclusions

Over the last three issues we have looked at the identification of HPHT and CVD Diamonds with basic gemological tools. Of all the gemstones used in jewelry, diamonds are by far the most popular and depending on the size and quality, can exhibit the greatest differences in value.

For decades, identifying diamonds was a simple task, but now like other important gems, diamond is being synthetically produced and is available on the market at prices that are lower than those being charged for natural diamonds. This obliges professionals to not only learn how to identify synthetic diamonds but also to invest in equipment and training so that they can make the correct determination.

As we have seen, basic gemological methods can be very useful in positively identifying colorless synthetic diamonds, or at least identifying stones that should be submitted to a specialized laboratory for further analysis. While these methods do not require a large economic investment, they do require knowledge and experience, which can only be acquired by working with known samples of both natural and synthetic diamonds of different types. Also, one has to remember that the methods of synthesis are improving continuously, so it is very important to keep updated on new synthesis types and identification tools.

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Sci-Fi Heaven or Plain Old Glass?

A client brought in a moldavite which was apparently purchased from a trusted seller in Sweden. The seller stated that the stone was a moldavite and the purchaser paid a high price because of the rare vivid colour. It had a very pleasing green colour and internally some swirls and gas bubbles. The client questioned friends on Facebook to see if she had made a good purchase, particularly in light of the great colour. Many people responded with several voicing their concerns regarding the intensity of the colour and the possibility that the stone could be a fake. It was subsequently sent to Swedish Gem LAB for testing (Image 1).

Initially a microscopic examination revealed polishing lines and some surface abrasions on the facet edges as well as spherical gas bubbles and swirls (treacle like) internally. For the untrained eye and novice regarding gemmology, the bubbles and "treacle" could very well be mistaken as positive signs of a natural moldavite. For someone who has been working in the gem industry and has had the opportunity to work with genuine moldavite, it would be far from convincing. The initial reaction was that it was a man-made glass especially after comparing it with some of the reference stones in our lab collection (Images 2 to 5).

Several tests, complementing the initial microscopic examination, were done to verify the, now suspected, man-made 'Moldavite' imitation (see chart below)

These standard gemmological tests were followed by further testing with modern lab equipment. Photoluminescence- and Raman spectra were taken with the aid of our GemmoRaman-532 unit (Spectra 1).

After the photoluminescence spectrum was taken the unit was adjusted for optimizing exposure time as well as number of exposures to get a good Raman spectrum for comparison of the known moldavites in our reference database (Spectra 2).

The Raman spectra of known moldavites in our reference collection all show some common peaks (Spectra 3).

The sample spectra in our lab reference library are completely in line with spectra collected during the research by Russian scientists M.V. Volovetsky, A.A. Averin and A.A. Shiryaev from the Vernadsky Institute of Geochemistry and Analytical Chemistry RAS, in their paper on the subject; RAMAN SPECTROSCOPY STUDY OF TEKTITES, presented at the CORALS II conference 2011.

By comparing the Raman spectrum of the stone, supplied by client, to the software connected reference library of the GemmoRaman-532 unit, a match for man-made glass imitations was found (Spectra 4).

Conclusion:

The gem supplied for testing was not a moldavite. It is not of natural origin but a man-made glass product. The trade name for this glass is 'Emeraldum and it is made for the sole purpose of imitating different green gemstones. Unfortunately, it seems to be used, all too often, to fraudulently sell cut stones as natural Moldavites. This is a practice that needs to be stopped. The best way of accomplishing this is to educate our consumers and not hesitate to expose the fraudsters (Image 6). As a result, the vendor has now removed all 'Moldavite' from their website.

Data	Tested Stone	Reference Stones
Shape	Oval faceted (Mix)	Pentagram cut (both)
Measurements	13.27 x 10.35 x 9.24 mm	8.85 x 4.27 and 7.71 x 3.81 mm
Weight	6.76 ct. (6.73 stated)	2.24 ct. and 1.44 ct.
Colour	Yellowish green	Greyish green (one light colour)
Rrefractive Index	1.516 (isotropic)	1.498 and 1.484 (isotropic)
Long Wave UV	Inert	Inert
Short Wave UV	Chalky bluish white	Inert


Image 1: Submitted Stone.


Image 2: Spherical gas bubble and swirls in the submitted stone. Note the vivid colour.

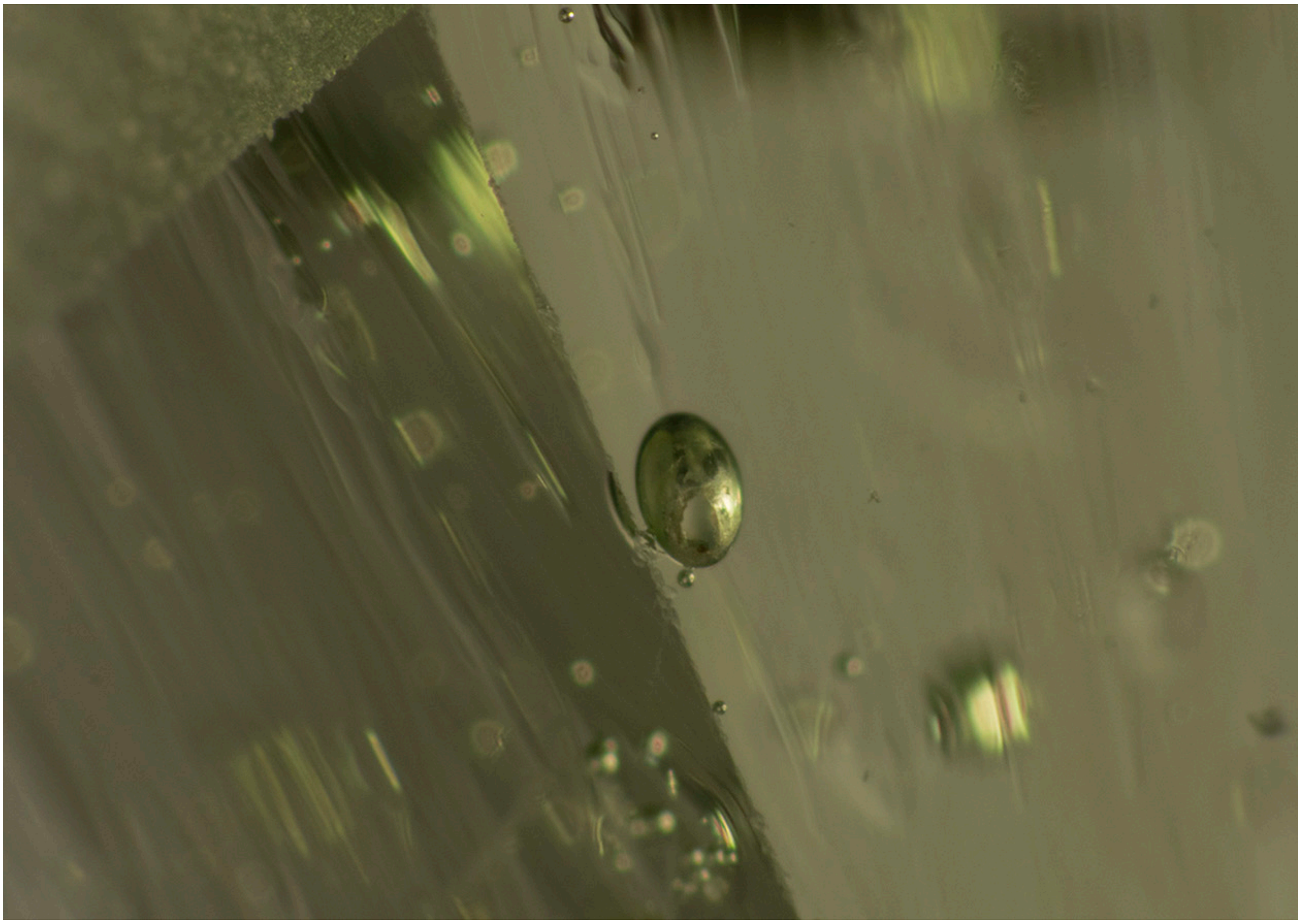


Image 3: Typical egg-shaped gas bubble and more or less haphazardly wavy swirls in natural moldavite.

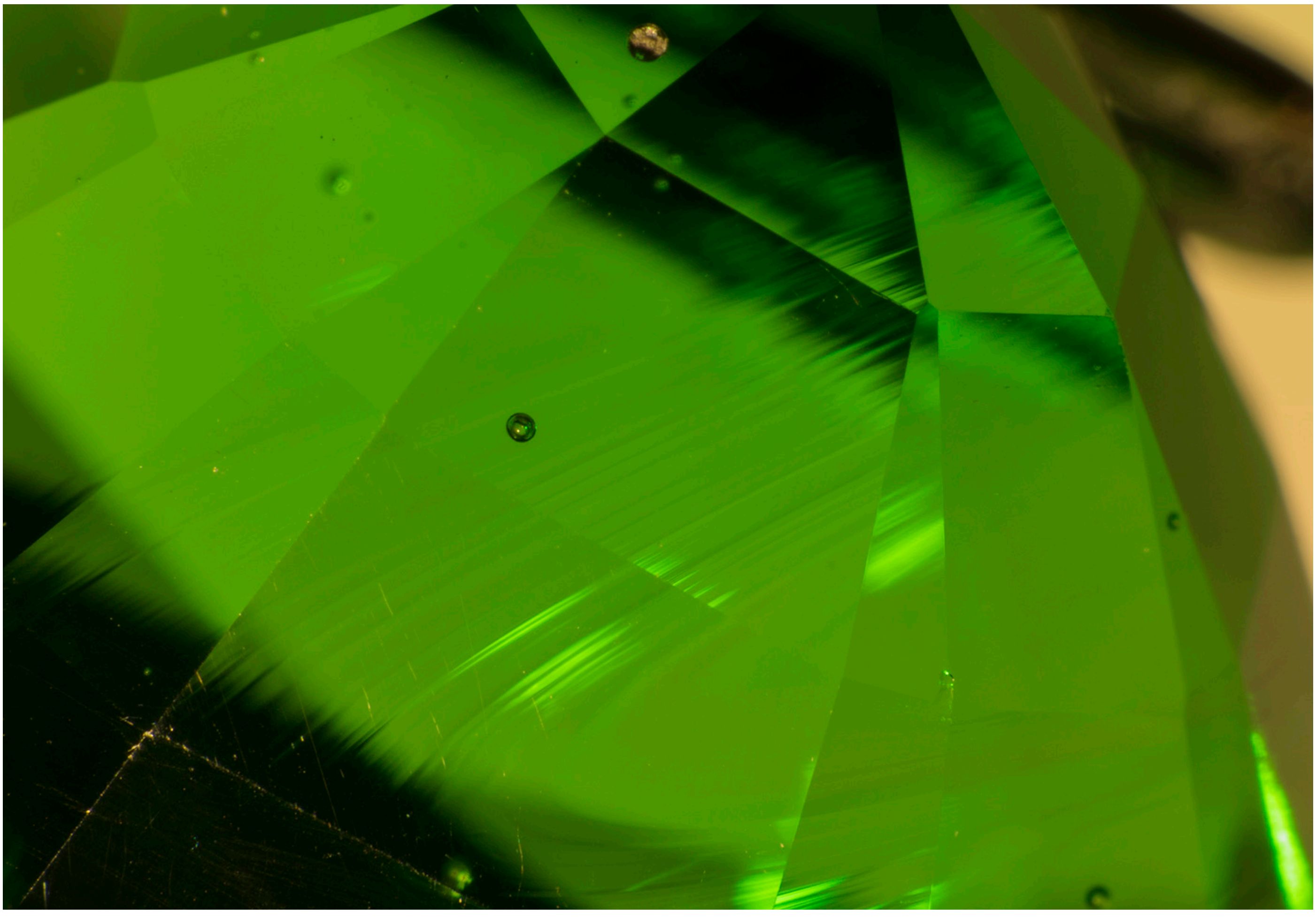


Image 4: Swirls very different from normal swirls in moldavite and more reminiscent of swirls found in man-made glass. Bubble near top center has been cut through and contains residue from polishing.

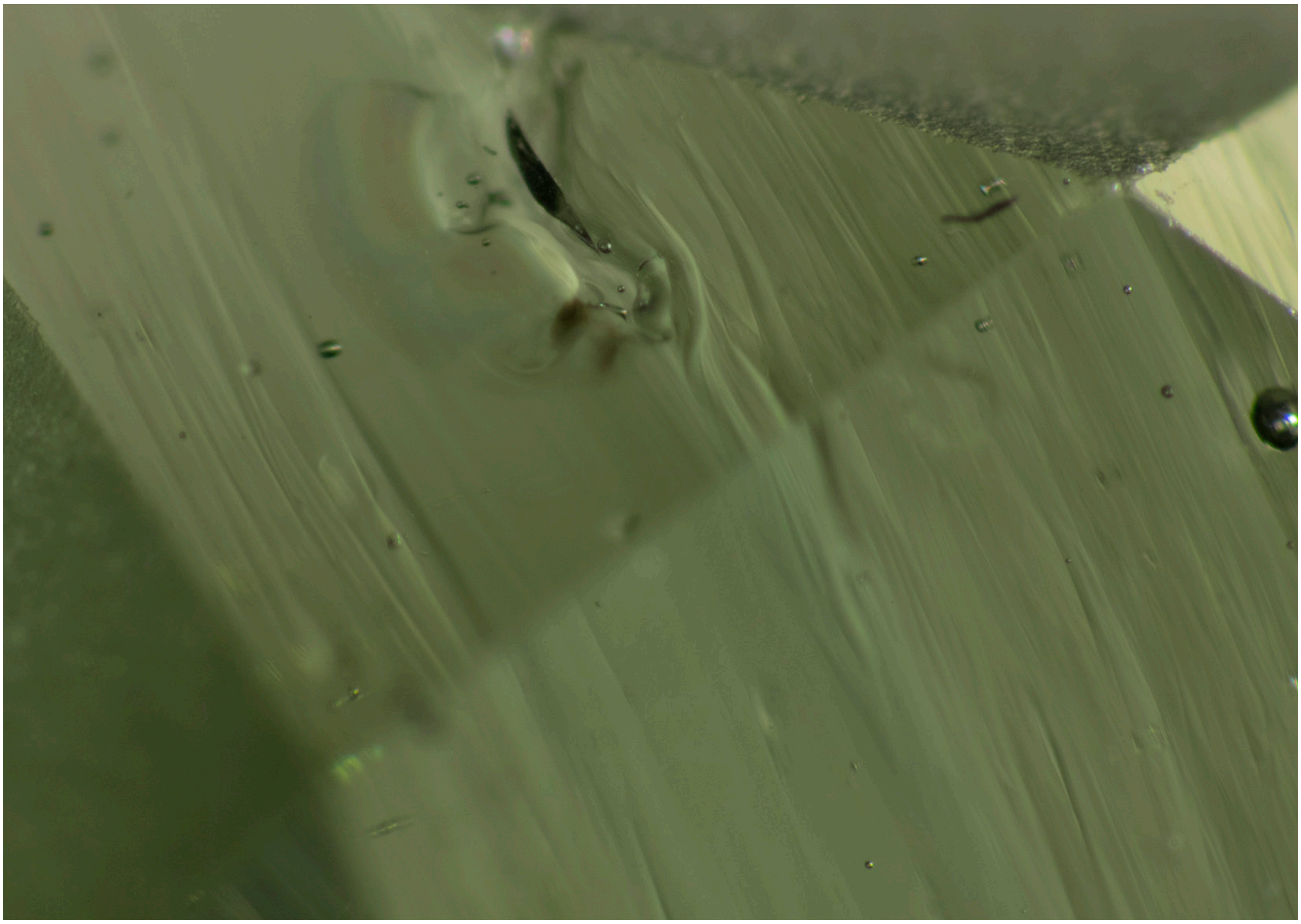


Image 5: Swirls, Lechatelierite inclusion and gas bubbles in natural moldavite.

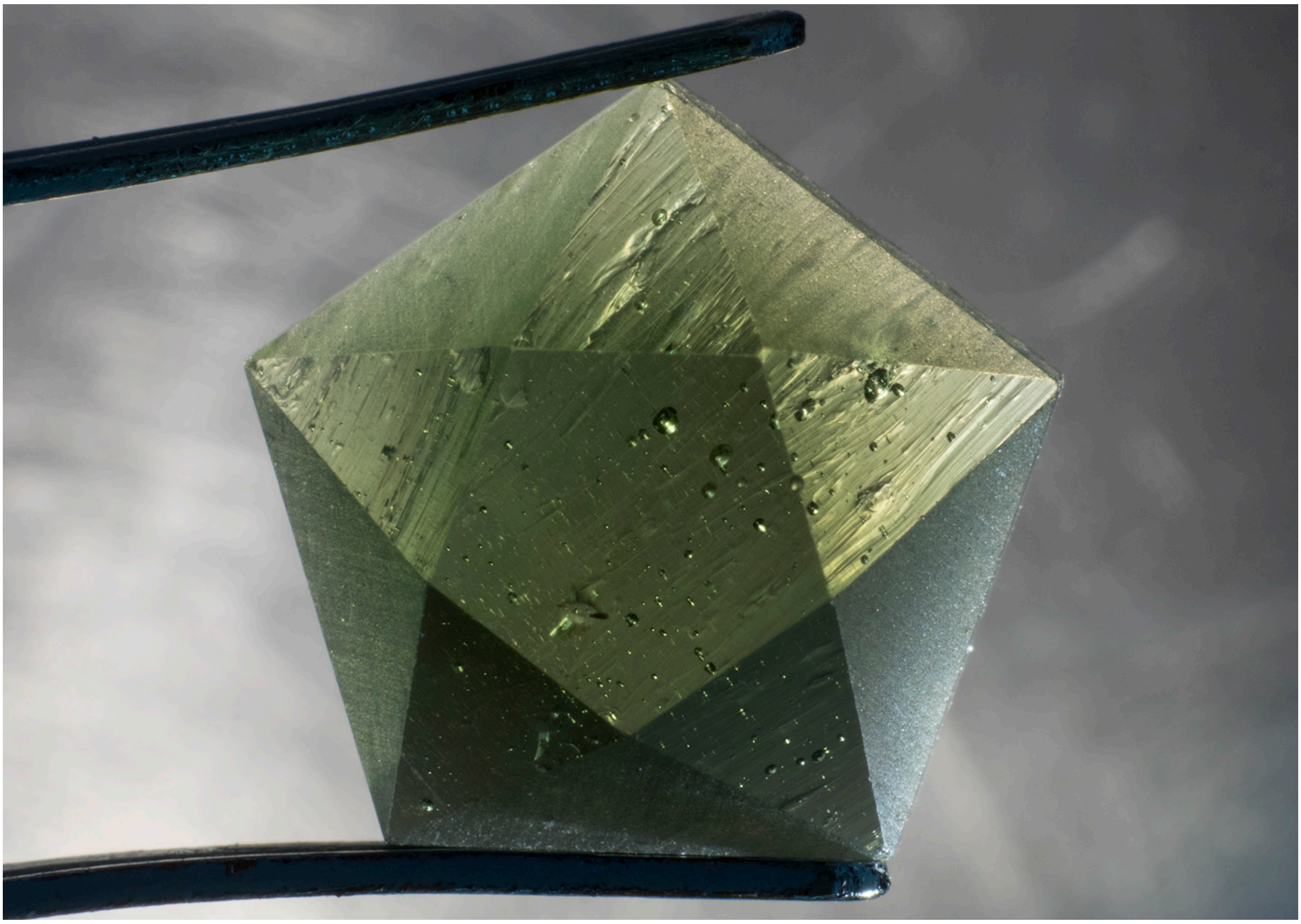
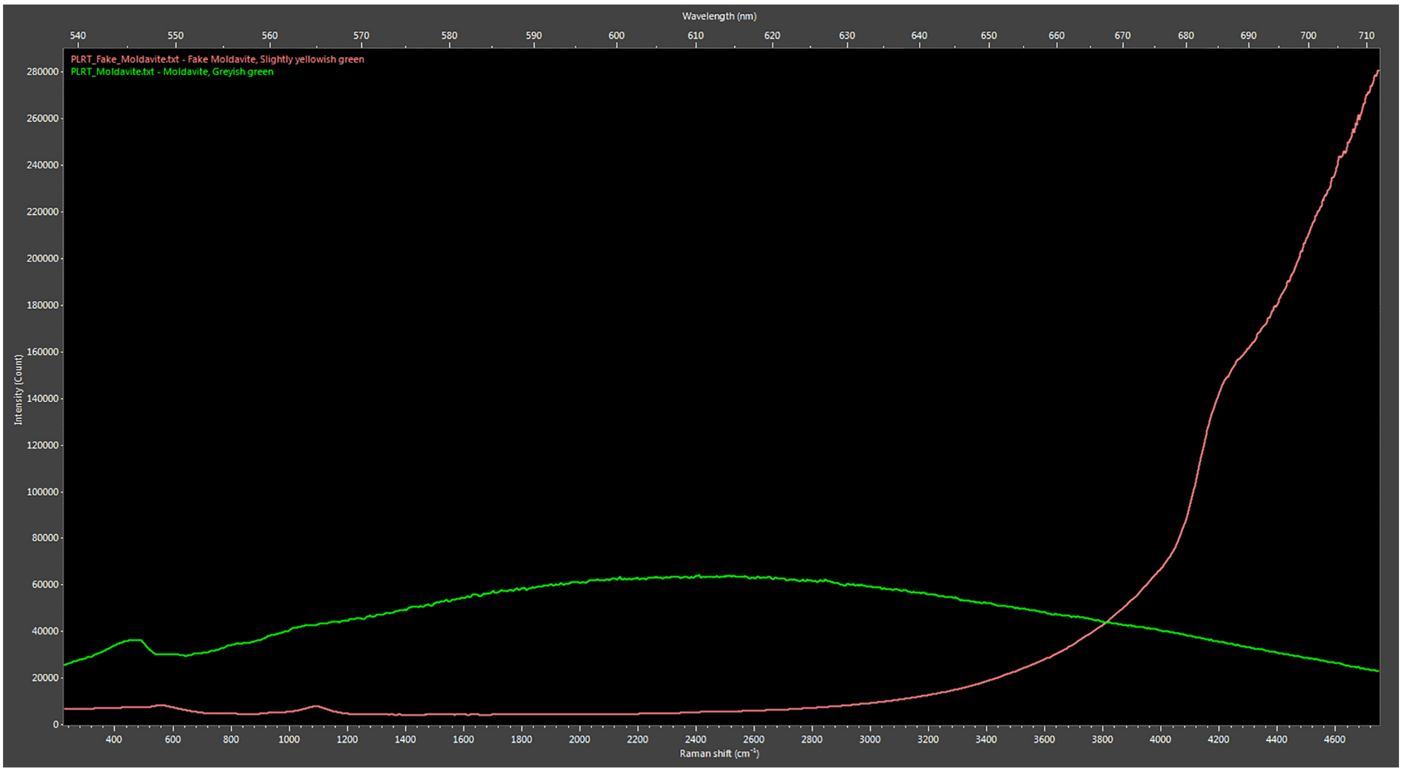
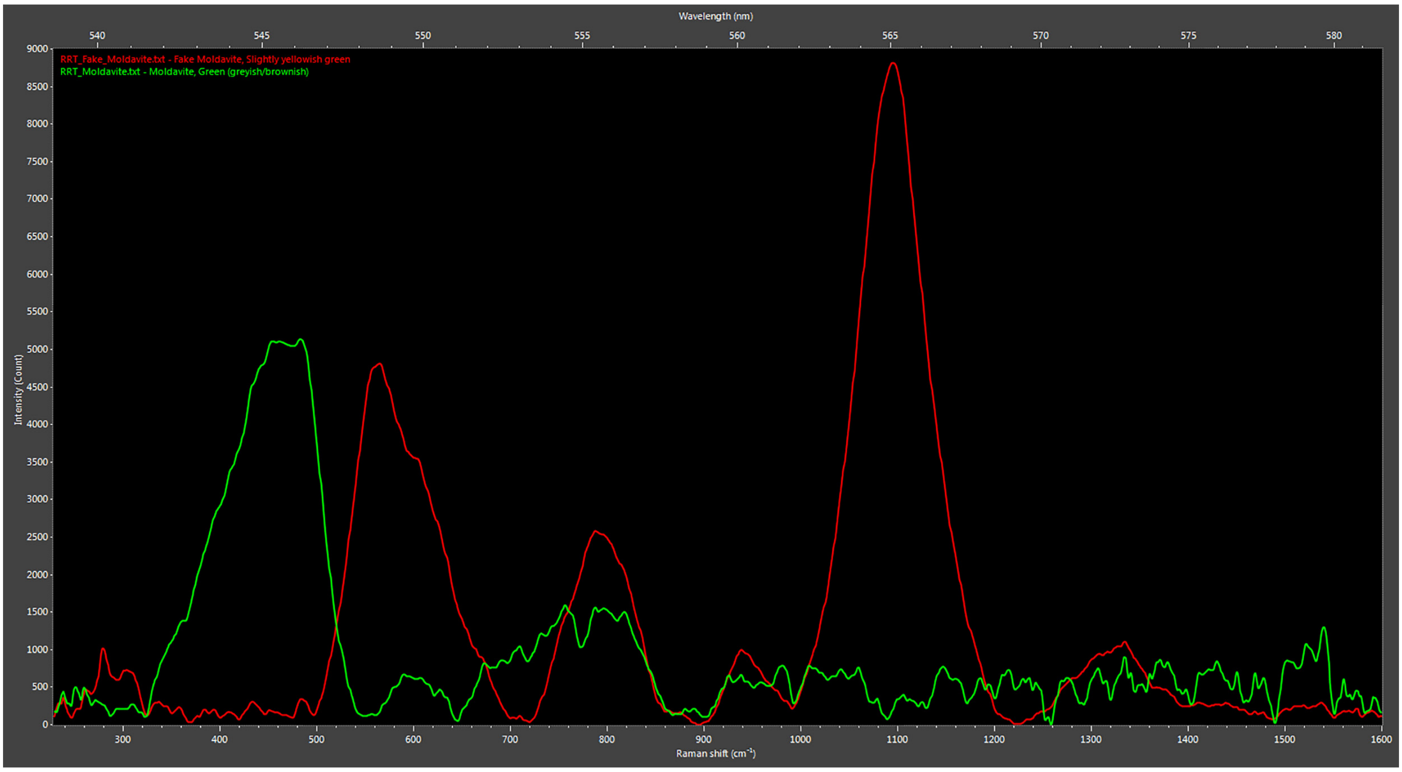


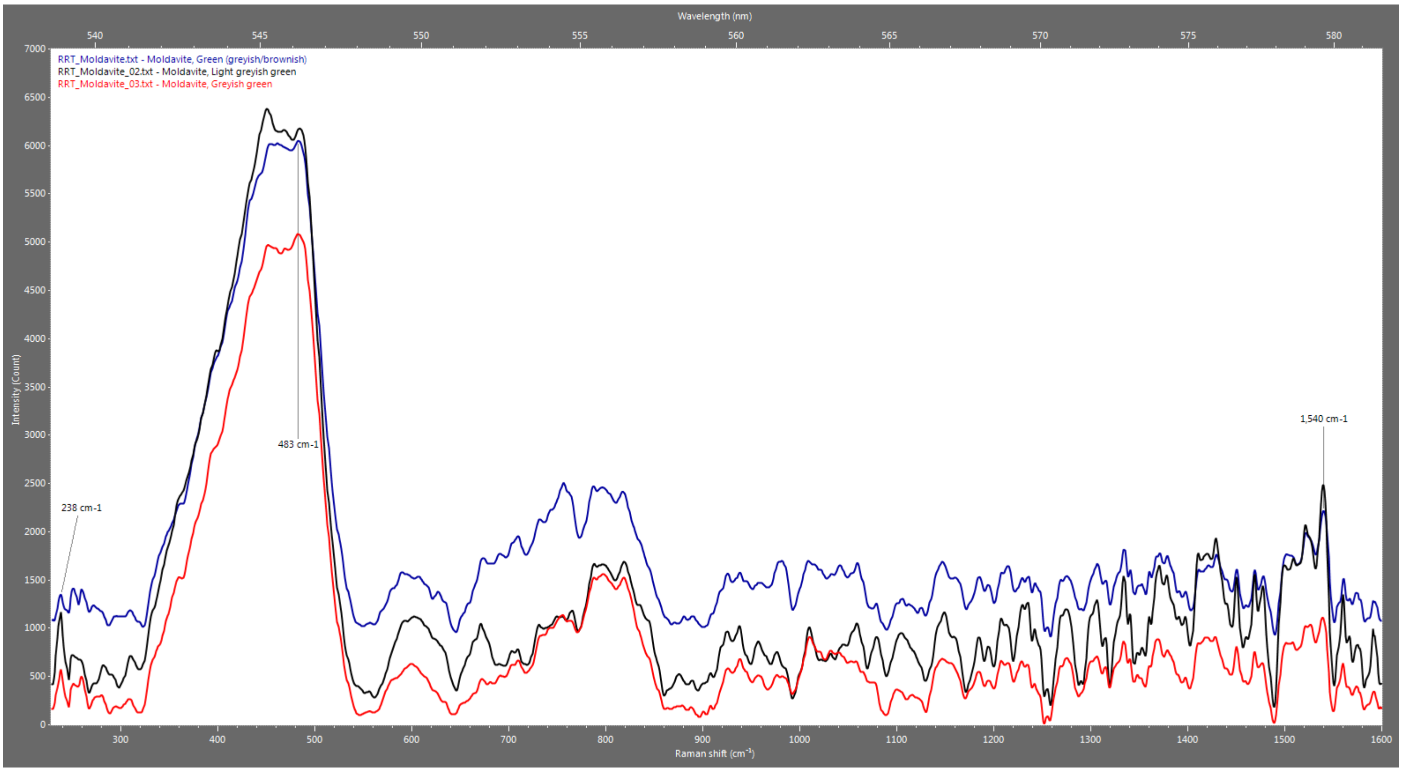
Image 6: How the majority of natural moldavite internals look.



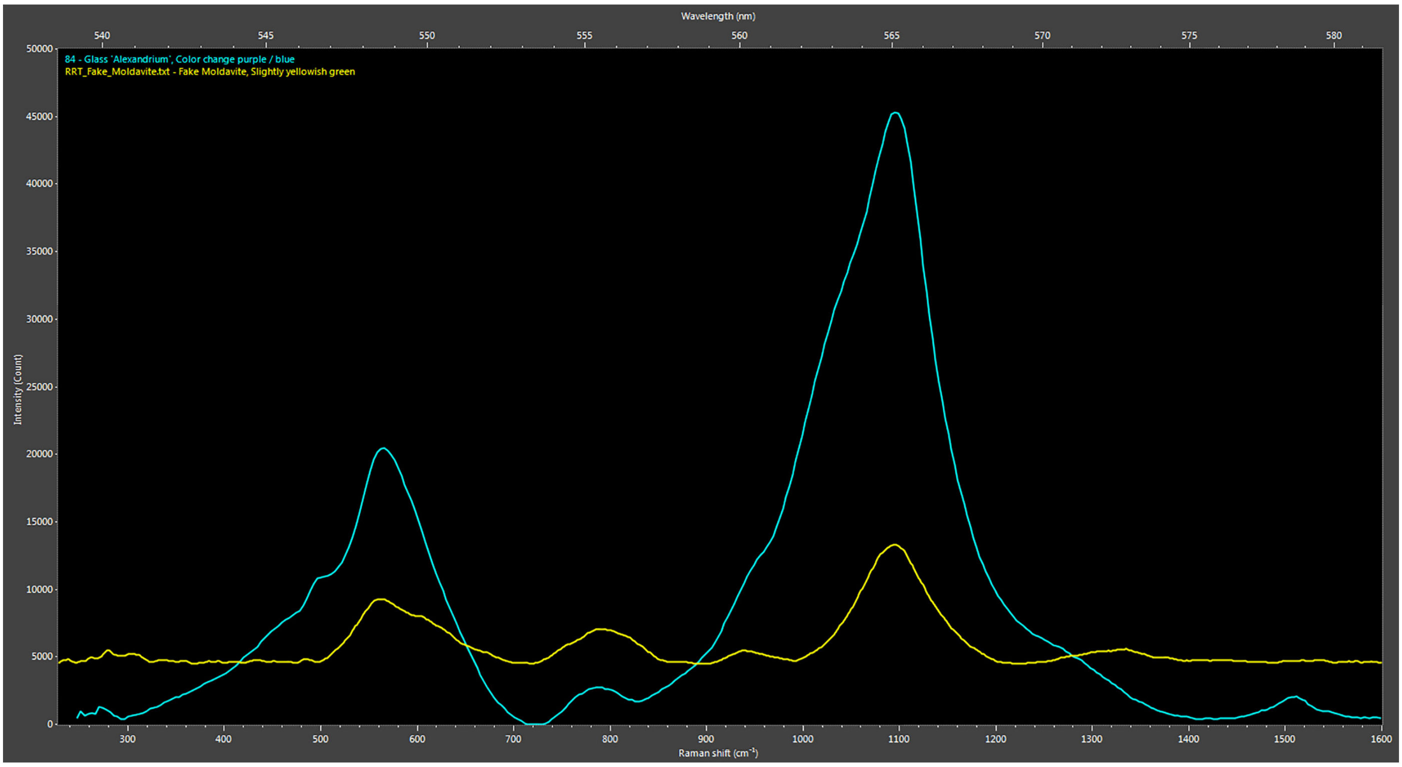
Spectra1: Photoluminescence spectra comparison. No match of materials seen.



Spectra 2: Even better visualization by Raman spectra, one can clearly see we have completely different fingerprints.



Spectra 3: Most prominent are the 483.0 cm-1 peaks but the peaks at 238.0 cm-1 and 1 540.0 cm-1 can also be mentioned. All spectra have been normalised as well as background corrected and have been vertically shifted for clarity.



Spectra 4: Raman fingerprint of supposed moldavite matches main components of man-made glass in database. Reference database says colour change but Raman do not see colour.

Suggested reading:

https://www.gia.edu/sites/Satellite?c=Page&childpagename=GIA%2FPage%2FGGArticleDetail&cid=1495238490537&d=Touch&packedargs=childpagename&pagename=GIA%2FWrapper
https://www.gemdat.org/gem-10860.html

Out in the Field
Gem Tripping for Gem Fanatics

JOEL DYER is a Canadian currently living in Finland whose greatest satisfaction comes from studying, experimentation and writing articles.

The Magical Quartz Forest of Selvino, Italy

View from Selvino Hills (Photo by Joel Dyer

In the beginning of June, I travelled to Italy to attend the bi-annual Curnasco Micromineral Exchange event in Bergamo. It was nice to see old friends again, after having had only email contacts for several years. New acquaintances were also made, and I took back some sunny memories to warm myself up with in the cool Finnish climate.

Finally, I was also able to visit Selvino in the hills outside Bergamo. The village of Selvino is situated around 1000 m above sea level, and is known for downhill skiing in the winter, but also for beautiful quartz crystals in the outlying forests.

Along with my friends Stefano and Vittorio, we drove up a serpentine road that displayed signs with famous names of Giro d'Italia cyclist participants at major bends. As it happens, one of my hosts Vittorio had also taken part in these races in past years. After arriving at a suitable parking spot, we went out in search for quartz crystals amidst beech, maple and other deciduous trees, mistletoe, and many flowering plants that included rare wild lilies. I heard that in the Autumn, boletes and other edible mushrooms can be found in these forest areas. What a delicious combination: 'Bergamo diamonds' and mushrooms!

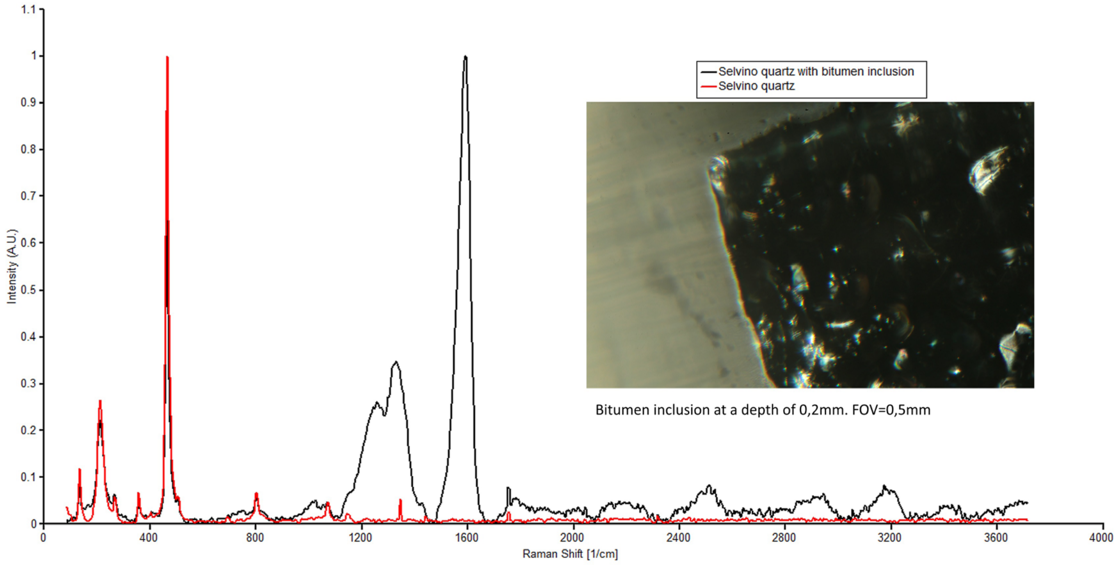
Hydrothermal Quartz Crystals hosted by Triassic Dolomite Rock

The Selvino hills are rich in dolomitic rocks dating from the Upper Triassic period, several hundred millions years ago. Later tectonic events brought within them hydrothermal fluids that contained silica, occasionally fluorine, and plenty of bitumen and other hydrocarbons. Because of thick, highly over-saturated silica content of the fluid, crystals started first to nucleate spontaneously without cavity wall attachment, according to certain theories. This, and the fact that the cavities were not lined with quartz but dolomite and some calcite, lead to perfectly formed crystals, up to a certain size. Similar formation conditions prevailed at Herkimer, USA, which is famous for its double-terminated 'Herkimer Diamonds'", which of course are also quartz. Herkimer diamonds similarly contain frequent hydrocarbon-rich inclusions.

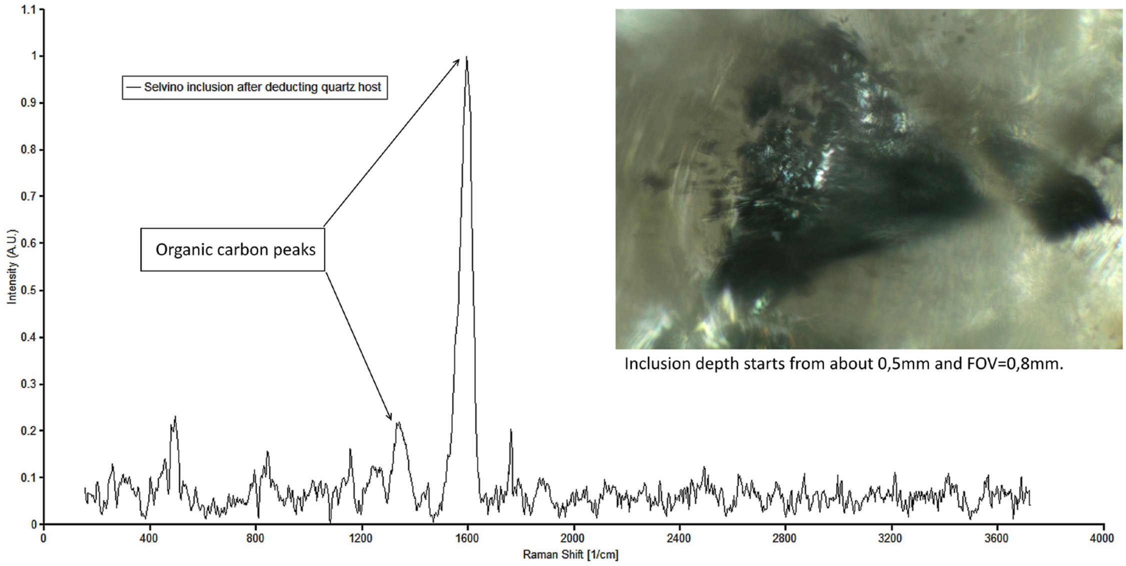
Normally, intrusive and pegmatite type quartz crystals grow out of the matrix and are usually not double-terminated. As the size and weight of quartz crystals grow, double-terminated crystals tend often to attach themselves more firmly to cavity walls, even under oversaturated hydrothermal growth conditions. The host rock is often brownish, with darker discolourations near cavity or vein areas, due to bitumen and other hydrocarbon content. Crystals are usually found loose on the soil surface, or embedded in the topsoil. The best time to search for crystals is after a period of heavy rain, which exposes they crystals. These 'natural quartz gemstones' reflect sunshine quite efficiently, again making the searching a little easier. The reason that so many crystals are found loose is that the dolomitic host rock has dissolved and eroded away during a period of millions of years.

Many Varieties of Shapes with some Twinning

Already in the 1600's, Selvino quartz crystals were mentioned in literature, and in the late 1990's an article by researcher F. Pezzotta was published in the Lapis magazine on the quartz crystals of Selvino. It is not that common to find well-formed, clear quartz crystals that are also double-terminated, due to



Investigation of a Selvino Quartz Crystal Inclusion (Image by Joel Dyer)



Selvino Inclusion spectrum after deduction of host quartz (Image by Joel Dyer)

Selvino Quartz Crystal Specimens up to 3cm in length (Photo by Joel Dyer) the special formation conditions that are required. Perhaps it is not so surprising then that such brilliant, 'well-faceted' crystals have been called 'such and such diamonds' in many places around the world. In former times, the additional lack or poor development of prism faces may have made the bipyramidal quartz crystals indeed look more like true diamonds.

Typically, clear Selvino crystals range in size from a few mm's to one to four cm's long, although occasionally up to 10cm, more imperfect or inclusion-rich crystals can be found. On rare occasions, some crystals can be found lightly connected to the matrix, or loose in cavities in larger rock exposures. Typically, the double-terminated crystals display normal elongation, but sometimes they have minimal prism faces. Sceptre crystals can also be found, as well as contact twins that are locally called 'marriage' twins.

The author managed to find some 1-2 cm long crystals that were rather oddly shaped, and seemed to be somehow twinned. One termination appeared to have veered off at an angle, and the other end seemed nearly squared. As there were some inclusions in these otherwise gemmy crystals, it is very likely that changing formation conditions and fluid compositions affected the normal or ideal crystallisation process.

Inclusions of Bitumen, Coal, Iron Compounds, Fluids and Gases

In the short time available, the author managed to collect several dozen fairly clear crystals, with the help of the seasoned guides Stefano and Vittorio. In addition to this, many crystals or broken crystals that displayed inclusions were eagerly gathered, as these specimens can be very interesting to study under the microscope.

The previous winter, I sent some Selvino crystals, received earlier as a gift, to the famous inclusionist and microscopist John Koivula at GIA. John wrote that after heating one of the crystals, a distinct smell of 'rotten egg' emanated from fractured fluid inclusions. This seemed to confirm earlier suspicions that some crystals contained organic compounds in addition to possible salt solutions, air and gases that typically occur in many quartz crystals.

When looking at the new crystals back in my home lab, there were black fragments, golden liquid-filled and colourless liquid or gas filled inclusions in many crystals. Some golden or amber coloured inclusions displayed a complicated, network-like or wrinkly structure. Perhaps former oils had partially oxidised and turned into what a geologist in Bergamo called 'dead oil', a term used in petroleum geology. Indeed, when striking the Selvino dolomite rock with a hammer or even scratching it, a strong 'whiff' resembling crude oil can be smelled.

The author has not yet managed to find any systematic documentation regarding Selvino quartz inclusions, but some observations can be made, supported by scientific literature. Using my self-built MicroRaman system, evidence of bitumen and other unknown hydrocarbons was found in some quartz crystals. Hydrocarbon inclusions are often difficult to identify, due to high background fluorescence, and the fact they are frequently complex mixtures. However, investigations are still ongoing and perhaps some day more information on this matter may be 'brought to laser light', so to speak.

A Magical Quartz Forest that yearns to be visited again

Hopefully, there will be a chance to visit the Selvino forest again. It is very strange to walk in a forest and literally pick up gleaming, gem-quality quartz crystals from the earth, while enjoying the abundance of varied plants, trees and fresh mountain air. It would be unforgettable to pick some delicious mushrooms at the same time, so Autumn would surely be a fabulous time to visit Selvino again.

Selvino quartz crystals are well known by local mineral hobbyists, but they are not nearly as famous or commercialised as Herkimer Diamonds, which occur in more perfect form often in larger size than their 'poor cousins' in Bergamo. Several Italian artisans also appear to make jewellery incorporating natural Selvino crystals.

The view alone from the hills over the valleys and towns is worth the windy drive up the steep hillside. The distance from Bergamo city is only around 20 km, so a day trip with a relaxed picnic break is quite feasible. Until next time, the mind can be nourished with pleasant memories and by viewing the fascinating quartz crystals with bare eyes, or under the microscope, which opens up a spellbound fairytale world of its own.

Further Reading & Information:

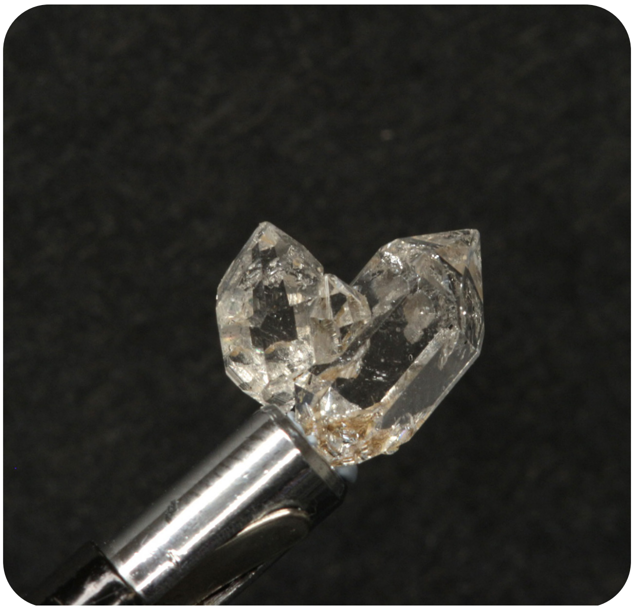
https://it.wikisource.org/wiki/Dei_cristalli_quarzosi_di_Selvino/Dei_cristalli_quarzosi_di_Selvino

http://www.quartzpage.de/

https://www.mindat.org/min-1877.html

https://www.mindat.org/a/curnasco_micromineral_exchange_2017

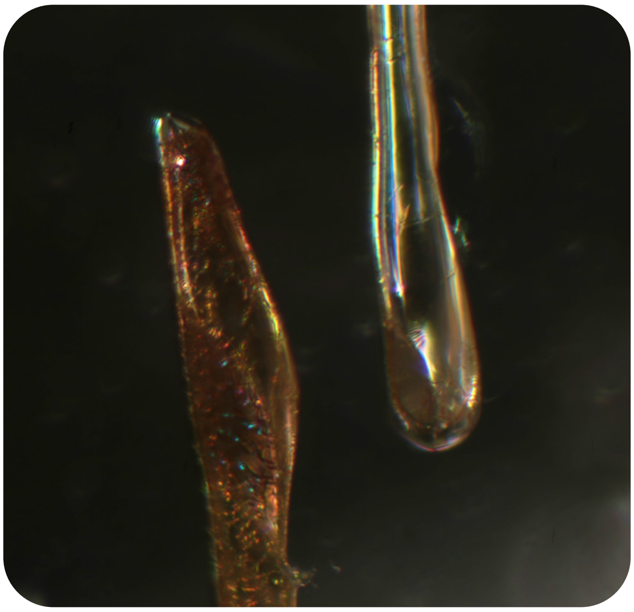
http://www.quarzidiselvino.it/gemme.htm (also jewellery)



Selvino Quartz Contact Twin Crystal (Photo by Joel Dyer)

Selvino Quartz Crystal with Inclusion (Photo by Joel Dyer)

Selvino 'Sceptre' crystal (Photo by Joel Dyer)



Selvino Quartz Crystal Inclusions (Photo by Joel Dyer)

Selvino Quartz Crystals
(Photo: Frederico Pezzotta - Lapis 1999 Article)

Help make a difference!

For many of us, life is pretty good. We have a job, a roof over our heads, food on the table and a family that supports us. However not everyone is as fortunate. In fact if we look around the world, the percentage of people who fall into the 'life is good' category is small compared to those who fall into the 'life could be so much better' category.

The problem of course is that if we look at the problems worldwide, they seem almost insurmountable and for many, they just cannot see how they can make a real difference.

Thankfully Kandy Kids feels differently. They realise that they cannot change the world but they are committed to improving the lives of children in the Kandy area of Sri Lanka, one child at a time.

On September 20th, 2017, our good friend Stuart Pool from Nineteen48 is once again going to help raise money for the charity. This year he will be participating in a 'mini-triathlon' that involves swimming, running and cycling. 100% of the money Stuart raises will go to Kandy Kids.

We know people are tired of donating money. There are so many good causes out there but only so much money to go around. The British Gem Academy would like to 'sweeten the pot' by matching 'pound for pound' any money you donate to this fundraiser with tuition credits for our digital gemmology courses offered through the World Gem Foundation. We believe this is a win/win situation for everyone. You will learn more about the fascinating world of gemstones, gaining valuable knowledge that will help you in your career and Kandy Kids will have much needed funds to help the orphans and underprivileged children in Sri Lanka.

You can donate money to Stuart's fundraiser by clicking on the following link:

https://mydonate.bt.com/fundraisers/stuartminitriathlon

On confirmation of your donation, the British Gem Academy will issue you a 'tuition credit' equal to your donation towards any of our digital gemmology courses. The more you donate, the bigger the tuition credit. We really hope that jewellers will get involved and in return for helping Kandy Kids will be investing in the education of their employees.

Please Note: This offer is only available to those donors living in the United Kingdom.

Kandy Kids (Charity Number: XT37134) is run by Steve O'Driscoll and Edith Bluker, who are based in the UK. The charity has been operating since 2007 and is focused on three key areas – food, fun and education. It supports several orphanages in the Kandy area of Sri Lanka with food and equipment (both general and educational), as well as providing support in the form of scholarships to individual children from underprivileged families from the Kandy area. They take a hands on approach, visiting Sri Lanka on a regular basis, working closely with the orphanages and local authorities to make sure all funds raised are spent wisely.

You can reach Kandy Kids at: http://www.facebook.com/kandykidscharity

To read more about Nineteen48's involvement, please click here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Tino Hammid Memorial Gemmological Scholarship

In 2018, the World Gem Foundation will award five scholarships allowing deserving students to take the World Gem Foundation theoretical ‘Career Gemmology’ course.

Tino Hammid Memorial Gemmological Scholarship

In every industry there are iconic individuals, giants who stand head and shoulders above the rest. In the field of jewellery and gemstone photography, there is little debate that Tino Hammid was a visionary, a rare talent who possessed the unique ability to capture the true beauty of gemstones. For almost forty years his photography adorned the pages of every important publication around the world, showcasing his unrivalled ability to inject realism into his work.

Tino started his career as a staff gem photographer at the Gemological Institute of America (GIA) in Santa Monica, California (1980 to 1982). In 1983 he started his freelance career in gem and jewellery photography and began a 25-year association with David Federman providing photographs for Modern Jeweler’s monthly Gem Profile column. During this period they jointly won two Jesse H. Neal awards from the Association of Business Publishers. In 1987 he acquired Christie’s Auction house as a client and photographed more than a hundred of their jewellery sales catalogues.

In 2012, Tino joined forces with gemmologist Geoffrey M. Dominy and provided the exquisite photographs for The Handbook of Gemmology, the first digitized gemmological textbook released in 2013.

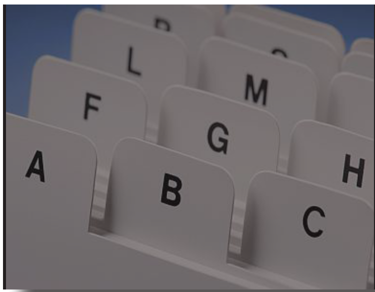
Sadly, Tino passed away in 2015 after a two-year battle with cancer, however through the Handbook of Gemmology and now the World Gem Foundation courses, his legacy and monumental contribution to our industry will live on for future generations to appreciate and admire.

In 2018, the World Gem Foundation will award five scholarships allowing deserving students to take the World Gem Foundation theoretical ‘Career Gemmology’ course.

The deadline for submitting your application is December 31st, 2017. All applications will be judged by Tino’s wife Petra and his oldest daughter Evelyn with the mandate to select those five candidates who, in their opinion, best epitomize the spirit of Tino.

To download the application form, please click on the image below:

Scholarship Application



Academy Directory & Contact Information

Academy Name	Address	Tel. No	E-mail Addresses
World Gem Foundation	Plaça de Quadrado 1, 4B, Palma, Mallorca, 07001 España	+34 871904592	information@worldgemfoundation.com
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