



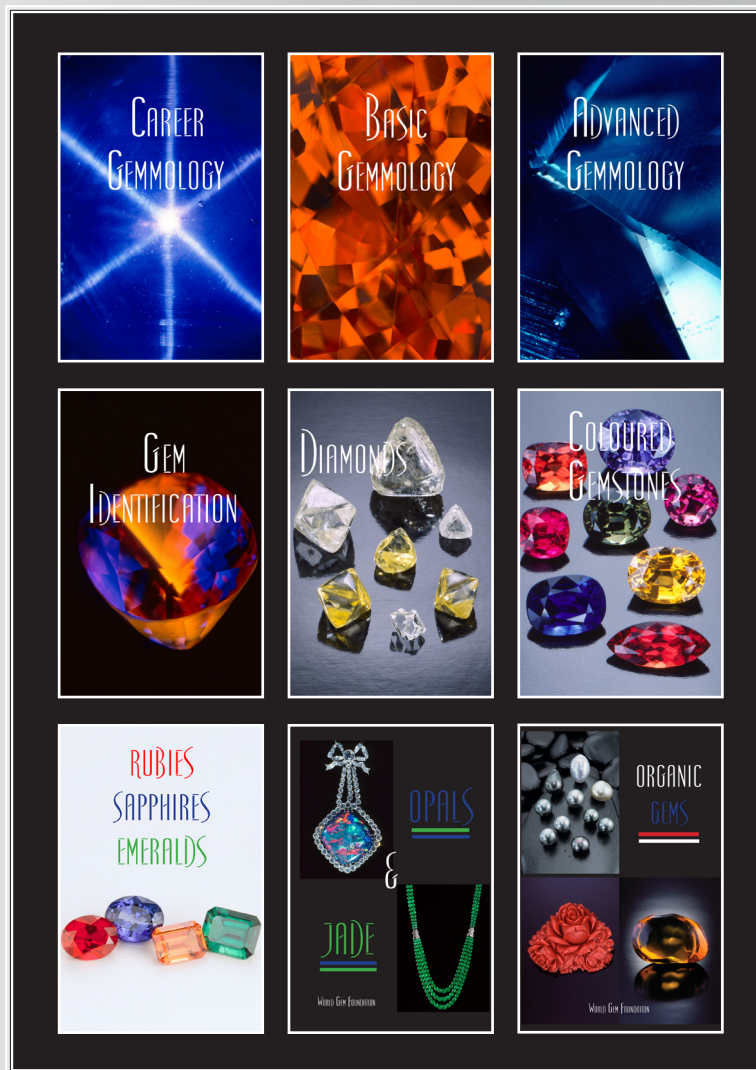
# Gemmology Today

February 2018  
Quarterly Publication



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Trapezoidal Emeralds courtesy of Gem Lovers

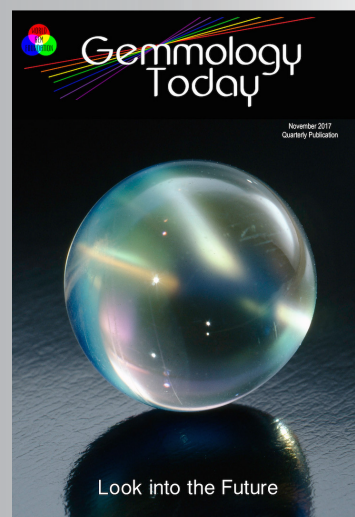
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November 2017 Issue





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



Music continues to play an important role in my life and I have to admit that when I went through Dmitry's photographs that accompany his interview, I immediately gravitated towards the photograph of the two trapiche emeralds that grace the cover of this issue. Are they not the gemmological equivalent of Pink Floyd's The Division Bell?

A lot has happened since the last issue. A new 'General Interest' course on rubies, sapphires and emeralds, two new 'Diploma' programs (Diamond Professional and Coloured Gemstone Professional), a new academy in the Democratic Republic of Congo that continues to demonstrate our desire to be more active in key gem producing areas, the unveiling of our first Spanish course (Gemología Básica), changes to our existing Gem Identification course and co-ordinating the plans for the new teaching centre here in Palma.

Petra and Evelyn Hammid have also selected the five recipients of this years Tino Hammid Memorial Gemmological Scholarship. Reading the email acknowledgements from Brandon, Asif, Teklebrhan, Shakeel and Khawaja really reinforced my belief that education is a powerful commodity. They were all thrilled to be accepted and hopefully they will seize this opportunity and embark on their own gemmological journeys.

We have also included online tutoring to our diploma program courses. Long distance learning offers many advantages but it does require a certain discipline. Being self-motivated is an important quality and it is not always easy when you are working alone. The tutoring is designed to help our students when they are struggling with certain scientific principles and to provide them with support and encouragement. It also allows us to 'connect' with our students and get to know them better.

Once again I would also like to thank all of our contributors and especially our readers who have made the first year a stunning success. We are certainly reaching far and wide and hopefully making gemmology not only more accessible but also a little less intimidating.





## The Origin of Diamonds in Europe - 16th & 17th Centuries

The historic diamond Le Grande Mazarin was put up for auction last November for the first time since 1887. The type Ila diamond, weighing 19.07 carats with a VS-2 clarity and light pink colour sold for \$14,463,493 CHF. The stone is one of the last historical diamonds of its kind still in private possession. The provenance of Le Grande Mazarin includes Jean-Baptiste Tavernier, Cardinal Mazarin, Louis XIV, Napoleon I, and Frederic Boucheron among others. The diamond was part of the French crown jewels from the 17th century when Cardinal Mazarin donated it to the crown as part of a collection of 18 diamonds (Christies 2017). Apart from the 18 'Mazarin diamonds', Cardinal Mazarin also gave the Queen 50 diamonds and the 14 carat Rose d'Angleterre to Anne of Austria (Bruton 1978 p 455). Le Grande Mazarin itself, as well as other famous Mazarin diamond such as the 'Sancy' and the now lost 'Mirror of Portugal', have interesting histories documented in novels and movies but here the focus will stay on the supply of diamonds to Europe in the 16th – 17th centuries.

Cardinal Mazarin, an Italian, had come into a powerful position in France and was close to Louis XIV. Mazarin bought most of his diamonds from Jean-Baptiste Tavernier (Bruton 1978 p 454). At the time Jean-Baptiste Tavernier brought Le Grand Mazarin and a number of other famous diamonds, including the French Blue, to Europe. It is usually noted in gemmological literature and educational material that all these diamonds originated from the Golconda region in India (Alam 2000). By the time the Grand Mazarin reached Europe, the mines of Golconda had been mined for at least 2000 years. India is usually mentioned as the only supplier of diamonds until 1725 when diamonds were discovered in Brazil.

The growing European diamond industry had emerged in the 14th century in Venice and also in certain cities in southern Germany and eventually resulted in the establishment of numerous diamond centres across the continent. Several early diamond centres are still today strongly associated with diamonds. The most obvious example is Antwerp but also Amsterdam and London became important diamond centres where traces are still visible today. The supply of diamonds from India was controlled in turn by the strongest seafaring nations of Europe; Portugal, Holland, England (Alam 2000).

Since the Portuguese had conquered Goa in 1510 they had control of the diamond trade from India for about a century. By the mid 1600s the Dutch gained control of most of the trade with diamonds from India. After the Portuguese lost control of the Indian diamonds, the European diamond centres that had depended on rough through Lisbon did not perish like Venice had done when they lost control of the supply of rough to Lisbon. Instead the existing diamond centres turned to the Dutch who in most cases were willing to continue supplying them with rough diamonds.

This competition between the large seafaring nations of Europe resulted in fluctuations regarding who had access to the most rough from India. It was not always the largest overall trade nation who controlled the majority of rough. The Indian mines were located in three different wide areas and fluctuations in local production and local economy also affected where the supply went. The Portuguese first described the diamond mines at the Deccan plateau, while the Dutch first described the deposits in Coromandel. The Indian system allowed diamond mines to be either owned or leased. The terms and conditions for leasing mines differed depending on which area they came from with some producers free to sell diamonds to anyone they wanted while others faced more restrictions in who they could sell to (Alam 2000).

Although to Europeans, India was probably the only known producer of diamonds, there was actually another producer. Diamonds from Borneo started to reach Europe during the 16th century and the supply continued into the 18th century. There are no exact numbers on the amount of diamonds imported to Europe from Borneo but during a ten year period in the early 17th century when the British East India Company tried to establish diamond trade on the island, it is estimated that as much as a few thousand carats a year may have reached London, even though initially imports were very modest. At a time when the supply through other European nations was insecure, the supply from Borneo was important to maintain the jewellery trade in Britain and gave important experiences for the British diamond trade in India (Ogden 2005).



In the 1650s the Dutch East India Company gained a full monopoly on the diamonds from Borneo and the Dutch kept their interest until the 1930s when they made their last effort to try to locate the primary source of the diamonds (Spencer et al 1988).

It is not known for how long diamonds have been found in Borneo. Webster claims in several editions of 'Gems, their Sources, Descriptions and Identification that Diamonds' from Borneo were known since about 600 CE. It is hard to find historical or archaeological evidence that confirms this but from around the 8th and 9th centuries CE there are archaeological findings supporting extraction and trade with diamonds from Borneo. When the Portuguese arrived on Borneo in the early 16th century, Duarte Barbosa provided the first written reference to diamonds on Borneo dated 1518. The diamonds were cut in Borneo with a similar technique as used in India suggesting earlier connections between the diamond producing areas in India and Borneo (Spencer et al 1988).

For short periods of time the supply of diamonds from Borneo might have had some importance for some of the European diamond centres and the European market but after the discoveries of diamonds in Brazil the production in Borneo became even more insignificant though production never ceased completely.

After the Dutch had left Borneo, locals and Chinese miners kept producing diamonds and in 1965 a pinkish 166.75 carat diamond was found. The stone was named 'Trisakti' which translates into 'three principles' and refers to the motto of the Indonesian republic. 'Trisakti' is the largest ever documented diamond from Borneo and one of two known diamonds with a weight over 100 carats. The 'Trisakti' was cut in Amsterdam by the Asscher & Co producing a 50.53 carat emerald cut (Spencer et al 1988; Larif).

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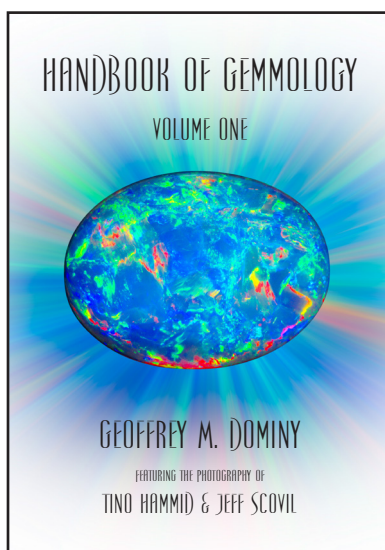
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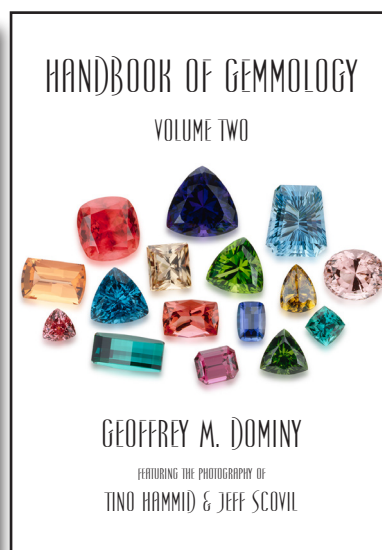


Rough Diamonds (Photo by Tino Hammid)

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After four decades, Dr. Kari A. Kinnunen is not quite ready to hang up his gemmological boots. He may be retiring but his passion for gemstones, minerals and rocks remains undiminished. Joel Dyer sat down with this Finnish Gemmological Giant to find out more.

## Meet Dr. Kari A. Kinnunen



Dr. Kari A. Kinnunen

Four decades of Gems, Gold and Photomicrography:  
A chat with Dr. Kari A. Kinnunen

After over four decades of work with gemstones, gold and minerals, a good acquaintance of mine at the Geological Survey of Finland's (GTK) Mineral Laboratory is now retiring – at least officially.

Interestingly, the careers of Kari A. Kinnunen and John Koivula have a lot in common. Both gentlemen are professional microscopists, and very familiar with inclusions in gemstones and minerals. Furthermore, both have a great love for photomicrography and a keen eye for beautiful and fascinating natural phenomena. And as some people know, John has Finnish roots as well: 'koivu' actually means birch tree in Finnish. Of course, Kari's work as a government research scientist in Finland is rather different than John Koivula's at

the Gemological Institute of America (GIA), yet even here in remote Finland, you can encounter some nice gemstones and gold nuggets. Recently there have also been fresh meteorite finds, with which Kari has been heavily involved. Perhaps surprisingly, Finland even has numerous kimberlite occurrences with small diamonds in many of them. But let's have a chat now with the man himself.

**GT:** How did you first get involved with minerals and gemstones?

**KK:** I have been a rock hound from my childhood. When my father bought me an old but decent microscope, gemstones and their inclusions opened up a new world to me. Chuboda & Guebelin's excellent book *Edelsteinkundliches Handbuch*, plus the samples I bought from the first gem and mineral shop in Finland, Tauno Paronen's gem shop, were my first

teachers. Without Internet in the 1960s, it was hard to get hold of sufficient quality information on gemstones. To my luck, the famous Dr. Edward Guebelin kindly took the time to answer my written letters, and our correspondence continued right up until his death in the 1990's. Dr Guebelin had a great interest towards Finland, although he did not know many people here. I think that the cooperation with Koivula in the field of inclusions was partly inspired by Edward's warm feelings towards Finland and people originating from here.

**GT:** Being a mineralogical 'multi-tasker', what work with gemstones do you most enjoy?

**KK:** The first inspection of an unknown gemstone with a good stereo-microscope is the most rewarding for me. At this stage all possibilities are open, and one must decide what further methods should be used to unravel the secrets of the stone. In addition, most gem materials are esthetically pleasing, especially when they contain inclusions.

**GT:** How would you describe the relationship between geology and gemmology?

**KK:** In my opinion most gemmologists are to some degree mineralogists, although they would not necessarily say so themselves. Geology and mineralogy are very important in gemstone exploration, yet the subjects are not covered very well in gemological courses. On the other hand, sophisticated geological and mineralogical research methods and instruments are increasingly used in gemmological studies as well. These include electron microprobe, Raman, SEM-EDS, LA-ICP-MS and PIXE.

Put simply, geologists and mineralogists identify natural gem materials, and gemologists both man-made and natural gem materials. I myself for example have only limited knowledge of man-made materials. That is why I consider myself a basic gemologist.

**GT:** What can 'classic' mineralogists learn from gemmologists, and perhaps vice versa?

**KK:** Simple instruments and methods used by practical gemmologists should be more widely utilized in mineralogical laboratories. They could save a lot of money in the first stages of identifying problematic materials. Gemmologists I think would benefit from more geology in their training programs

**GT:** Could you share some highlights in your long experience with mineral and gemstone photography?

**KK:** The shift from analog to digital was a real revolution for gemstone and mineral photography. With focus stacking, totally new specimen types entered into the domain of photography. In analog times, there were very few photographers specializing in gemstones. Today, one can 'Google' excellent photos taken

all around the world from specimens not seen in earlier classical literature.

**GT:** I understand that during your career you've been also involved with diamonds?

**KK:** Indeed I have. Starting from the beginning of the 1990's I have been microscoping and photographing diamond crystals, mainly microdiamonds, found in kimberlites and lamproites in Eastern Finland. The work has been carried out mainly for foreign exploration firms, mostly junior ones. The results of the work are still mainly confidential. Some of the results have been published, including in the new Finnish Gemstones book. My work has mostly involved documenting and classifying diamond crystals, as well as writing reports.

**GT:** Is it challenging to serve such diverse customers as ore geologists, mining companies, mineral collectors and others parties, as a government employee?

**KK:** Yes, the work really is challenging. Every customer type needs the results to be written in a way they can understand it. My research requires a high degree of popularization. It has been good practice for my present job to be the Editor of the Mineralia magazine published in Finland, unfortunately only in Finnish.

**GT:** What are some of the more memorable gemstone and other samples you have dealt with?

**KK:** The first Finnish ruby and sapphire finds and their identification work was the most memorable project for me. Sheen cordierite, a new gem cordierite type from Finland, is equally important as well. The most memorable specimens were the largest Lapland gold nuggets that we studied. Likewise, the first iron meteorite from Finland that we identified last summer in the GTK laboratory.

**GT:** Will you be dealing with gemstones and minerals after your retirement?

**KK:** Yes! Gemstones and minerals have been both my hobby and profession. In the following years I will have a better opportunity to concentrate on this passion of mine.

**GT:** Any thoughts on the future of gemmology and possible gemstone mining in Finland?

**KK:** Gemmology today is to a high degree, and will become even more so, the identification of synthetics, simulants and treatments. Training spent on learning these matters is time taken away from the study of natural gemstones, and this is sad.

In Finland everybody is waiting for our first diamond mine, perhaps in Lahtojoki, to be opened on a commercial scale.

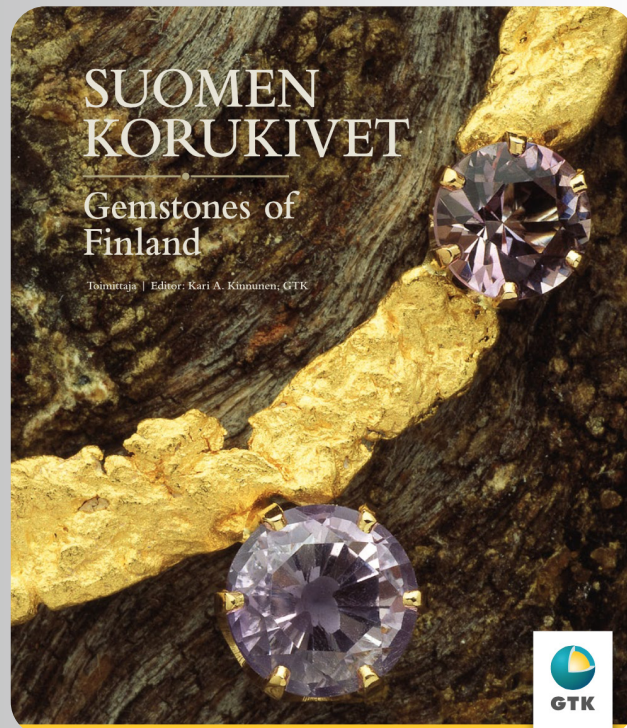


Spectrolite quarries have reserves sufficient for tens of years of mining. The gem beryl quarry in Luumäki has good potential for new pocket discoveries.

Many more Finnish gemstone mines should be opened for tourists. Now there are only three: Luosto and Lampivaara amethyst mines in Lapland, the chrome diopside and Uvarovite tourist mine in Outokumpu, and the large Li-rich pegmatite quarries in Ostrobothnia in Western Finland.

Kari was interviewed by Joel Dyer, a Canadian currently living in Finland whose greatest satisfaction comes from studying, experimentation and writing articles.

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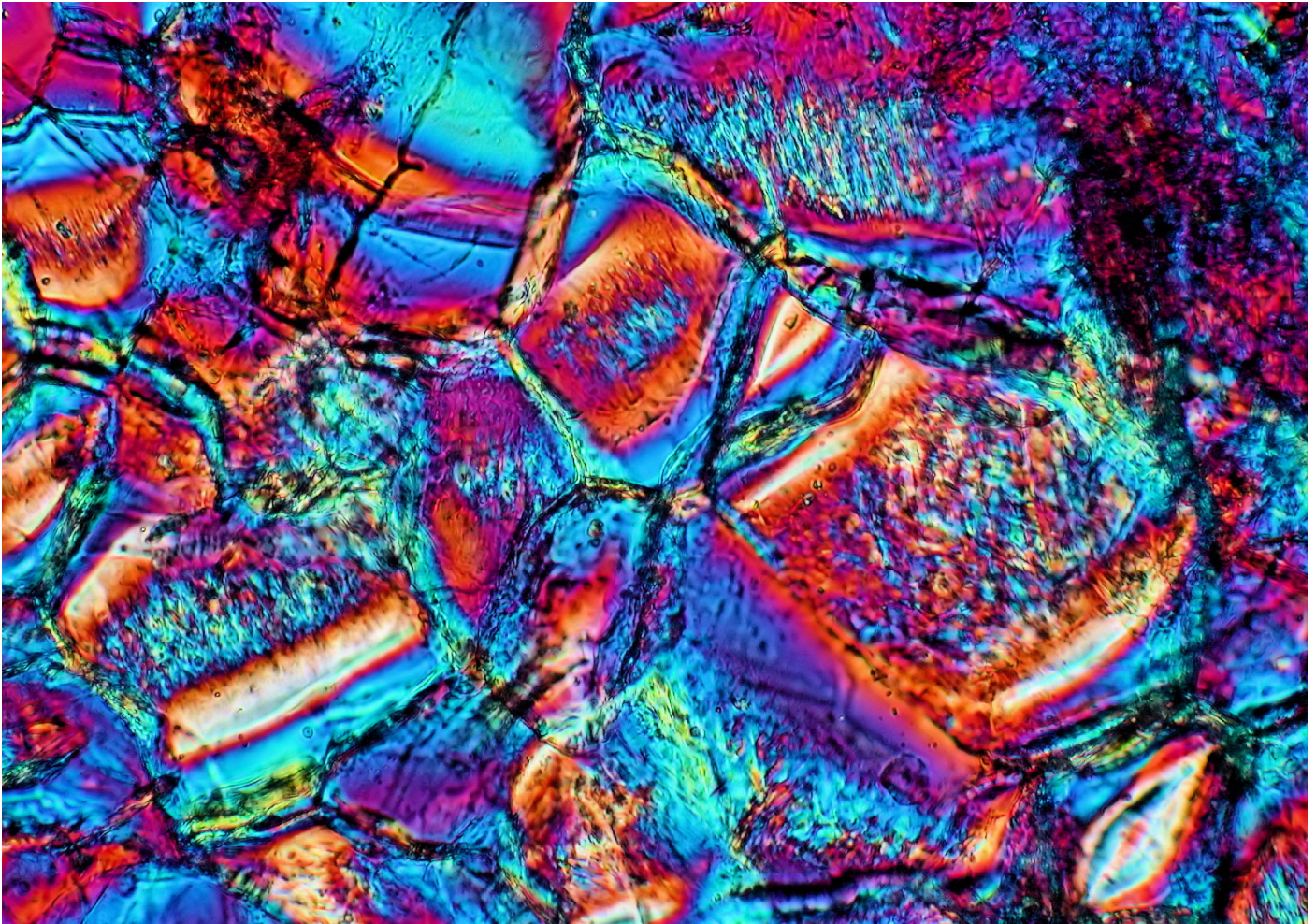


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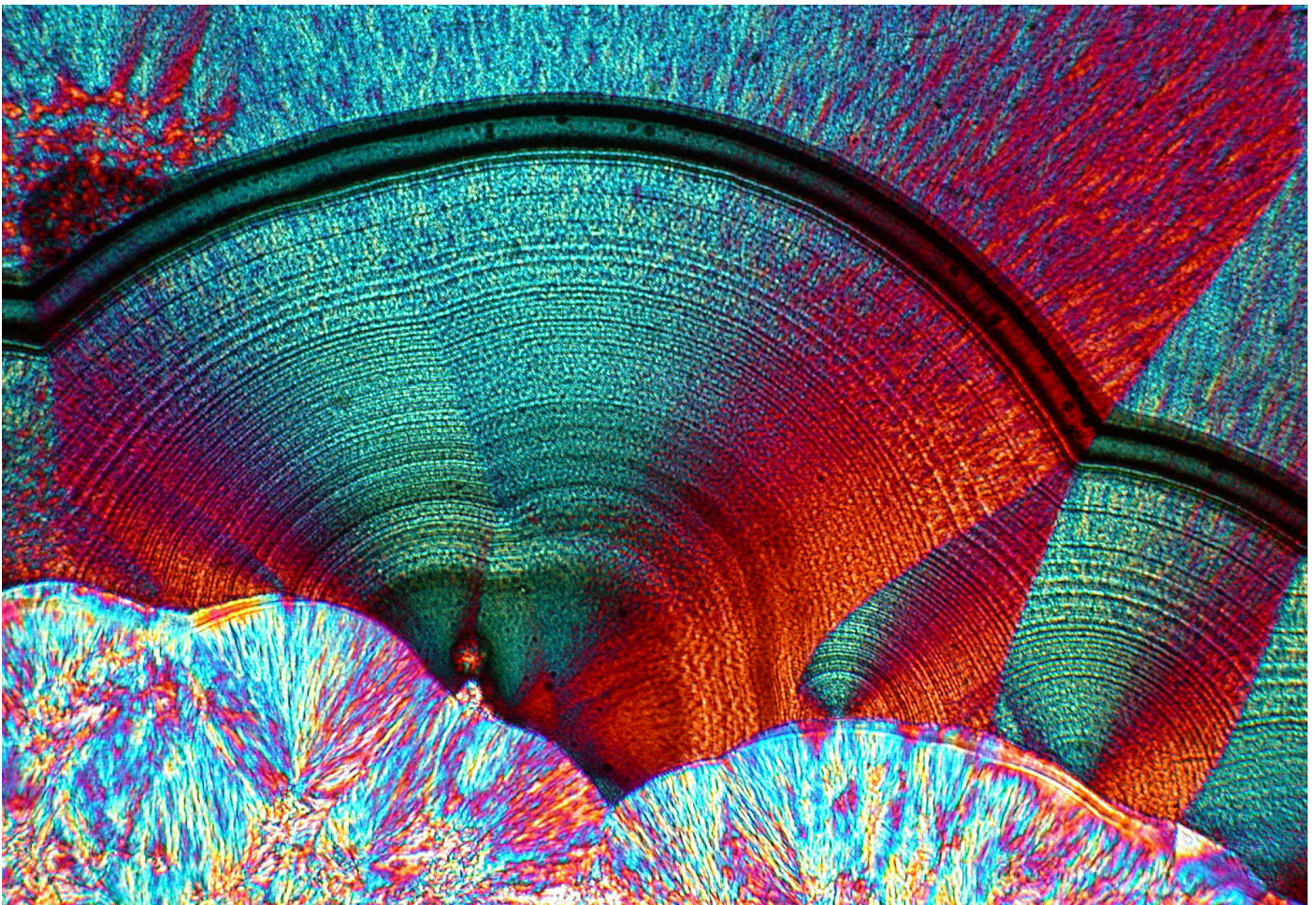


Lahtojoki Diamonds (maximum 2mm) in Eclogite Xenolith (Photo by Dr. Kari A. Kinnunen)



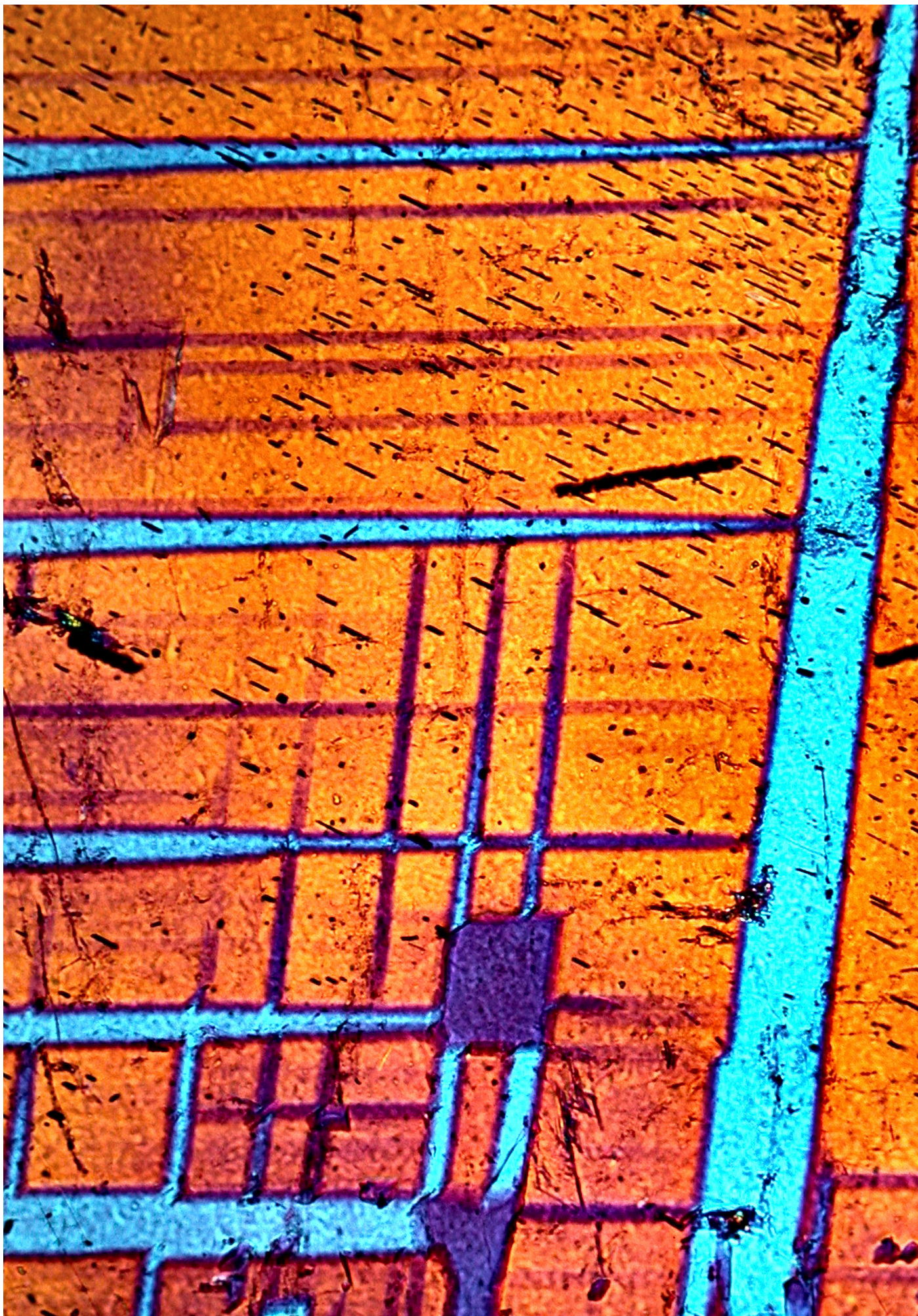


Gem Serpentine from Ankele (0.7mm Thin Section Polarizing Microscope) (Photo by Dr. Kari A. Kinnunen)



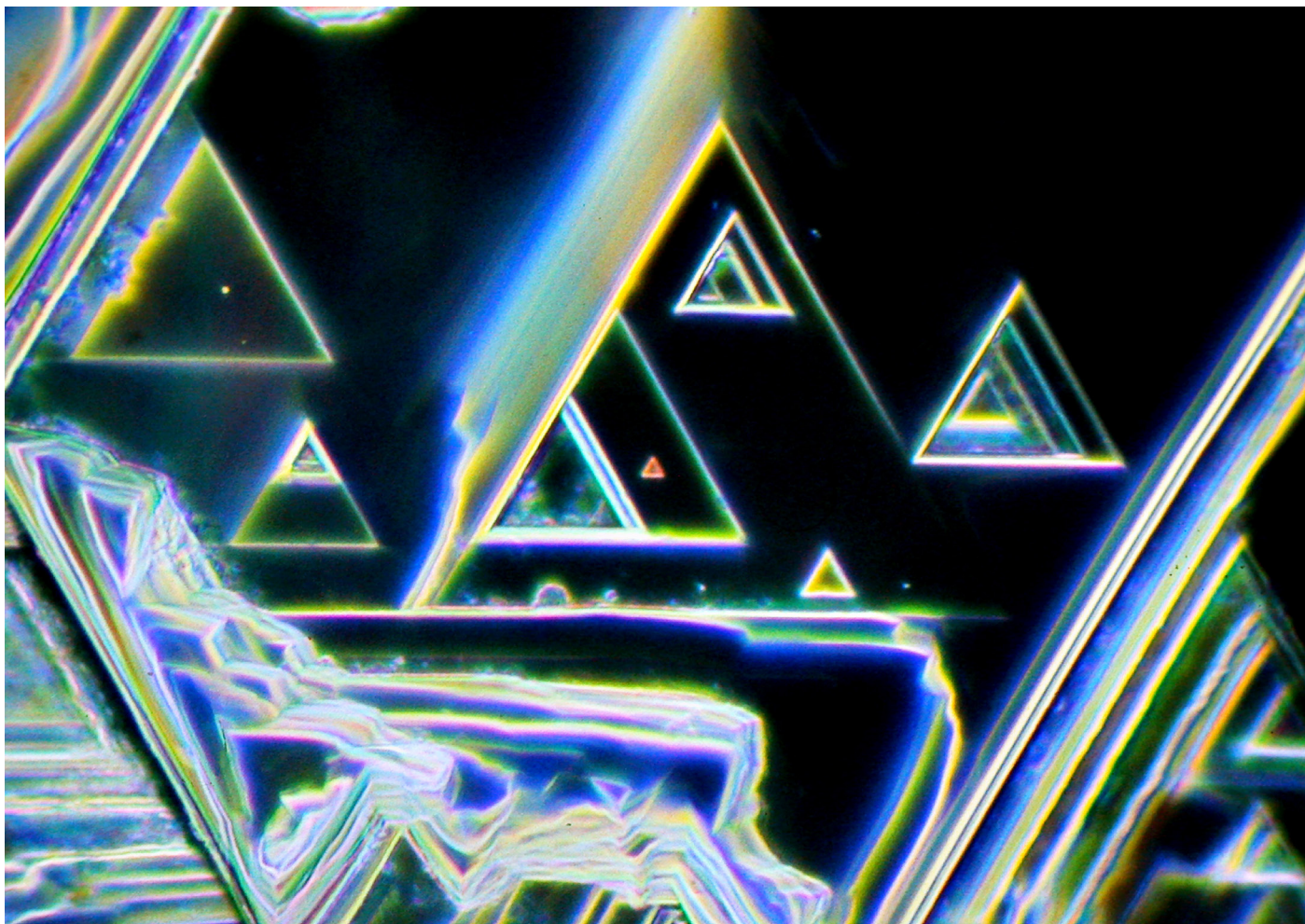
Agate from Sññksjñrvi (Thin Section Polarizing Microscope - Width 3mm) (Photo by Dr. Kari A. Kinnunen)



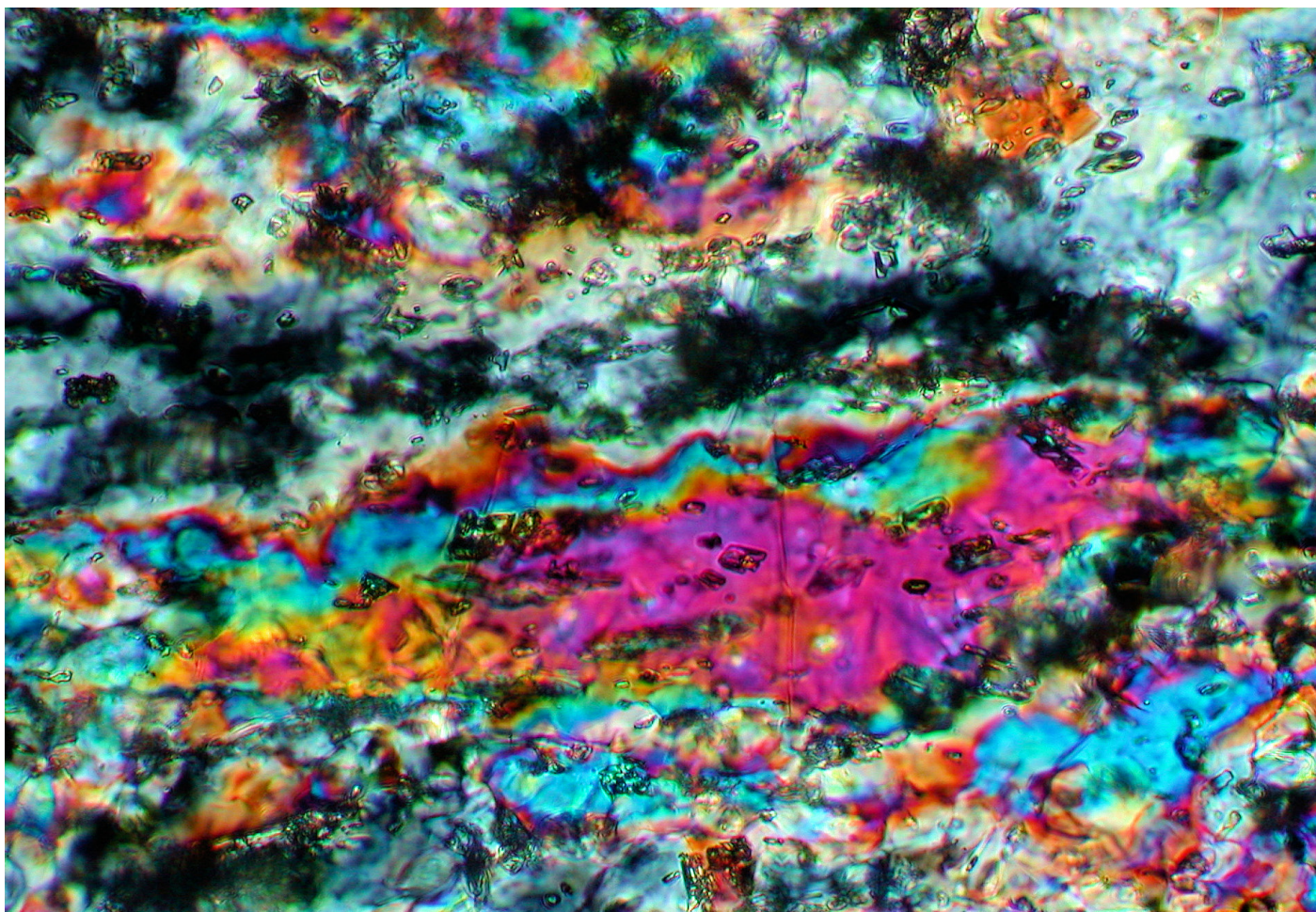


Thin Section of Spectrolite from Ylämaa (Height 4mm) (Photo by Dr. Kari A. Kinnunen)





Etch Trigons on Diamond from Lahtojoki (Width 0.2mm) (Photo by Dr. Kari A. Kinnunen)



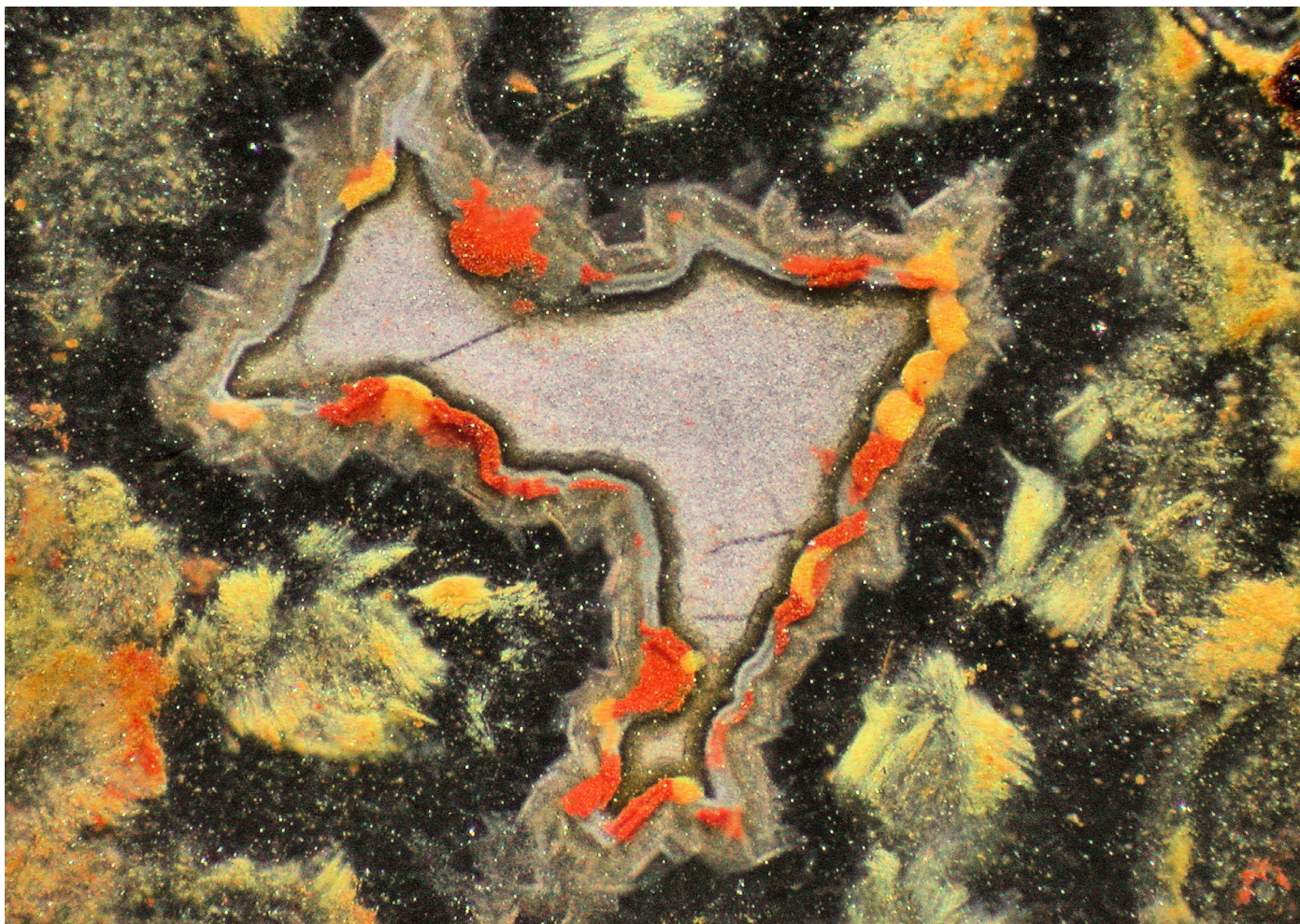
Photograph of Rhodonite Rock from Ylistaro Polarizing Microscope (Width 0.7mm) (Photo by Dr. Kari A. Kinnunen)



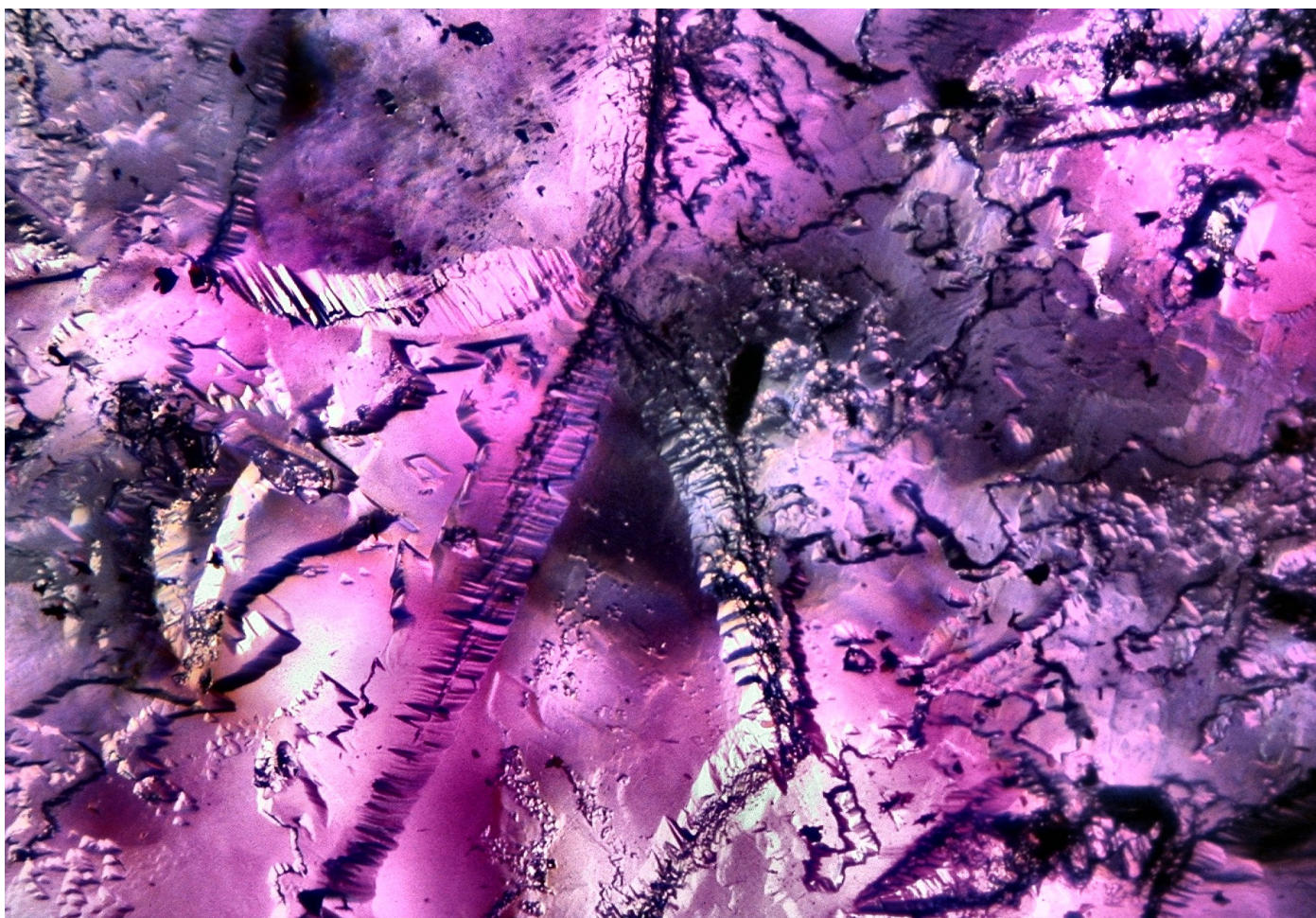


Surface Texture of Gem Topaz Crystal from Kotka (Height 4mm) (Photo by Dr. Kari A. Kinnunen)



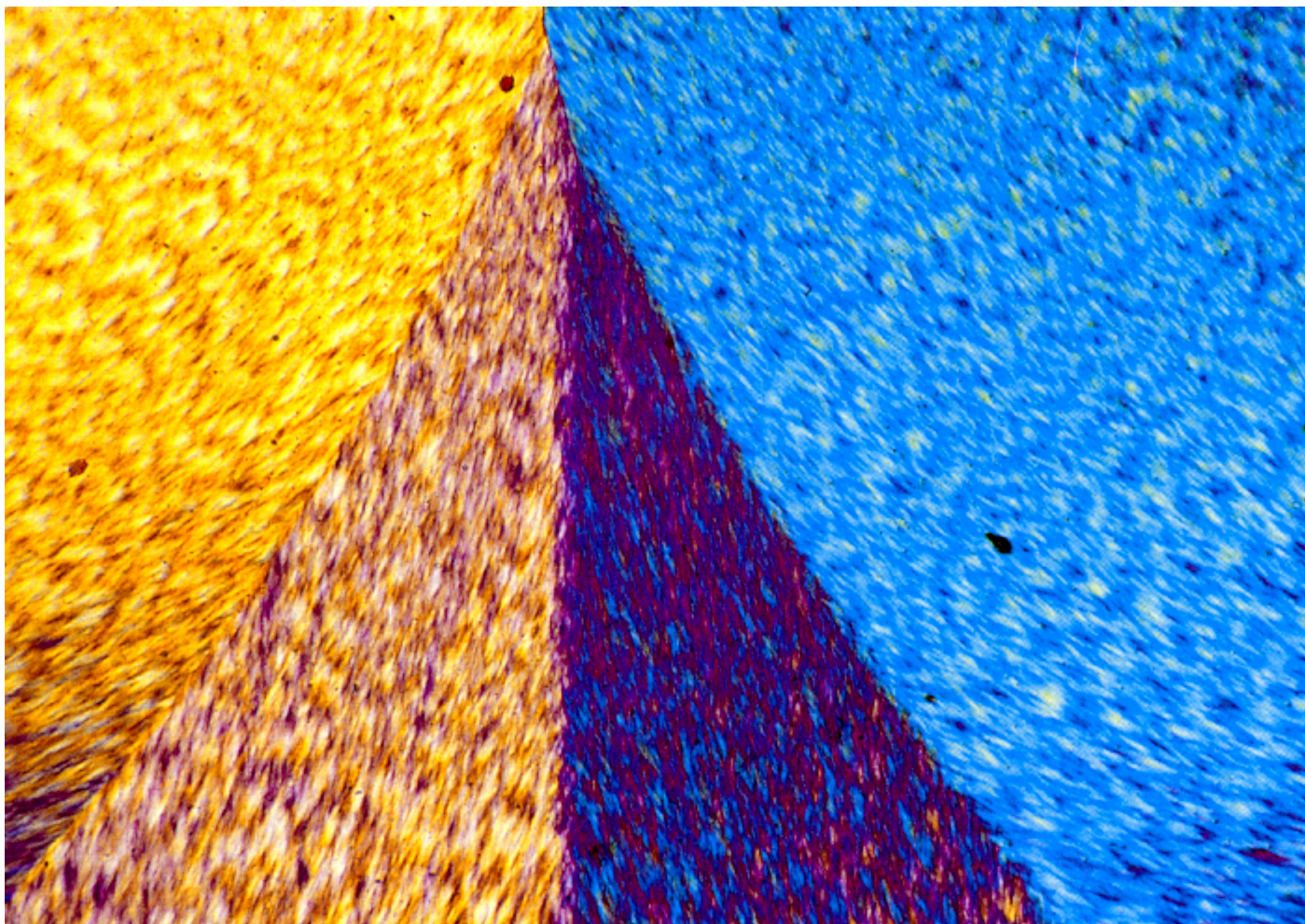


Agate in Chalcedony Rock from Vuotso (Width 1mm) (Photo by Dr. Kari A. Kinnunen)

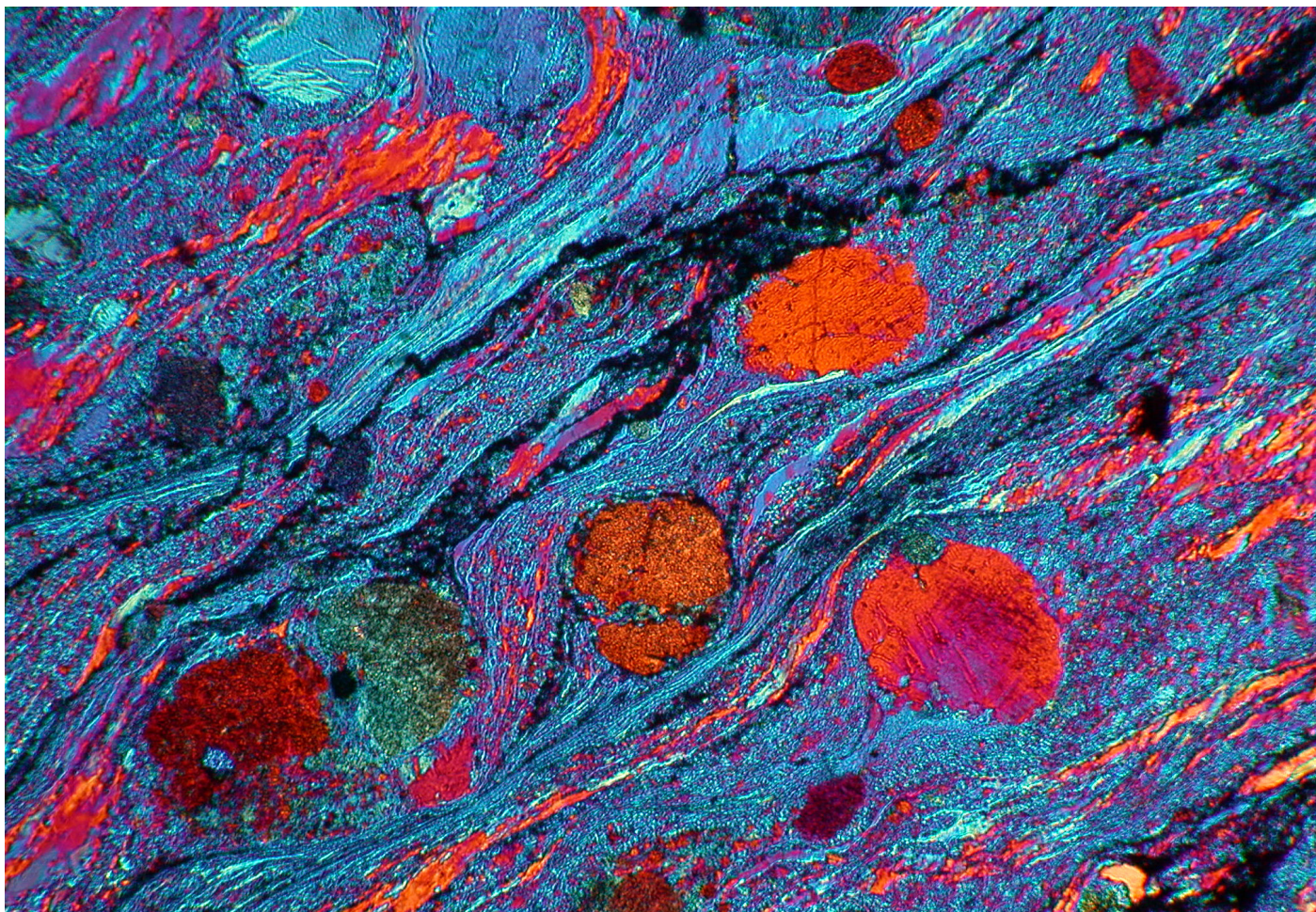


Surface Textures of Amethyst from Lampivaara (Width 7mm) (Photo by Dr. Kari A. Kinnunen)





Agate from Sñksjñrvi (Thin Section Crossed Polars - Width 1mm) (Photo by Dr. Kari A. Kinnunen)

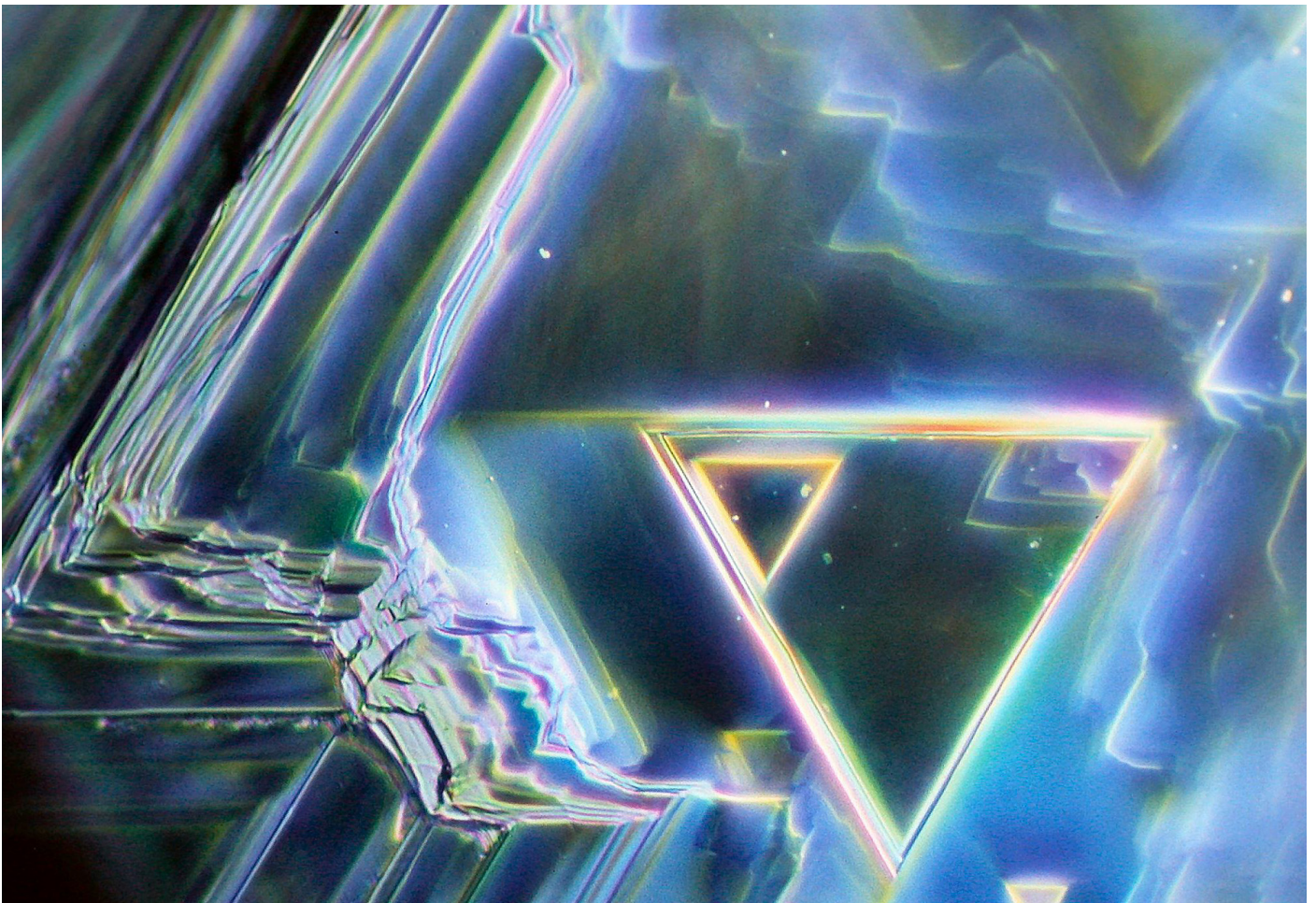


Mylonite from Tapiola (Thin Section Polarizing Microscope - Width 3mm) (Photo by Dr. Kari A. Kinnunen)





Surface Textures of Gem Beryl from Luumäki (Width 4mm) (Photo by Dr. Kari A. Kinnunen)



Surface Texture of Diamond Octahedron from Lahtojoki Kimberlite (Width 0.3mm) (Photo by Dr. Kari A. Kinnunen)





Ruby from Sotajoki, Lapland (8.6 carats - 12 mm) (Photo by Dr. Kari A. Kinnunen)

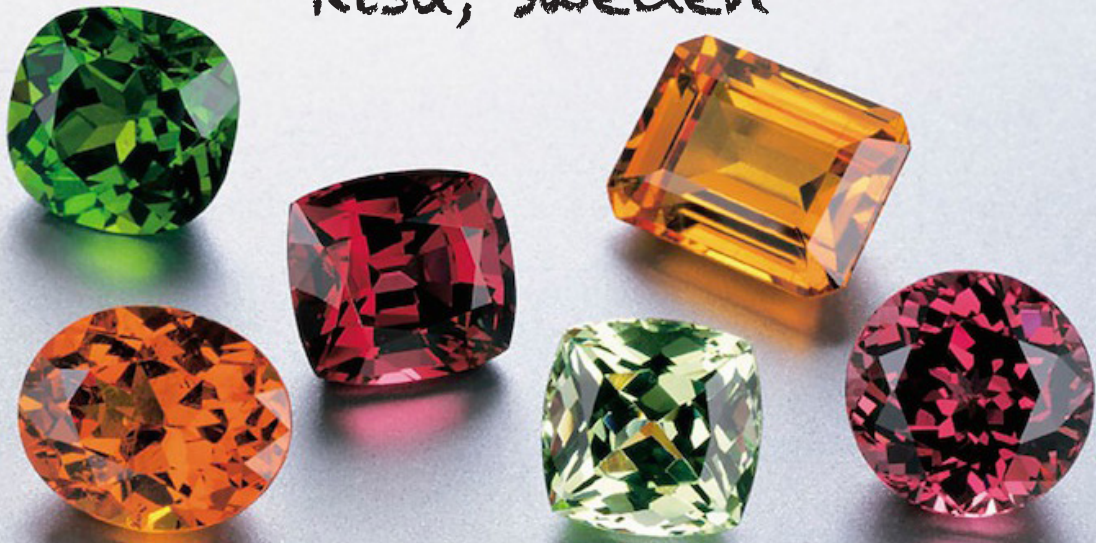


Edelweiss Gold Nugget from Miessi Lapland (108 grams - 47mm) (Photo by Dr. Kari A. Kinnunen)



## Upcoming Gemmological Conferences

### Scandinavian Gem Symposium Kisa, Sweden



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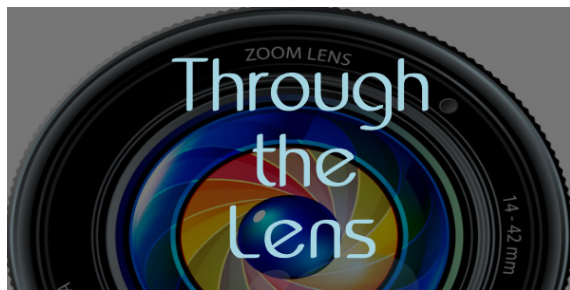


### MALLORCA GEMQUEST

GEMMOLOGICAL CONFERENCE

SEPTEMBER 22 - 23, 2018





A natural or acquired talent? Capturing the true beauty of a gemstone is not an easy task. In this issue we talk to Dmitry Stolyarevich, an exciting photographer who is pushing all the right buttons.....

## From Russia with Love - Dmitry Stolyarevich



**GT:** Who is Dmitry Stolyarevich? Tell us about your background?

**DS:** I was born and live in Moscow, my father worked as a gemmologist and I got used to hearing stories about gemstones and the way this micro-world works since childhood. After school I decided to follow my Dad's footsteps and entered Moscow State University thinking about starting my career at Gemmological Center after graduation.

**GT:** When did you first develop a passion for gemstone photography? Was there a defining moment when you realised this was what you wanted to do?

**DS:** Once I was helping our technician with shooting items for reports and came across a diamond so pure and beautiful that it impressed me so much I decided to do my best to show it's 'perfection'. It struck me, gems, jewellery are worth time and endeavours spent to reveal their splendour

**GT:** Natural talent or acquired through study?

**DS:** Some of my friends/clients tell me it's natural talent, but I used to think it's study. The first photo, which made me feel pleased/satisfied came after a year of persistent efforts, various experiments and courses/master classes. I admired photos of E. Laptev, E. Edvards and aimed to shoot at their level. Evgenii Laptev training enabled me to make a significant leap forward towards my ideals.

**GT:** Accomplished anglers always talk about the 'one that got away'. Is there one gemstone shot that has eluded you over the years?

**DS:** I've faced various difficulties in my experience, but one situation is particularly memorable. The task was to shoot two D/IF brilliants, emerald cut, made from one piece. It seemed pretty simple, but despite all my efforts these gems looked absolutely different in the frame. I'd spent all day working on this curious phenomenon, at one point half of the staff were following this struggle.

**GT:** What is the one most memorable gemstone you have photographed and why?

**DS:** It was 'Drop of Compassion' by Viktor Tuzlukov. It took me two days to convey a message hidden inside. I've discovered an amazing effect of facets reflection – I saw a man in a hat walking towards a temple (other people see palms combined together in a form of a candle). At this moment I found the soul of the stone and this brought me the most joy so far.

**GT:** Is there still a place for analog film in the world of gem photography?

**DS:** I believe that shooting with analog film will only complicate the process. Using it makes sense only in order to get some artistic effect but very few can appreciate that. I've nothing against it, but I have no reasons to try it myself.

**GT:** Are you a purist or do you use software, such as Photoshop, to bring out the best in your photographs?



**DS:** I stick to the principle to draw with light and by use of my camera, not with Photoshop or other software. I always try to communicate a vision exactly as I see it myself. To show the gemstone or piece of jewellery in the same way that I observe it with my eyes. So I use Photoshop to clean the dust or scratches. However sometimes a client asks to change something in the photo in this case the only way is to use Photoshop magic.

**GT:** Guitarists are always asked about the equipment they use and the ones they most prefer. What is your camera of choice and why?

**DS:** Frankly speaking I don't see much difference among cameras. First time it was quite exciting to compare models and argue which is better suited for a particular purpose, but in the end I came to the conclusion that the most important characteristics for me are the user-friendliness/ease of use and pixel range. My first camera – Nikon D5100, I liked it very much, and now nothing changed – Nikon D810. As for guitars, my choice is a Schecter Hellraiser

**GT:** Where do you see the future of gemmology ten years from now?

**DS:** Already we're witnessing the growing demand for disclosure and documenting of a gemstone's uniqueness. The relevance of gemmological knowledge for end-user, 'romanticization', and storytelling will become trends. Gemmology will become less subjective, new instrumental diagnostic methods will be developed, and other manual ones will be used less often. I believe that interest to high-quality photography will grow taking into account digitalization processes and market activity in the internet.

**GT:** If we were sitting here a year from now celebrating what a great year it's been for Dmitry Stolyarevich professionally, what would you say was the reason?

**DS:** Last year I worked extensively with Alrosa in shooting unique brilliants, including uncut named diamonds. These photographs look spectacular, and got spread over the web. I believe these images can become kind of a 'Business Card' for me along with photos for Viktor Tuzlukov.



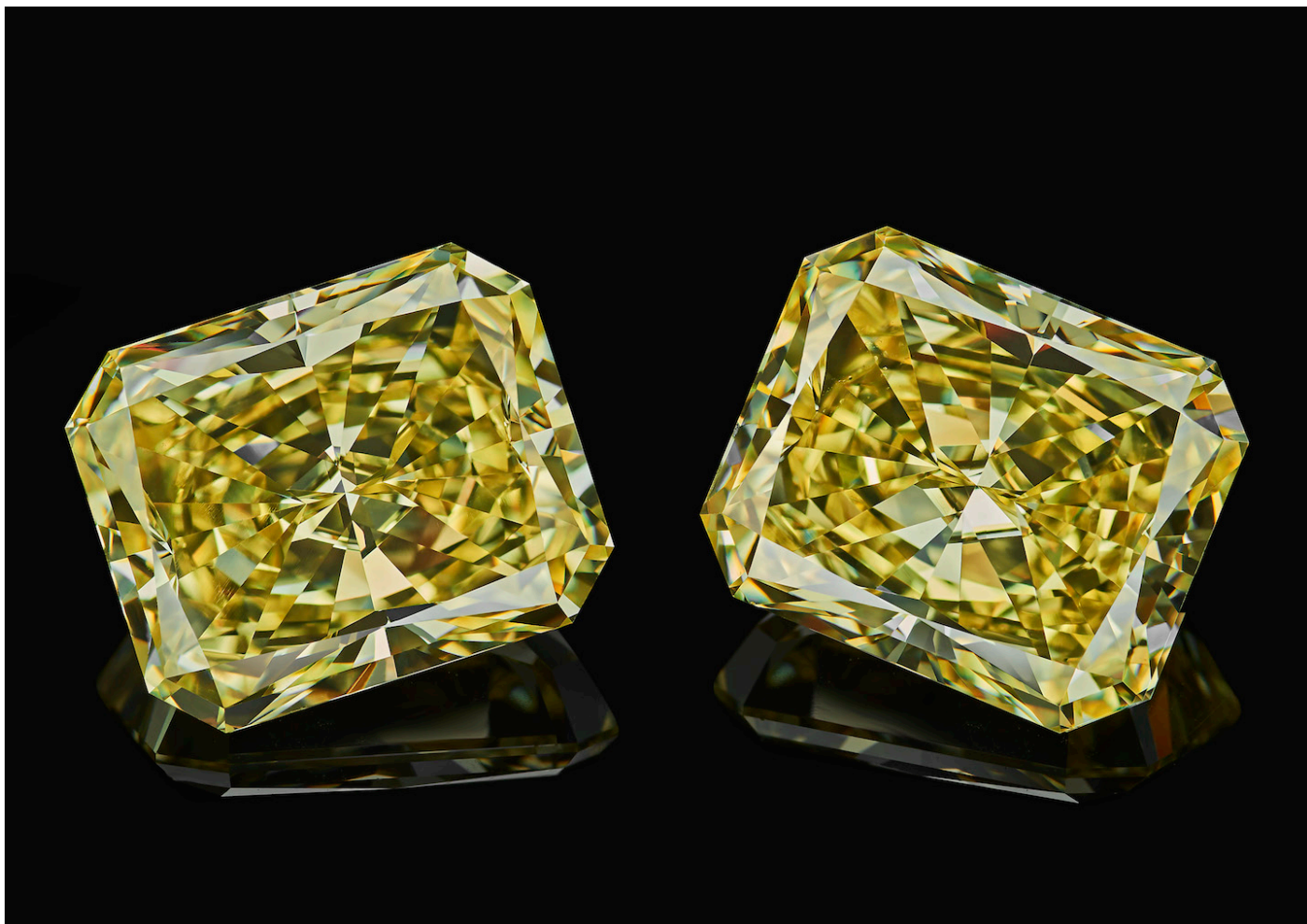
Tanzanites (Photo by Dmitry Stolyarevich) (Courtesy of Gem Lovers)





Diamond Octahedron (Photo by Dmitry Stolyarevich) (Courtesy of ALROSA)





Natural Yellow Diamonds (Photo by Dmitry Stolyarevich) (Courtesy of ALROSA)



Blue Sapphire with Tsavorite Garnets and Diamonds (Designed by Julia Irtuga) (Photo by Dmitry Stolyarevich)





Rubies, Blue Sapphires, Emeralds, Diamonds and Turquoise (Photo by Dmitry Stolyarevich) (Courtesy of Anton Shevnin)





Rough Pink Diamond (Photo by Dmitry Stolyarevich) (Courtesy of ALROSA)



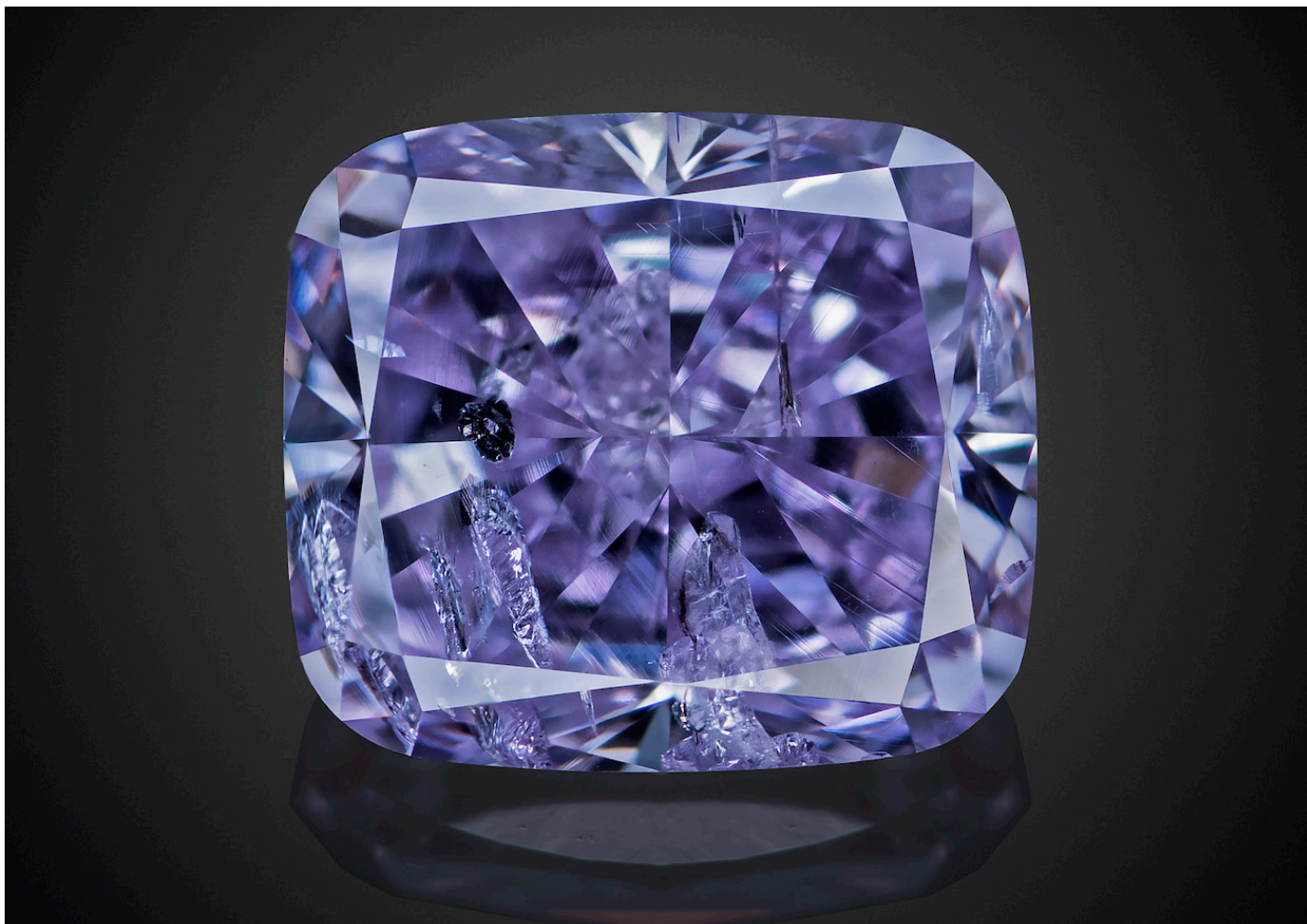
Natural Yellow Diamond (Photo by Dmitry Stolyarevich) (Courtesy of ALROSA)





Natural Sri Lankan Blue Sapphire, Pink Sapphires and Diamonds (Photo by Dmitry Stolyarevich) (Courtesy of Gem Lovers)





Natural Purple Diamond (Photo by Dmitry Stolyarevich) (Courtesy of ALROSA)



Rough Diamond (Photo by Dmitry Stolyarevich) (Courtesy of ALROSA)





Diamond Octahedron (Photo by Dmitry Stolyarevich) (Courtesy of ALROSA)





Opal 'FireBird' (Photo by Dmitry Stolyarevich) (Courtesy of Anton Shevnin )



Glorious Opals (Photo by Dmitry Stolyarevich) (Courtesy of Anton Shevnin )





## Education - A Cost of Doing Business or an Investment in Your Business?



I am sure I am not alone when it comes to purchasing and paying for insurance. I understand the need for it; I just don't like paying for it. Somehow I always feel cheated; to pay for something that I may never actually use. It seems very unfair.

Of course we buy it because we are afraid that if we don't, something bad will happen. Life insurance, medical insurance, travel insurance, extended warranties, the list goes on and on. Then there is the fine print, those little details that only come to life when you realise that the policy you purchased does not actually cover the situation you are facing.

I have now lived for three and a half years in Spain. When I arrived I purchased a private medical plan. Every year the monthly premiums have increased even though I have never used it. The one time I did need to see a doctor, I was told that my policy did not cover it. I am not sure why I had the

impression that a medical plan would. Perhaps it was just wishful thinking.

Retailers love to sell you 'extended warranties'. I always think that if the manufacturer does not have faith that their product will last more than a year, why should I? If you do purchase one of these 'warranties', you are often faced with having to ship the item back to the manufacturer even though you purchased it and paid for the warranty at the store. Good luck trying to find the receipt, the warranty and the right packaging. I doubt many people actually take the item to the post office, insure it and pay for tracking and then wait months for the item to be returned.

Can you think of one item you would buy with an extended warranty that you could afford to be without for weeks on end? I can't.....



To be honest, I have never really understood how rent a car insurance works. It's pricey (sometimes costing more per day than the car itself) and is often sold by sales associates who do their level best to put the fear of god into you. In most cases they are successful because none of us want to be involved in an accident and end up paying a carzillion euros in damages.

Jewellers adopt a similar philosophy when it comes to education. Now I admit that I am 'biased' but let me ask you another question. Can you think of one consumer product that rivals gemstones in terms of product complexity?

Gone are the days when you can get away with simply selling the 'beauty' of a gemstone. Today consumers are far savvier and often come armed with a wealth of knowledge and questions procured from hours spent researching their proposed purchase on the Internet. Of course much of the information they find on the Internet is wrong but even then, a misinformed client can be even more challenging than one who actually knows what they are talking about.

Selling gemstones can be a veritable 'mine field'. All it takes is a client asking if a sapphire has been heat-treated, a diamond irradiated, a ruby glass-filled or a gemstone sourced ethically to create a challenging scenario and one that cannot be handled or brushed aside by a sales associate that has no gemmological background.

You may be able to verify that the sapphire is not heat-treated, that the colour of the diamond is natural, that the ruby is not glass-filled and that the diamond is not a 'blood' diamond but what if the client takes it to the next level? What if they ask you why gemstones are heat-treated? Why the colour changes? If the treatment is stable or if they should be concerned about the use of irradiation? In a highly competitive market, can you really afford to lose a client because your sales associates cannot answer these questions?

Of course much depends on the products that you sell. I once worked for a jeweller in Canada who started out selling only DEF colour, VVS clarity diamonds. Within five years they were selling I clarity stones with lower colours. I was managing the store at the time and I remember getting a memo from our Head Office instructing us to tell the staff that if a client mentioned the 'yellowish' or 'brownish' colouration in the diamond that we should say it was the 'body warmth' of the diamond. Imagine! That particular 'memo' was never passed on.....

In this case, having knowledgeable sales associates will hinder the sales process and to be honest, people who buy fracture-filled diamonds, glass-filled rubies and coloured gemstones that are better suited gracing the bottom of a fish tank are probably not looking to be 'educated'. There are times when ignorance can be bliss.

So the question is 'Is education a cost of doing business or an investment in your business?'

The answer depends on how you look at it; is the glass half empty or half full?

Will the cost of educating your sales associates directly translate into increased sales? Of course it will. There is simply no substitute for a professional and knowledgeable sales associate. While many consumers will consult the Internet, buying gemstones for most is a 'blind' purchase. Having knowledgeable sales associates helps your clients achieve a level of comfort. Being confident and instilling confidence in your customers is crucial if you are going to be successful. The more 'tools' you can give your sales associates the better. You may be selling the same product as your competitor but if your sales associates are better trained and knowledgeable that could be the decisive factor in who makes the sale.

While luck can sometimes play a role in making a sale, it is important to remember that in most cases a sales presentation goes through a series of well defined steps (known as the anatomy of a sale). Being aware of these steps and following them religiously will increase your ability to close sales. Ask yourself why customers are in your store. They are not window shopping, they are there for a reason and it is up to you to find out why.

So often sales associates brush off a 'missed' sales opportunity by saying that the customer was 'only looking'. In reality they failed to identify the 'real' reason why the customer was in the store. If they had followed the 'Anatomy of a Sale', step by step, the customer would be walking out of the store having made a purchase or at the very least with the promise of coming back.

The chart below illustrates, based on your cost of sales, how much an employee needs to generate in 'added' business to pay back your investment in their education. If for example you are working on a 50% cost of sales and invest \$ 4,000 in their training, the employee will need to sell \$ 8,000 more to cover the cost.

### Increase in Sales Productivity

Investment	Cost of Sales			
	70%	60%	50%	40%
\$ 1000	\$ 3400	\$ 2600	\$ 2000	\$ 1700
\$ 2000	\$ 6800	\$ 5200	\$ 4000	\$ 3400
\$ 4000	\$ 13600	\$ 10400	\$ 8000	\$ 6800
\$ 6000	\$ 20400	\$ 15600	\$ 12000	\$ 10200
\$ 8000	\$ 27200	\$ 20800	\$ 16000	\$ 13600
\$ 10000	\$ 34000	\$ 26000	\$ 20000	\$ 17000



Is that achievable? Do I really need to ask?

Of course you will not make this investment unless you are sure the employee will stay long term and without question, you would need to implement a system that ensures that if they leave before a certain time period, the investment is refunded but given the numbers, why would you not make this investment?

What's more, the employee will feel a greater sense of loyalty and gratitude because you have invested your money to help them become a better sales associate.

In reality you are simply stacking your odds of increasing your sales by having more knowledgeable and professional sales associates on your payroll but so what? Is that a bad thing? If everyone wins, the store, the sales associates and the clients how could this possibly be bad for business.

You will never reap a harvest unless you sow seeds and you will never reap a bountiful harvest unless you plant the right seeds.

Sow.....what are you waiting for?

**Image:** Please note that the image used in this article was adapted from 'WikiHow to do Anything' with additional text added over the images of the two cars.

## Article 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

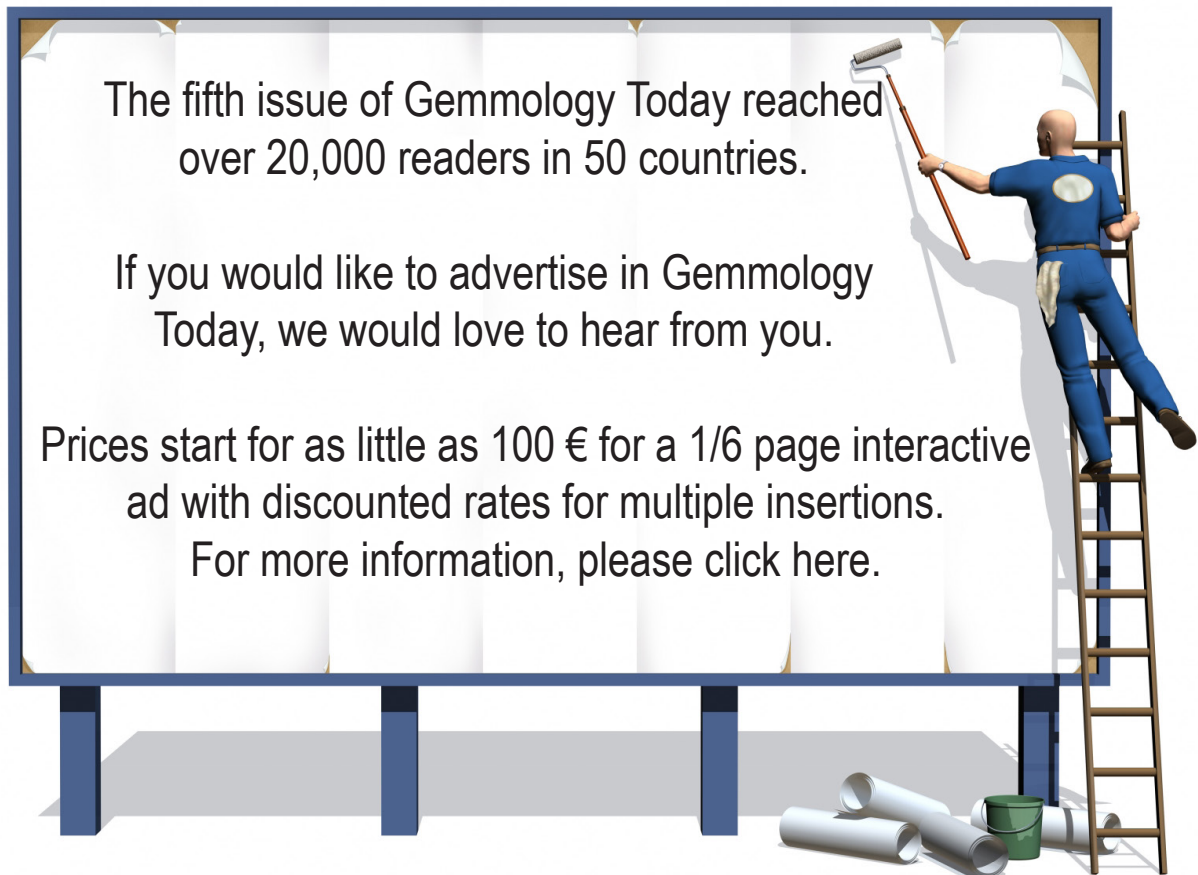
April 15th, 2018

### 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. Wherever possible please try to supply images from the same photographic source or at the very least are compatible with each other. This will ensure that the article is aesthetically pleasing as well as informative.
- We reserve the right to refuse articles

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For centuries, spinel has lived in the shadows of the nobler ruby and blue sapphire, often misunderstood, certainly undervalued and definitely under appreciated. In the immortal words of Bob Dylan 'The times they are a changin'.

## Spinel - The Times They Are A Changin'



Spinel Super Trillion™ (3.07cts) Cut by John Dyer (Photo by Lydia Dyer)

There is no question that spinel has suffered from its close connection with ruby. This is clearly evident from the many references to '*balas rubies*' that can be found in books on gemstones and jewellery. Of course, the comparisons are quite understandable given the fact that the finest red spinels, like rubies come from Myanmar, are found in the very same geological environments and are often quite similar in colour.

Interestingly, red spinels can be found in the state and private collections of numerous monarchies around the world, often labeled incorrectly as rubies, leading many to assume that in the past, past generations were unable to distinguish between the two.

We now know however that as early as 1606, the distinction between rubies and red spinels was possible and this is confirmed by an inventory that was prepared of the crown jewels, where the large irregular shaped pierced red stone was described as a '*Ballace*', a term used to for spinel.

The most notable red spinels include the 170 carat '*Black Prince ruby*' set in the British Imperial State Crown, the 353

carat '*Timur ruby*' presented to Queen Victoria in 1851 by the East India Company and formerly owned by Mahajara Ranjit Singh, and the 500 carat roughly polished stone in the Iranian crown jewels.

The host rocks for spinel include gneiss, serpentine and crystalline limestone rocks with most found in secondary alluvial deposits as water-worn pebbles.

Found primarily in Myanmar, Sri Lanka, and Cambodia, spinel is also found in Tanzania (Umba Valley), Afghanistan, Brazil, Madagascar, Nepal, Vietnam, Kenya, Pakistan, Tajikistan, Nigeria, Thailand (black only), the U.S, Sweden, and Australia.

It is invariably found in well-formed octahedrons, octahedral crystals with the edges truncated by the dodecahedron faces and as contact twin crystals known as 'spinel twins'.

Spinel is a magnesium aluminium oxide with a chemical formula of  $MgAl_2O_4$ . Other varieties include magnetite ( $Fe_3O_4$ ), chromite ( $FeCr_2O_4$ ), gahnospinel ( $MgZnAl_2O_4$ ), pleonaste ( $Mg,FeAl_2O_4$ ), and gahnite ( $ZnAl_2O_4$ ).



Red and pink spinel owe their colour to the replacement of aluminium by chromium ions while cobalt blue spinel, as the name implies, owes its colour to cobalt. Other colours are caused by the replacement of magnesium by either ferrous iron ( $\text{Fe}^{2+}$ ) or manganese and aluminium by ferric iron ( $\text{Fe}^{3+}$ ).

Common inclusions include rows of octahedral crystals, often belonging to another member of the spinel family or cavities filled with calcite or dolomite, apatite crystals, limonite, quartz, olivine, phlogopite mica, sphene, uranite, iron-stained feathers, and zircon haloes.

However when it comes to price, the similarities between the two end abruptly and this is perhaps where red spinel has the greatest advantage over ruby. With fine quality rubies

becoming scarcer and scarcer and prices at an all time high, red spinel offers a viable alternative at a fraction of the price.

The chart below not only shows us how quality and carat weight impact on the price of red and blue spinel (using the 5.00 to 9.99ct/Extra Fine as our base) but also how they compare to rubies and blue sapphires in three weight categories and four quality grades.

As we can see from the comparison charts a three-carat ruby will sell for anywhere from 158% to 567% more than an equivalent quality red spinel while a blue sapphire will sell for between 259% and 450% more than an equivalent quality blue spinel.

Natural Red Spinel				
Weight	Commercial	Good	Fine	Extra Fine
1.00 - 2.99ct	- 98.00%	- 94.00%	- 75.33%	- 40.00%
3.00 - 4.99ct	- 96.93%	- 92.00%	- 60.00%	- 20.00%
5.00 - 9.99ct	- 93.33%	- 84.00%	- 40.00%	Base
Natural Blue Spinel				
Weight	Commercial	Good	Fine	Extra Fine
1.00 - 2.99ct	- 97.88%	- 90.91%	- 83.33%	- 75.76%
3.00 - 4.99ct	- 96.97%	- 89.39%	- 78.03%	- 63.64%
5.00 - 9.99ct	- 93.94%	- 86.36%	- 66.67%	Base
Comparison between Red Spinel and Ruby				
Gemstone	Commercial	Good	Fine	Extra Fine
Red Spinel	Base	Base	Base	Base
Ruby	+ 248%	+ 567%	+ 158%	+ 250%
Comparison between Blue Spinel and Blue Sapphire				
Gemstone	Commercial	Good	Fine	Extra Fine
Blue Spinel	Base	Base	Base	Base
Blue Sapphire	+ 450%	+ 286%	+ 259%	+ 275%

GemGuide January/February 2017



Gemstone	R.I. Range	D.R.	D	O/S	S.G. Range	H
Diamond	2.417 – 2.419	–	.044	I	3.50 – 3.53	10
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
Colour Change Garnet	1.79 (Mean)	–	.027	I	3.78 – 4.10	6 ½ – 7 ½
Almandite Garnet	1.770 – 1.820	–	.027	I	3.93 – 4.30	6 ½ – 7 ½
Ruby & Sapphire	1.762 – 1.778	.008	.018	U-	4.00	9
Benitoite	1.757 – 1.804	.047	.046	U+	3.64 – 3.68	6 – 6 ½
Alexandrite	1.746 – 1.763	.007 – .011	.015	B+	3.70 – 3.78	8 ½
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
Taaffeite	1.719 – 1.730	.004 – .009	–	U	3.60 – 3.62	8 – 8 ½
Kyanite	1.710 – 1.734	.015	.020	B-	3.53 – 3.70	4 to 7
Tanzanite	1.691 – 1.700	.009	.030	B+	3.35	6 ½ – 7
Kunzite	1.660 – 1.681	.014 – .016	.017	B+	3.15 – 3.21	6 ½ – 7
Apatite	1.628 – 1.649	.002 – .006	.013	U-	3.16 – 3.23	5
Tourmaline	1.614 – 1.666	.014 – .032	.017	U-	3.01 – 3.11	7 – 7 ½
Topaz	1.609 – 1.643	.008 – .016	.014	B+	3.49 – 3.57	8
Beryl	1.562 – 1.602	.004 – .010	.014	U-	2.66 – 2.87	7 ½ – 8
Quartz	1.544 – 1.553	.009	.013	U+	2.65	7
Scapolite	1.540 – 1.579	.006 – .037	.017	U-	2.57 – 2.74	5 ½ – 6
Sunstone	1.525 – 1.548	.010	–	B+	2.62 – 2.65	6 – 6 ½

## Identifying Spinel

The chart above includes the physical and optical properties of gemstones that can be confused, at least superficially, with spinel.

While at first glance the list looks quite imposing, in reality one simple test will allow us to eliminate almost 70% of the gemstones and that 'test' involves the determination of the optical character of the gemstone (whether it is singly or doubly refractive). This can be achieved in a matter of seconds using either a polariscope or a dichroscope.

### Red Spinel

Although spinel and garnet are both singly refractive, spinel can be separated from spessartite, almandite and rhodolite garnets by the significant differences in their refractive indices. At the low end of the R.I. range, there may be some confusion between spinel and pyrope garnet, but as with all red and pink spinels, their characteristic organ pipe absorption spectrum, with lines at 686nm, 684nm, 675nm, 665nm and 595nm to 490nm will help to separate the two.

Unlike almandite, pyrope and spessartite garnets that exhibit a strong magnetic attraction to an N-52 grade neodymium magnet, red spinel shows weak to moderate paramagnetism.

Red spinel will also fluoresce under both short wave and long wave UV light, whereas all garnets will remain inert.

### Blue Spinel

Fortunately, natural blue spinel is the only naturally occurring gemstone (other than diamond) that is singly refractive. This important characteristic is extremely useful when separating natural blue spinel from blue sapphire, tanzanite, benitoite, and iolite.

### Lavender Spinel

Light coloured lavender spinel from East Africa is often confused with both kunzite and topaz; however, since spinel is singly refractive and kunzite and topaz are doubly refractive, identification should be relatively straightforward.





Suite of Spinel (Photo by Tino Hammid)



## Lab-created Spinel

### Flame Fusion

From an identification standpoint, spinel is perhaps the easiest lab-created gemstone to identify. Often, they are sold to imitate more valuable stones, such as aquamarine, blue sapphire, blue topaz, blue zircon, and in the triplet form, emerald or green tourmaline. However, since all of these gemstones are doubly refractive and therefore dichroic or trichroic, it is easy to spot the isotropic nature of spinel.

As a result of the increased alumina used in the manufacturing process, marked differences in the R.I. of lab-created and natural spinels (R.I. of 1.727 compared to 1.718 for naturals) make their separation relatively straightforward using the refractometer.

Gas bubbles and curved growth lines are normally absent in flame fusion spinels due to the slower growth rate of the boules. In spite of this, curious two-phase inclusions are sometimes seen consisting of a gas or liquid bubble connected by a short tube to a second bubble, parallel and below the first.

While both natural cobalt spinel and lab-created spinel will both exhibit a reddish colour under the Chelsea filter, the size and optical purity of the latter usually betrays its laboratory origin.

A spectroscopic analysis will reveal marked differences between natural and flame fusion blue spinel with the latter showing three prominent bands. These are often very strong and broad and appear to extinguish most of the orange to green portion of the spectrum. Again, the strength of these absorption bands is dependent on the depth of colour, which is directly related to the amount of cobalt used.

Natural blue spinel contain iron impurities in addition to cobalt, and will therefore show a weak to moderate magnetic attraction when the flotation method is used. Lab-created blue spinel, on the other hand contain no iron and are diamagnetic. Even though cobalt can create strong blue colours in lab-created spinel, the concentration of cobalt is almost always too low to induce magnetic attraction.

Ultraviolet light is particularly useful when identifying flame fusion spinels, especially small white spinels set in jewellery. These will exhibit distinctive bright bluish-white fluorescence under short wave UV light, unlike diamonds, which have a bluish fluorescence under long wave UV light.

Dark blue flame fusion spinels will fluoresce red, pink, orange or even bluish-white under short wave UV light and red, pink or blue under long wave UV light depending again on how much cobalt is present. Natural dark blue spinels will remain inert due to the presence of iron, unless they contain cobalt. Pale blue flame fusion spinels fluoresce a bright apple green under long wave UV light and exhibit a similar response when exposed to shortwave radiations.

Finally, the only 'Flame Fusion' lab-created spinels that are likely to cause any problems are reds since they have the same ratio of magnesia to alumina as natural stones. This results in almost identical physical and optical properties, however, as a result of the difficulty in producing anything other than small stones, few are likely to be encountered.

The presence of gas bubbles, pronounced curved colour zoning producing a Venetian blind effect, and the absence of the characteristic organ-pipe absorption spectra are often enough to prove that they were created in the laboratory. However, due to the presence of chromium in both natural and lab-created red spinel, both will fluoresce under short wave and long wave UV light.

### Flux Melt

Flux-melt spinels produced by the Russian Academy of Sciences have R.I.'s and S.G.'s similar to those for natural stones. Red flux-melt spinels fluoresce a strong purplish-red to slight orange-red under LWUV light with a similar but weaker reaction under SWUV light. Unlike natural red spinels, they do not exhibit the characteristic organ-pipe absorption spectra but do have emission lines at 685, 680 and from 560 to 510nm.

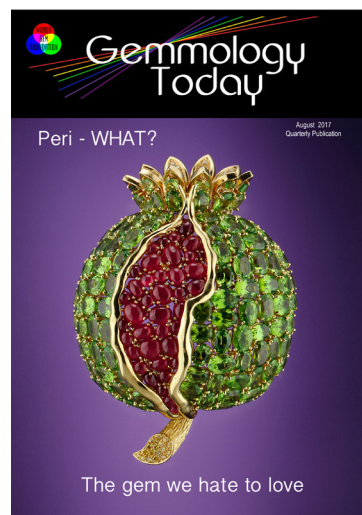
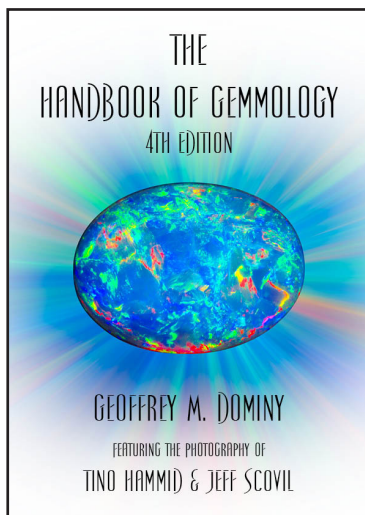
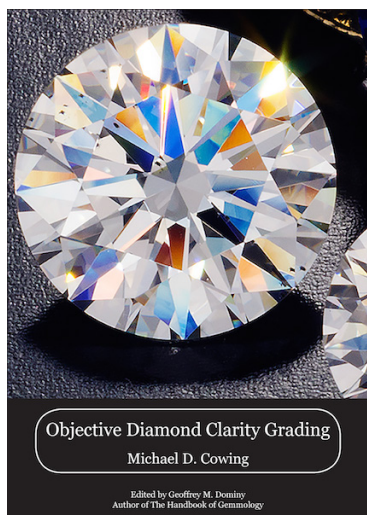
Blue flux-melt spinels often show flashes of red under strong light and appear a weak to chalky reddish-purple under LWUV light with a similar but stronger reaction under SWUV light. Through the spectroscope, one can expect a characteristic cobalt absorption spectrum with a red to orange reaction under the Chelsea Filter.

Internally one can expect small tension cracks surrounded by strong anomalous double refraction, undigested black flux inclusions in net-like formations or isolated pieces with jagged edges. Some may contain gas bubbles and metallic fragments from the crucible. Larger inclusions of flux tend to form in pyramidal shapes, which are aligned along the edges of the octahedron similar to those found in natural spinels.





## 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.

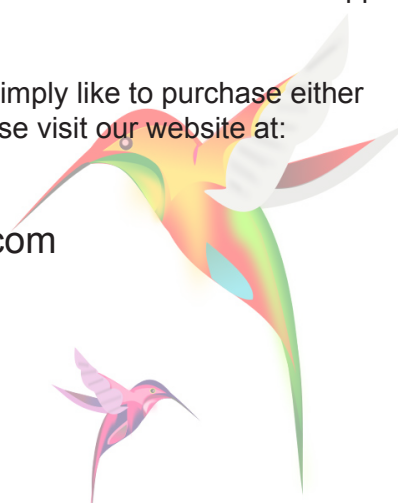
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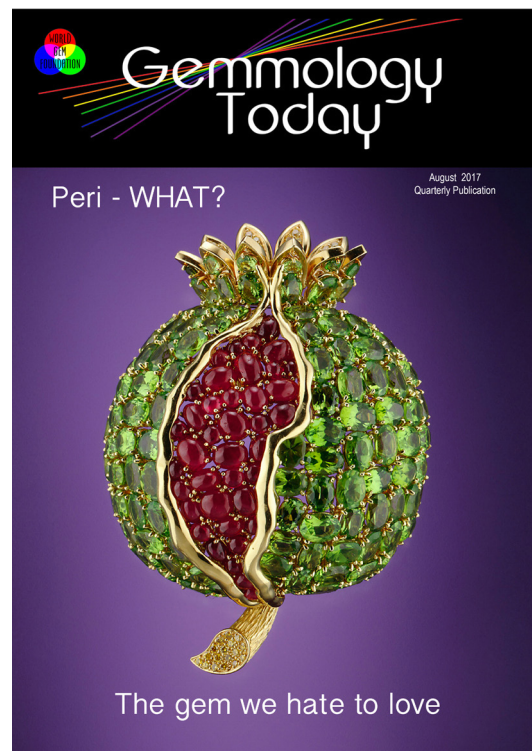
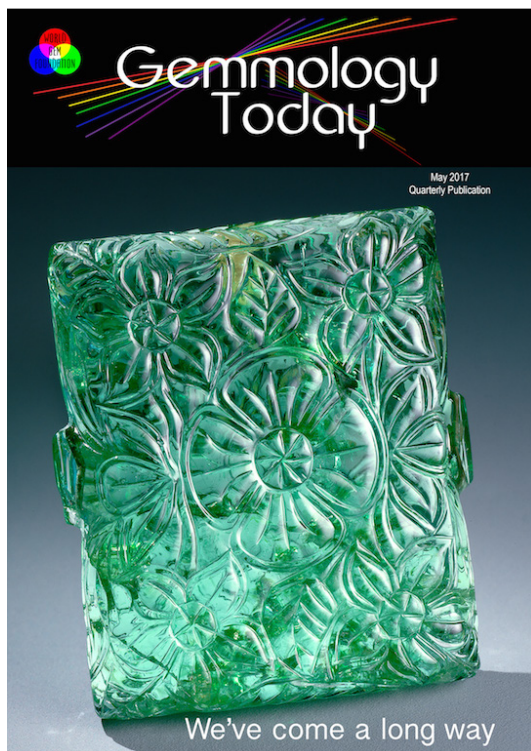
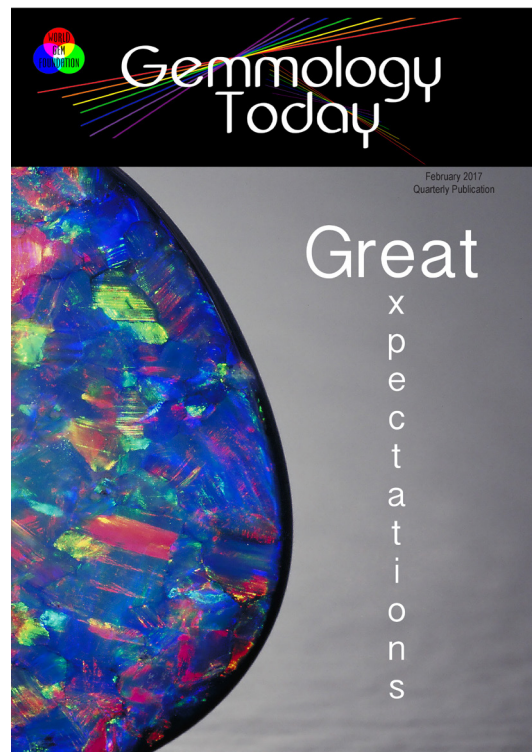
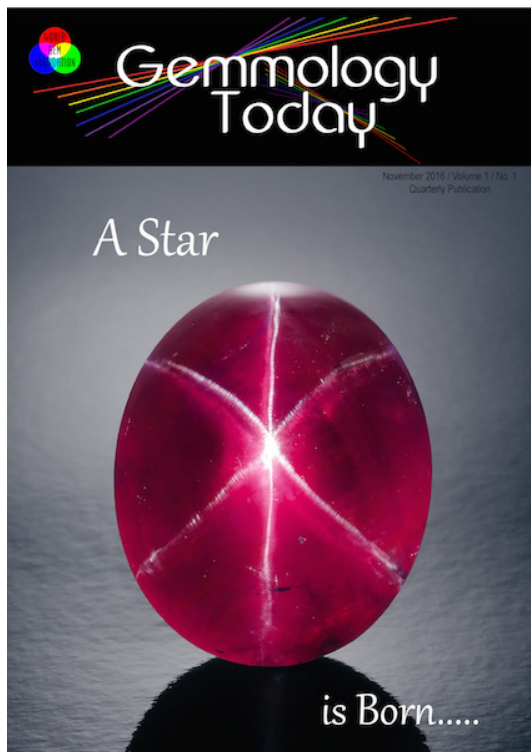
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ANTOINETTE MATLINS, PG, FGA, is an internationally renowned gemologist and is the author of the best selling books *Jewelry & Gems: The Buying Guide*; *Gem Identification Made Easy*; *Diamonds*; *Colored Gemstones* and many other books about buying and enjoying jewelry and gems.



## The Value Of Simple, Portable Instruments – Part 2 My Favorite Gem-Testing Tool: The Calcite Dichroscope

### Editor's Note:

This is the second of four articles where Antoinette explores everyday tools available to gemmologists and how to truly push their limitations to achieve maximum mileage.

As we discussed in my previous article, there are many troublesome gemstones in today's market, including stones misidentified by sellers, gemstones that occur naturally in similar colors, as well as synthetics. No one can carry an entire lab with them, but that doesn't mean there is nothing you can do; and it is increasingly important to check every stone because human error occurs as well as fraud.

Where colored gemstones are concerned, I find using the Chelsea filter (covered previously) in combination with a calcite dichroscope, to be an unbeatable combination for knowing the variety of gemstone you're examining, and in some cases, even serving as the first alert to alteration of color and/or clarity. In short, sometimes, this dynamic duo tells you everything you need to know...quickly and easily!

Interestingly, I find that many, if not most, gemologists never bother to use a dichroscope. In fact, I'm often asked why I don't just use a refractometer, especially since there are nice portable models today. The answer is easy: sometimes you just can't use a refractometer because to use a refractometer the stone must have a good polish and must have an area that can be in direct contact with the hemi cylinder at the top of the refractometer. So first, this would eliminate its use for 'rough' material or for stones mounted in settings that prevent the stone(s) from making direct contact with the hemi cylinder, or if you have a stone with a refractive index (RI) that is higher than what the refractometer is designed to read. Furthermore, a refractometer tells you ONLY the identity, whereas the dichroscope, or combination dichroscope/Chelsea filter, often raises red-flags re: color-alteration resulting from treatments. For example, if the colors you see are weird — not quite right for the material — you know to be suspicious of what the material actually is, and / or whether or not it has been

treated and you know you must check it further. When the reaction through the dichroscope is what you expect, it is normally indicative that just your 3 simple tools — Chelsea filter, dichroscope and loupe — are all you need to know what you have!

Like the Chelsea filter, the dichroscope is very easy to use. It is used only for transparent colored stones (this means it is useless for colored opaque stones and also for amber and opal) and is one of the easiest and fastest ways for differentiating transparent stones of the same color from one another. The gemologist, gemstone buyer and jeweler who knows how to use this instrument can easily distinguish, for example, a ruby from a red garnet or a red spinel (increasingly popular and now an important and increasingly valuable gemstone); a blue sapphire from fine tanzanite or blue spinel; an amethyst from purple glass; or an emerald from many of its imitations or look-alikes.

The dichroscope we recommend is a calcite-type (not a polarizing type). This is because the polarizing type will indicate whether or not a stone is double-refracting, but it won't show you the specific colors that you need to see as easily and as clearly as the calcite type, especially with pastel stones.

The calcite type is a small tubular-shaped instrument that is approximately 2 inches long and ½ inch in diameter. In most models, the tube has a small round opening at one end, and a rectangular opening at the other (in these models, look through the round opening). Some models have two round openings, one slightly larger. Look into the dichroscope without any stone or piece of jewelry. Just hold the instrument up to your eye, then hold it toward the light, and look through it. Do you see two small rectangular windows at the opposite end? If not, look through the other end. The important thing is to be sure that when you look through the opening, you are looking through the end that allows you to see a pair of rectangular windows at the opposite end.



When colored stones are viewed with the dichroscope, some will show the same color in both rectangular windows while other stones will show two colors, or two different tones or shades of the same color. For example, you might see blue in one window and yellow in the other. Or, you might see pink in one window, and red in the other. In either case, the colors you see would be considered 'two' colors, even though pink is really a lighter shade of the color red. If you were to see orangey-red in one window and violet-red in the other, this would also be considered seeing two colors, even though they are really different shades of the same color.

One can successfully use the dichroscope without understanding why only one color is seen with some stones and more than one with others. However, we think it is interesting to understand why, so I'll take a moment to explain it in very simple terms because I think it will help you better understand the importance of using the instrument properly; this is where many gemologists fall short because they've forgotten how to use it!

When a ray of light enters a colored gemstone, depending on the particular properties of that stone, it will either continue travelling through as a single ray, or the ray of light will divide into two rays. Stones through which the light continues as a single ray are said to be 'single refracting'; stones through which the ray splits and travels as two rays are 'double refracting'. To better understand this, if you simply take any stone that is strongly double-refractive, place it over something like newsprint, and then look through the material, you will actually see two images, one overlapping the other; in short, it's like you're 'seeing double'! Try this with a piece of calcite — simply write your name on a piece of paper and then hold the calcite over it and read what you wrote while looking through the piece of calcite — you'll see double.

Or, take a cut/polished zircon (a very popular and increasingly costly stone now enjoying a revival in the jewelry market) and examine it with your loupe, focus on the back facet joins, and you'll see they are 'doubled'! I remember being with a very competent gemologist at an event in Maine many years ago, where people in the audience were invited to send up jewelry pieces for identification and valuation by a 'panel of experts'... an event in which I refused to participate since the environment was horrible for any gem ID, and it sent a wrong message to the audience about the complexities of reliable identification, quality evaluation and thus, value! But this gemologist friend was confident that it would be unlikely he couldn't at least identify the material: then the unimaginable happened and he had a large blue gemstone that baffled him! He sought my help and when I saw it, I decided not to refuse, but to turn it into a teaching moment. Being older than he was, I recognized it immediately — one of the few gemstones I can ID in a split second — a blue zircon! I suggested he look at the very strong doubling of the facet joins, indicating very high birefringence which, combined with the color, narrowed the possibilities immediately to one stone: blue zircon. I then showed him how

to confirm it with a simple calcite dichroscope, in which he saw a blue color in one window (the same hue as the color of the zircon) and the other window was colorless.

Singly refractive stones are those that will always show the same color in both rectangular windows of the dichroscope. Only a few gemstone materials are singly refracting — diamond, garnet, spinel, glass, colored YAG, colored CZ, and plastic. Therefore, if you have a stone that only exhibits one color, identification can be fairly quick, since there are so few possibilities.

Most gems are double refracting and will show two colors, one color in one rectangular window of the dichroscope, and a different color or distinctly different shade of color in the second window. We call these stones "dichroic" (di = 2; chro = color). When a ray of light enters the stone and splits into two rays (as it does with all doubly refractive colored gemstones), each of the two rays will travel through the stone at a different angle and speed. The angle and speed at which light travels determines the color we see. So, if we could separate the rays and see each one individually, we would see a different color for each. This is what the dichroscope does. It separates each of the two rays so we can see both colors.

Some stones show three colors when viewed with the dichroscope. We call these stones trichroic (tri = 3; chro = color). These stones are also doubly refractive, but when light enters from certain directions we get one pair of rays (travelling at certain angles and speeds), and when it enters from another direction, we get a different pair. In the second pair, one of the two rays will travel at an angle and speed different from either of the two rays in the first pair; this is why we see a third color. We get two colors (one in each rectangular window) in certain directions, and two colors from another direction, but not the same two colors; one of the colors in the second pair will be different from the colors seen in the first pair.

The specific color or shades of color seen through the dichroscope present a very important clue to the identity of a stone. It is also important to note subtle differences in the hue, because this is critical to differentiate and define when trying to determine what the material is.

Let's take two red stones that are approximately the same color red — ruby and red spinel — and view them through the dichroscope. We would be able to separate the two immediately by the colors we see in the windows of the dichroscope. In the case of the ruby, two distinctly different shades of color would appear, one in each of the two small rectangular windows: a strong orangey-red is seen in one window, and a strong purplish-red is seen in the other. However, the red spinel would exhibit the same color in both windows — there would be no difference in tone or shade of red, but exactly the same red. (Note: the dichroscope can





Suite of Zircons (Photo by Tino Hammid)





Peridot (Arizona, U.S.A) (Photo by Tino Hammid)



separate stones that look like one another in color — ruby from glass, sapphire from spinel, and so on — but cannot separate natural from synthetic. Additional tests are required for that.)

The dichroscope may also help you determine whether or not the color of a gem is natural. Sometimes the color in one window seems too pale for the depth of color of the stone; this should make you immediately suspicious. In other cases, the dichroscope might indicate treatment. Such is the case with the popular, strongly trichroic blue gem called ‘tanzanite’, a member of the zoisite family. Zoisite occurs naturally in a wide range of colors from brownish or greenish-yellow to lavender, to violet-blue or deep sapphire-blue. However, naturally-occurring stones in the lovely blue colors that are so desirable today are rare; most of the blue tanzanite we see began as brownish zoisite that was subjected to heat to transform it into the lovely blues. When heated, the brownish color changes to a much prettier blue color. But heating changes more than just the body color seen; it changes the trichroic colors seen with the dichroscope. Natural color blue tanzanite exhibits three distinct, different colors: a pronounced blue, purple, and green are typically seen. Sometimes the purple color is very reddish, and sometimes the green may appear more yellowish-green or yellow, but the important thing to note is that you will observe three different colors. ‘Heated’ blue tanzanite, however, usually exhibits two colors — purple and blue — but you will see two different shades of blue, one distinctly lighter than the other, so it is still considered a ‘trichroic’ gem. What is important to note is that the green/yellow color is usually absent in heated blue tanzanite. When checking tanzanite with the dichroscope, the presence of green or yellow in the trichroic colors seen may indicate that the stone’s blue color is natural; the absence of green or yellow usually indicates heat-induced color.

### How to use the Dichroscope

Although the dichroscope is simple to use, it is important to make sure you have proper light and that you rotate the dichroscope. You must also remember to view the stone from five different directions. Keeping these points in mind, proceed as follows.

1. Hold the dichroscope between your thumb and forefinger, gently resting it against the stone being examined.
2. Place your eye as close as possible to the end of the dichroscope. Be sure you are looking through the end that allows you to see a pair of rectangular windows at the opposite end.
3. View the stone with strong light that is transmitted through the stone. A small high-intensity utility lamp is a good source for transmitted light (these lamps offer the added benefit of stronger light since the stone can be held close to the light source). A strong penlight also provides good light to use with the dichroscope.

You can also use light coming from a ceiling fixture (hold the stone and dichroscope up, looking into the light, with the light coming through the back of the stone).

4. To view the stone with the dichroscope, hold the dichroscope as close as possible to the stone, even touching it if the stone is a very hard stone (be sure a strong light is coming through the stone, from behind it).
5. Look into the dichroscope and slowly rotate it (not the stone) at least 180 degrees. Does a second color appear in either of the windows as you rotate it? For example, while looking at ruby you may see the same color in both windows as you begin, possibly an orange-red color. Then, as you turn the dichroscope, you will see a second color appear. You will still see the orange-red color you’ve seen all along in one window, but in the second window the color may change to violet-red. If there is no apparent change of color in one of the windows, continue rotating the dichroscope until you have turned it at least 180 degrees. If you still don’t see a second color, change the direction through which you are viewing the stone.
6. Following exactly the same procedure described above, examine the stone from another direction. You must examine the stone from five different directions to be sure that there is, or is not, a second color (or a third). The five directions are: top to bottom; side to side; front to back; on a diagonal to one of those directions; on a diagonal to the other direction.

Using the ruby again as an example, if we viewed it from only one direction, even though we rotate the dichroscope, we might only see a single color in the two boxes. If we stopped here, we could draw a false conclusion that a genuine ruby was a garnet or spinel. If we do not detect more than one color in the first direction, we must repeat the examination from a second direction, and again from a third direction, and so on, until we have examined it from all five directions.

**REMEMBER: AS YOU VIEW THE STONE IN EACH DIRECTION, YOU MUST ROTATE THE DICHROSCOPE.**

7. Note the color seen in each window, in each direction. You may see only one color; or two colors (in which case you are observing dichroism); or, in some stones, three colors (trichroism).

In the case of trichroic stones, you will see one pair of colors in the rectangular windows when viewed from one direction, and a second pair when viewed from a different direction, only one color of which will be the same in both pairs.



Andalusite provides a good example of trichroism. When it is viewed with the dichroscope in one direction, you may see yellow in one window and green in the other. Then, when viewing it from another direction, you might see the same yellow you saw in the first pair of colors and, in addition, a reddish-brown in the other window.

The specific colors seen in the rectangular windows, as well as the number of colors seen (two or three), can help you make a positive identification of most colored stones. But remember, you must observe the stone from at least five different directions. A second color will often fail to show up when viewed from only one direction. And, of course, a third color, which would indicate a trichroic stone, might be present. If you think a stone might be one that exhibits trichroism, you must not stop after seeing a second color, but continue through all five directions until you have, or have not, detected the third. This can be especially important in gem identification since far fewer stones are trichroic and, therefore, the test would give positive ID on the spot.

While the dichroscope is an easy instrument to master, we recommend having someone who is already familiar with it assist you the first time. This will help insure that you are holding it properly and have the proper lighting. It shouldn't take more than 15 minutes to get the hang of it.

### **What The Dichroscope Will Show**

Once you feel comfortable handling the dichroscope, you are ready to start viewing stones. If only one color is observed with the dichroscope, it usually indicates that you have a 'non-dichroic' material. There are only a few gemstones that fall into this category.

Most gemmological books list the 'pleochroic colours' seen in most common gemstones. Once you have noted the colors you see with the dichroscope, you can check these charts to see which stone(s) show these colors. If there is only one, you can now make a positive identification. If there is more than one, you may need to use the Chelsea filter, loupe or other instrument to confirm identity.

**REMEMBER:** The dichroscope can separate stones that look like one another in color — ruby from glass, sapphire from spinel, and so on — but cannot separate natural from synthetic. Additional tests are required for that.

### **Learn to use the three pocket instruments together**

Sometimes a gemstone that should show dichroism doesn't. Two stones that demonstrate how checking for dichroism alone may be inconclusive for gem ID are peridot and green zircon. These exceptions offer excellent examples of how useful the loupe, Chelsea filter, and dichroscope can be in assuring accurate gem ID when used together.

Peridot and green zircon can resemble each other. There is also green glass that can look like both of them. The dichroic colors of green zircon will differentiate it from peridot and glass (and vice versa) when you can detect them, but sometimes they are too weak to detect. And sometimes green zircon just doesn't exhibit dichroism. Here's where using another one of our three pocket instruments can be useful.

If you examine a green zircon with a Chelsea filter you will see a reddish coloration, which you will not see with peridot (peridot remains green when viewed with the filter). However, it could still be green glass.

Now your loupe will come to the rescue. First, the loupe may reveal 'doubling'. This is an optical effect that makes you think you are 'seeing double'. To observe doubling, look through the stone (check from several different directions). If the edges of the back facets appear double, as if you have double vision, you are seeing 'doubling' (sometimes the facet edge, instead of looking like a single line, will resemble a narrow set of railroad tracks).

Zircon will exhibit doubling (peridot will also show doubling of the back facets, but we eliminated it with the Chelsea Filter — since peridot will remain green). Glass is still a possibility. However, glass will not show any doubling while zircon does. So by checking with the loupe to see if there is doubling, we can determine the identity of the stone. If we see doubling, we now know we have a zircon.

If you are not sure whether or not you see doubling, the loupe will still aid you. It will tell you from the presence and type of inclusions whether it is glass or zircon.

Next let's take a look at peridot. If you are able to detect trichroism, this will confirm that it is a peridot. But peridot often shows only two colors and might be confused with green zircon. To further complicate matters, there are three types of zircon, all of which may occur in some shade of green: 'low' (also called 'metamict'), 'intermediate', and 'high'.

The crystalline structure of zircon has been broken down as a result of naturally occurring exposure to radiation and may exhibit virtually no double refraction, no dichroism, and no doubling; intermediate zircon has had a less severe breakdown of the crystal structure than the 'low' type so it will exhibit double-refraction, weak dichroism, and doubling (but less strong than peridot); 'high' zircon has strong double refraction, and will exhibit good dichroism and very strong doubling, even greater than peridot. Usually green zircon is either 'low' or 'intermediate' so seeing strong doubling would lead us to conclude the stone is peridot. Furthermore, 'high' zircon is also typically light green, while peridot can be medium to deep green. So if the color is



a deeper green, strong doubling might lead us to conclude the stone is peridot. Peridot is also encountered far more frequently than green zircon. Nonetheless, in this example, you might not be able to make a positive determination with just the loupe and dichroscope. Here again, using another instrument, in this case the Chelsea filter, will give you the answer. If the stone is peridot, it will remain greenish when viewed through the filter, but if it is green zircon it will look reddish through the filter.

Another important use of the dichroscope is for separating tanzanite from its imitations. Many imitations are single-refracting and exhibit no dichroism, while tanzanite is trichroic. Synthetic corundum (sapphire) is produced in tanzanite colors, but it is dichroic only (no 'third' color will be seen) and produces different dichroic colors.

Synthetic forsterite could be mistaken for tanzanite, but it is also dichroic, not trichroic. However, one of the colors seen in forsterite (purplish pink) might suggest tanzanite, especially if mounted in such a way that prevents checking the stone from multiple directions. In such cases, examination with an ultraviolet lamp can be definitive (ALL of the tanzanite imitations exhibit fluorescence under long and/or shortwave radiation, while tanzanite does NOT fluoresce). A refractometer will also provide positive identification if the stone is cut, has a good polish, and can make contact with the hemi cylinder of the refractometer.

Practice using these three pocket instruments together. Within a surprisingly short period of time, you'll become much more confident, and begin to enjoy the rewards of accurate gem ID using only pocket tools!

## Gemmology Today Quiz #6



To successfully identify a gemstone, there are four essential components needed: access to a wide range of gem testing equipment, a thorough working knowledge of how each instrument works, proper access to the stone, and a logical mind.

Gem identification is a forensic science, a form of detective work, requiring the collection of pertinent data followed by a detailed analysis of it.

## How is your knowledge of Gem Identification?

[Click Here  
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"Education inflames our intellect and makes us grow. It widens our horizons, adds value to our name and instills in our clients, staff, management and industry colleagues, a confidence in our ability that can only be gained from being assessed to the highest of standards by our peers."

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President NCJV

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# 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. To recognise this, we have introduced two new 'Diploma' programs (Diamond Professional and Coloured Gemstone Professional) for 2018.

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,



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 to estimate the weight of '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.

## Diamond Professional Program

Designed specifically for those engaged in the diamond trade, this program covers the same theoretical information covered in our 'Diamonds' course plus our eight-day Diamond Grading and Lab-created Workshop.

## Coloured Gemstone Professional Program

If your area of expertise is coloured gemstones, this program is ideally suited for you. The CGP program involves the completion of four theoretical courses (Basic Gemmology, Advanced Gemmology, Gem Identification and Coloured Gemstones) plus our two five-day practical Gem Identification workshops, our five-day Coloured Gemstone Grading #1 workshop, our five-day Lab-created and Treated Gems workshop plus our 100 hour online Coloured Gemstone Grading #2 course.

## Courses in Spanish

We are currently translating all of our 'Diploma' program courses into Spanish to meet the needs of our Spanish speaking students.

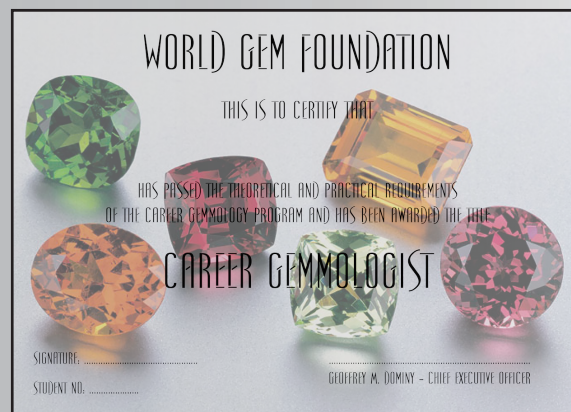
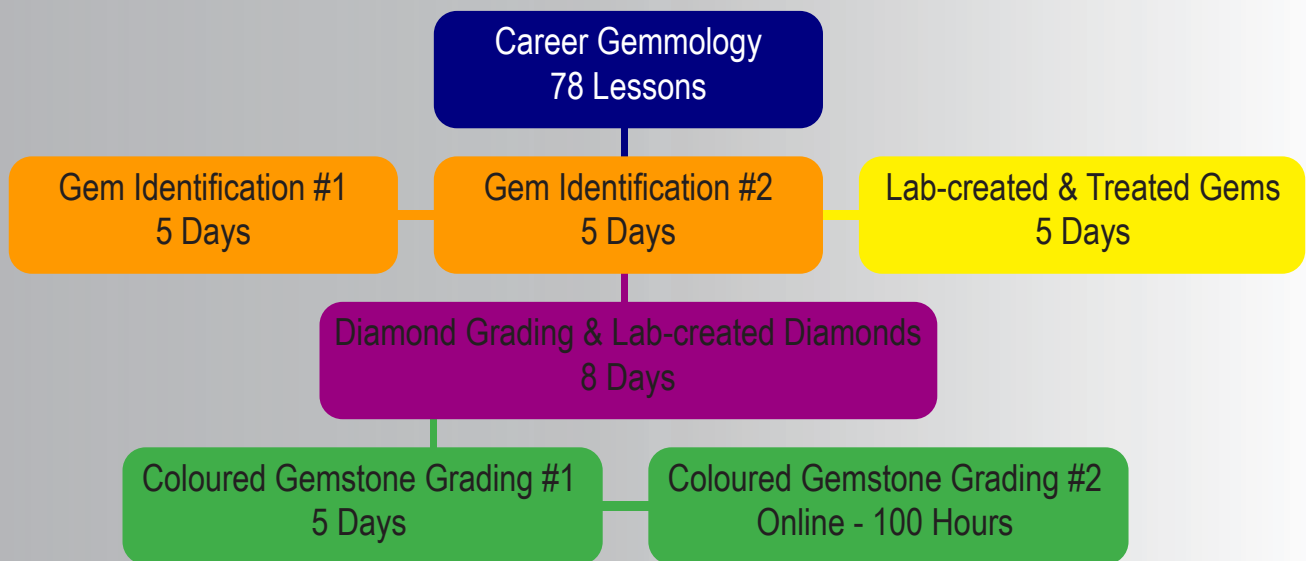
Currently our Gemología Básica (Basic Gemmology) is available in both digital and print and also online.

## General Interest Courses

For those interested in gemstones but not wishing to take our 'Diploma' programs, all of our theory courses can be taken independently without prerequisites. In addition to the six theoretical courses (Career Gemmology, Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds and Coloured Gemstones) that make up our Career Gemmologist, Diamond Professional and Coloured Gemstone Professional 'Diploma' programs, we also offer three 'General Interest' courses (Rubies, Sapphires and Emeralds, Opals and Jade and Organic Gems).



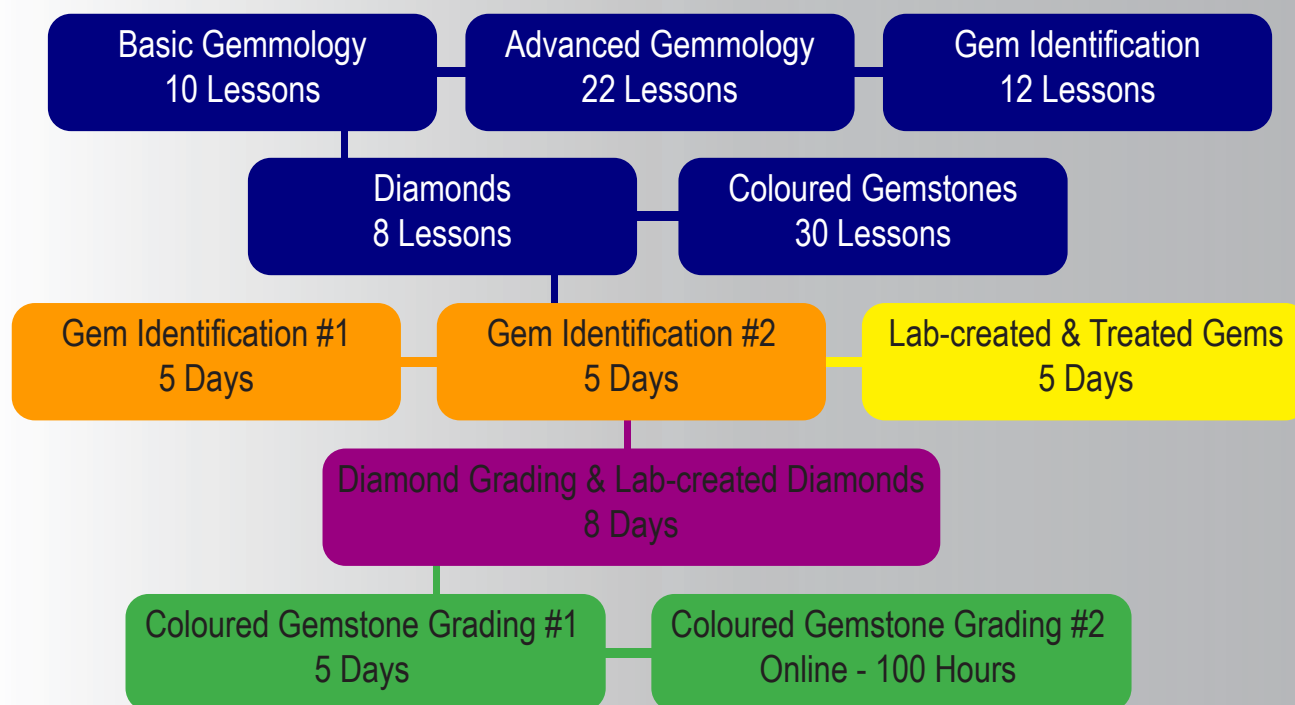
# GEMMOLOGY SEVEN PROGRAM



Career Gemmology Seven	Digital Fees			Printed Fees		
Course Name	Euros	Pounds Sterling	USD	Euros	Pounds Sterling	USD
Career Gemmology (Theory)	1400	1100	1600	1570	1235	1795
Gem Identification #1	500	400	550	500	400	550
Gem Identification #2	500	400	550	500	400	550
Coloured Gemstone Grading #1	500	400	550	500	400	550
Coloured Gemstone Grading #2	1000	800	1150	1000	800	1150
Diamond Grading/Lab-created Diamonds	1750	1400	2000	1750	1400	2000
Lab-created & Treated Gems	500	400	550	500	400	550
Examinations Fees ( Final Exam)	250	200	280	250	200	280
<b>Total Cost</b>	<b>6400</b>	<b>5100</b>	<b>7230</b>	<b>6570</b>	<b>5235</b>	<b>7425</b>



## GEMMOLOGY ELEVEN PROGRAM



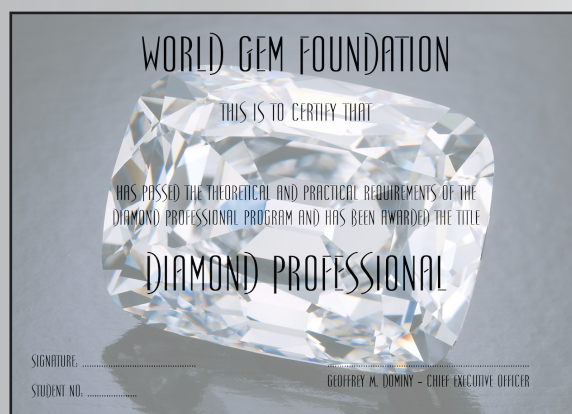
Career Gemmology Eleven		Digital Fees			Printed Fees		
Course Name	Euros	Pounds Sterling	USD	Euros	Pounds Sterling	USD	
Basic Gemmology (Theory)	200	150	225	235	180	265	
Advanced Gemmology (Theory)	400	300	450	430	325	485	
Gem Identification (Theory)	225	175	250	255	200	285	
Diamonds (Theory)	225	175	250	255	200	285	
Coloured Gemstones (Theory)	500	400	550	565	450	625	
Gem Identification #1	500	400	550	500	400	550	
Gem Identification #2	500	400	550	500	400	550	
Coloured Gemstone Grading #1	500	400	550	500	400	550	
Coloured Gemstone Grading #2	1000	800	1150	1000	800	1150	
Diamond Grading/Lab-created Diamonds	1750	1400	2000	1750	1400	2000	
Lab-created & Treated Gems	500	400	550	500	400	550	
Examinations Fees ( Final Exam)	250	200	280	250	200	280	
<b>Total Cost</b>	<b>6550</b>	<b>5200</b>	<b>7355</b>	<b>6740</b>	<b>5355</b>	<b>7575</b>	



# DIAMOND PROFESSIONAL

Diamonds  
Theory  
8 Lessons

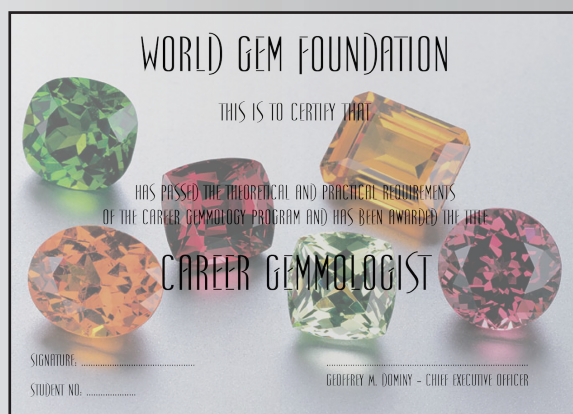
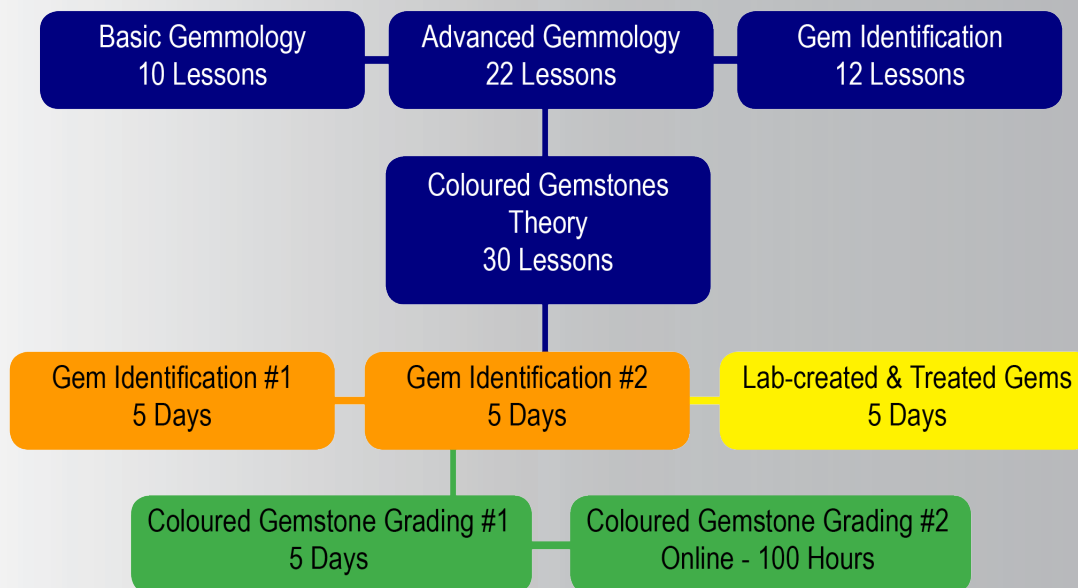
Diamond Grading & Lab-created Diamonds  
Practical Workshop  
8 Days



Diamond Professional	Digital Fees			Printed Fees		
Course Name	Euros	Pounds Sterling	USD	Euros	Pounds Sterling	USD
Diamonds (Theory)	225	175	250	255	200	285
Diamond Grading/Lab-created Diamonds	1750	1400	2000	1750	1400	2000
Examinations Fees ( Final Exam)	250	200	280	250	200	280
<b>Total Cost</b>	<b>2225</b>	<b>1775</b>	<b>2530</b>	<b>2255</b>	<b>1800</b>	<b>2565</b>



## COLOURED GEMSTONE PROFESSIONAL



### Coloured Gemstone Professional

### Digital Fees

### Printed Fees

Course Name	Euros	Pounds Sterling	USD	Euros	Pounds Sterling	USD
Basic Gemmology (Theory)	200	150	225	235	180	265
Advanced Gemmology (Theory)	400	300	450	430	325	485
Gem Identification (Theory)	225	175	250	255	200	285
Coloured Gemstones (Theory)	500	400	550	565	450	625
Gem Identification #1	500	400	550	500	400	550
Gem Identification #2	500	400	550	500	400	550
Coloured Gemstone Grading #1	500	400	550	500	400	550
Coloured Gemstone Grading #2	1000	800	1150	1000	800	1150
Lab-created & Treated Gems	500	400	550	500	400	550
Examinations Fees ( Final Exam)	250	200	280	250	200	280
<b>Total Cost</b>	<b>4575</b>	<b>3625</b>	<b>5105</b>	<b>4735</b>	<b>3755</b>	<b>5290</b>



## Rubies, Sapphires & Emeralds

This course focuses on three coloured gemstones (rubies, sapphires and emeralds) that individually and collectively are considered the cornerstones of the coloured gemstone trade. Lessons include a complete overview of their physical and optical properties, principal sources, mining, how they can be identified from gemstones that can be deceptively similar in appearance and their lab-created counterparts, common treatments and enhancements, pricing guidelines, what constitutes the best quality and how to properly care for them.

## 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.

## Online Tutoring

While clearly the ideal way to learn a particular subject is with one-on-one tutoring, we appreciate that this is difficult when you enrol in a long distance study program.

Fortunately, new distance learning technologies are changing. Now teachers can connect with their students virtually using a variety of virtual tutoring tools, such as Skype.

The chart below outlines the number of online tutoring hours that are included in your course price. If you require more online instructional tutoring, please contact your education coordinator to discuss availability and pricing.

Course Name	Hours
Basic Gemmology - Theory	2
Advanced Gemmology - Theory	4
Gem Identification - Theory	2
Diamonds - Theory	2
Coloured Gemstones - Theory	5
Career Gemmology - Theory	14

We strongly suggest that you contact your instructor beforehand by email with your questions so that you will derive maximum benefit from your online session. Please remember that these sessions are designed to provide you with 'coaching' rather than direct instruction.

## Course Fees

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.



## Practical Workshops

### Gem Identification #1



**Dates:** May 7 - 11, 2018

**Venue:** Mallorca Teaching Centre

**Course Cost** € 500

[Reserve Your Place Now](#)

This five day (30 hour) practical workshop focuses on the study and identification of six colour groupings (colourless/white, red, pink, orange, yellow and green) and basic crystallography. Gemstones covered in this workshop include:

Natural Diamond, Natural Ruby, Natural Sapphire, Emerald, Beryl, Garnets (Spessartite, Almandite Rhodolite, Pyrope, Colour Change, Hessonite, Demantoid, Tsavorite and Grossular), Spinel, Tourmaline, Topaz, Beryl, Quartz, Zircon, Alexandrite, Chrysoberyl, Apatite, Kunzite, Sunstone, Sphalerite, Sphene, Phenakite, Brazilianite, Scapolite, Hiddenite, Danburite, Benitoite, Diaspore, Epidote, Kyanite, Idocrase, Sinhalite, Diopside, Kornerupine, Enstatite, Euclase, Andalusite, Ekanite, Idocrase, Moldavite, Obsidian, Chrome Chalcedony, Amazonite, Jadeite, Nephrite, Chalcedony, Dyed Jasper, Chrysoprase, Maw-Sit Sit, Rhodonite, Rhodochrosite, Amber, Coral, Fire Opal, Lab-created Moissanite, Cubic Zirconia, GGG, YAG, Lab-created Rutile, Strontium Titanate, Lithium Niobate, Lab-created Spinel, Glass, Lab-created Alexandrite, Garnet-topped Doublet, Spinel Triplet, Copal Resin, Bakelite and Imitation Coral.

**Prerequisites:** Basic Gemmology or Equivalent

### Gem Identification #2



**Dates:** May 14 - 18, 2018

**Venue:** Mallorca Teaching Centre

**Course Cost** € 500

[Reserve Your Place Now](#)

This five day (30 hour) practical workshop focuses on the study and identification of four colour groupings (blue, violet/purple, brown and black) plus unusual and phenomenal gemstones. Gemstones covered in this workshop include:

Sapphire, Benitoite, Spinel, Tanzanite, Apatite, Tourmaline, Topaz, Aquamarine, Quartz, Iolite, Zircon, Scapolite, Garnet (Grape, Rhodolite and Hessonite), Chrysoberyl, Taaffeite, Idocrase, Ekanite, Sinhalite, Kornerupine, Andalusite, Kyanite, Euclase, Smithsonite, Sugilite, Charoite, Lapis Lazuli, Sodalite, Turquoise, Odontolite, Serpentine, Chrysocolla, Petrified Wood, Hematite, Marcasite, Pyrite, Jadeite, Jet, Chalcedony, Jasper, Coral, Obsidian, Cubic Zirconia, Bakelite, Dyed Jasper, Lab-created Forsterite, Lab-created Spinel, Lab-created Quartz, Glass, Gilson Lapis Lazuli, Gilson Turquoise, Stained Howlite, Star Sapphire, Star Ruby, Star Almandite Garnet, Star Diopside, Cat's Eye Chrysoberyl, Cat's Eye Tourmaline, Cat's-Eye Quartz, Hawk's Eye Quartz, Tiger's-Eye Quartz, Bi-Colour Tanzanite, Bi-Colour Tourmaline, Ametrine Quartz, Watermelon Tourmaline, Usambara Tourmaline, Trapiche Emerald, Labradorite, Moonstone, Bloodstone, Tortoiseshell, Shell Cameo, Hardstone Cameo, Lava Cameo, Ammolite, Fire Agate, Black Opal, Crystal Opal, Semi-Crystal Opal, Larimar, Malachite, Lab-created Cat's Eye Chrysoberyl and Imitation Cameo.

**Prerequisites:** Gem Identification #1 or Equivalent

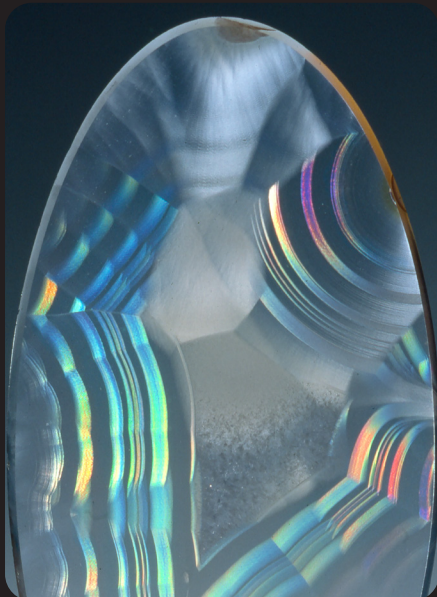


## Practical Workshops

### Coloured Gemstone Grading #1

This five-day (30 hours) workshop includes practical instruction on how to access the hue, tone and saturation of coloured gemstones using three popular colour grading systems (Gemological Institute of America, GemDialogue and World of Color) and how to grade pearls, jadeite and opals.

**Prerequisites:** None

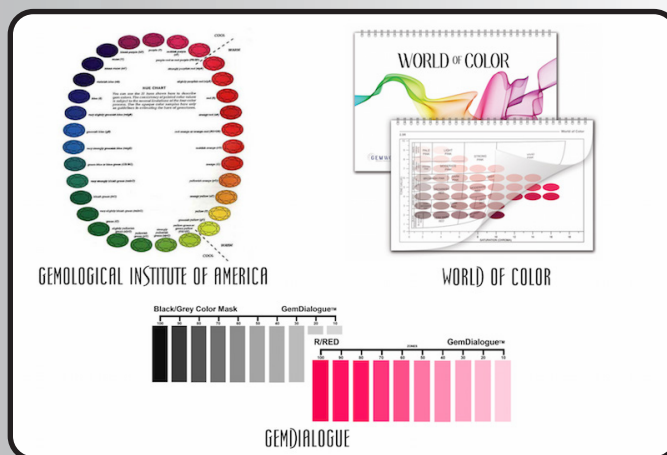


**Dates:** May 21 - 25, 2018

**Venue:** Mallorca Teaching Centre

**Course Cost** € 500

[Reserve Your Place Now](#)



### Coloured Gemstone Grading #2

This 100 hour online course consists of a comprehensive overview of the GemWizard Colour Grading System including colour theory (hue, tone and saturation), how they impact on the value of gemstones, practical exercises that are completed online, and a six month subscription to the Gemewizard program.

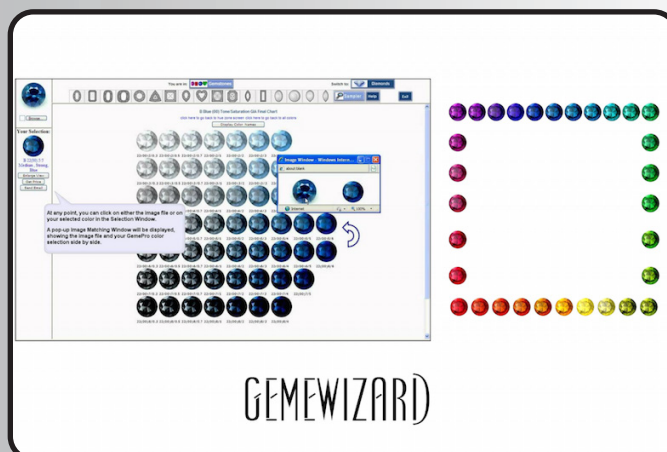
**Prerequisites:** None



**Online Course**

**Course Cost** € 1000

[Reserve Your Place Now](#)





## Practical Workshops



**Dates:** May 28 - June 1, 2018

**Venue:** Mallorca Teaching Centre

**Course Cost** € 500

[Reserve Your Place Now](#)

### Lab-created & Treated Gems

This five day (30 hour) practical workshop focuses on lab-created gemstones (specifically rubies, sapphires and emeralds) and the many treatments and enhancements that are used to improve the appearance and/or value of gemstones, including:

- Heat treatment
- Surface and Sub-surface Diffusion
- Irradiation
- Fracture Filling
- HPHT Treatment
- Oiling
- Waxes & Dyes
- Sugar/Acid & Smoke Inhalation
- Quench-crackling with Dyes
- Coating & Foil Backs
- Laser Drilling

**Prerequisites:** Advanced Gemmology or Equivalent



**Dates:** June 4 - 8 & 11 - 13, 2018

**Venue:** Mallorca Teaching Centre

**Course Cost** € 1750

[Reserve Your Place Now](#)

### Diamond Grading & Lab-created Diamonds

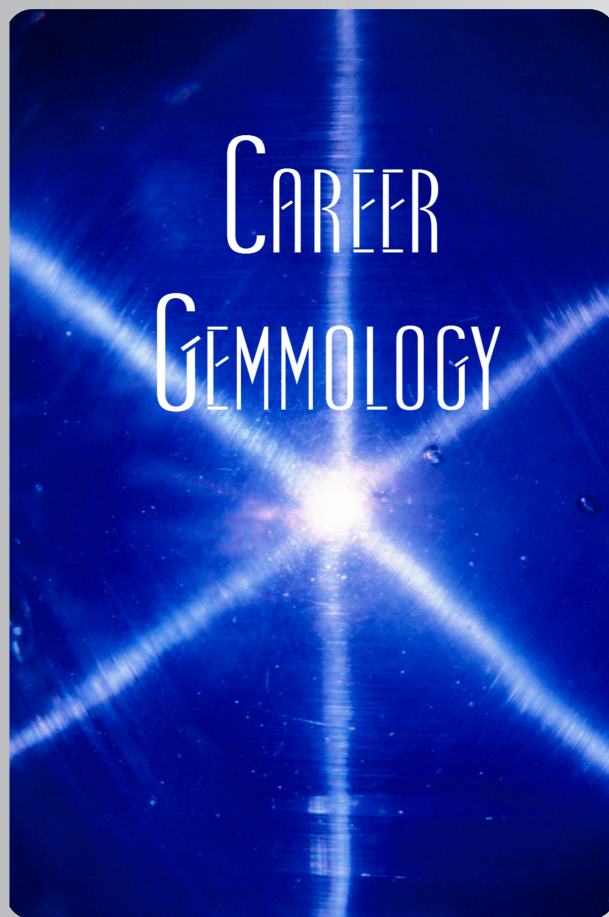
This eight day (48 hour) practical workshop focuses on the clarity and colour grading of diamonds, how to measure the proportions and how to distinguish natural from HPHT and CVD diamonds.

Topics covered include:

- Clarity Grading
- Colour Grading
- Calculating Table Percentage
- Calculating Crown Angle
- Calculating Pavilion Percentage
- Estimating Girdle Thickness
- Assessing Symmetry & Polish
- Lab-Created Diamonds
- Practical Review

**Prerequisites:** Diamonds or Equivalent





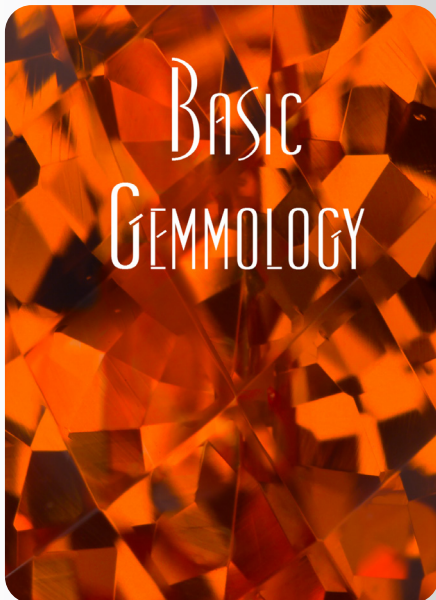
## Course Content

The chemical nature of gemstones, their physical and optical properties, basic crystallography, the absorption of light, the spectroscope, refraction, reflection and the refractometer, polarized light, the polariscope, pleochroism, the dichroscope, colour filters, specific gravity, luminescence, magnification, thermal conductivity, imitation, assembled and lab-created gemstones, the methods used to manufacture lab-created gemstones including Verneuil, Czochralski, flux melt, hydrothermal, skull crucible, zone melt, horizontally oriented crystallization, high pressure, high temperature (HPHT), chemical vapour deposition (CVD), detonation, ultrasonic cavitation, sublimation method, and modified Stober method, their unique identifying features, treatments and enhancements including 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, high pressure, high temperature (HPHT), quench-crackling, surface modifications, coatings and foil backs, laser drilling, and irradiation, gem mining and cutting, diamond and coloured gemstone grading, gem identification by colour and transparency, advanced gem testing techniques and a comprehensive overview of the twenty-seven most common groups, species and varieties including diamonds, corundum (rubies and sapphires), beryl (emeralds, aquamarines and other precious beryls), chrysoberyl (alexandrite and other chrysoberyl), spinel, zircon, topaz, tourmaline, peridot, quartz, garnet, tanzanite, lapis lazuli, turquoise, opal, jadeite, kunzite and hiddenite, feldspars, iolite, andalusite, diopside, apatite, pearls, coral, jet, ivory and amber.

**Course Cost:** € 1400

**Prerequisites:** None

**Please Note:** This course includes all the information contained in the Basic Gemmology, Advanced Gemmology, Gem Identification, Diamonds and Coloured Gemstones courses.



### Course Content

The chemical nature of gemstones, 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.

**Course Cost:** € 200

**Prerequisites:** None

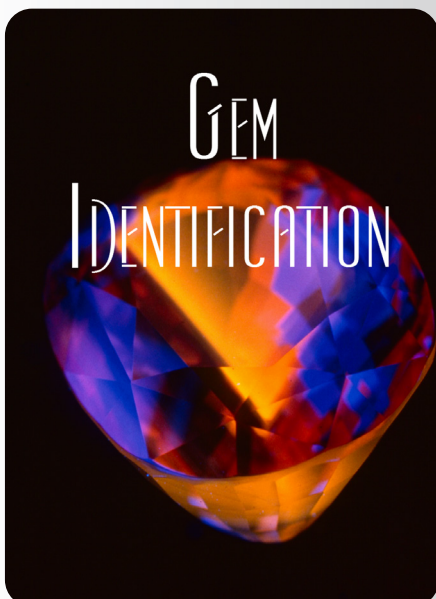


### Course Content

Imitation and composite gemstones, methods used to manufacture lab-created gemstones including Verneuil, Czochralski, Flux Melt, Hydrothermal, Skull Crucible, Zone Melt, Horizontally Oriented Crystallization, HPHT, CVD, Detonation, Ultrasonic Cavitation, Sublimation Method, and Modified Stober Method, their unique identifying features, treatments and enhancements including 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, irradiation, and advanced gem testing techniques.

**Course Cost:** € 400

**Prerequisites:** Basic Gemmology or Equivalent



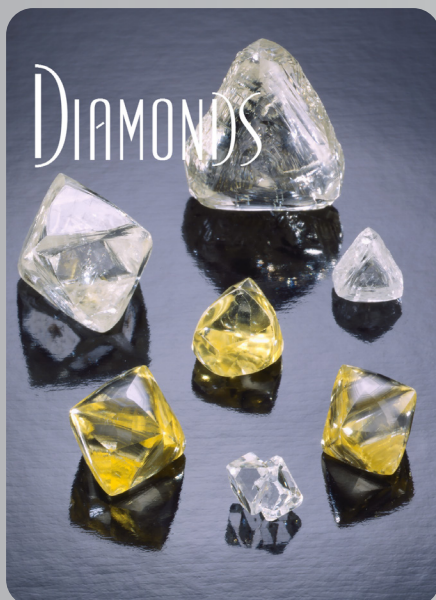
### Course Content

Introduction to gem identification and the tests that are commonly used to identify gemstones. An in-depth look at each of the ten colour groupings (colourless or white, red, pink, orange, yellow, blue, green, violet or purple, brown, black or grey) plus phenomenal or unusual gemstones. 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 tourmaline, diamond and lab-created moissanite) or have physical and optical properties that are similar (i.e. amethyst quartz and purple scapolite). All lab-created, imitation, treated and enhanced gemstones that are found in each colour grouping.

**Course Cost:** € 225

**Prerequisites:** Basic & Advanced Gemmology or Equivalent



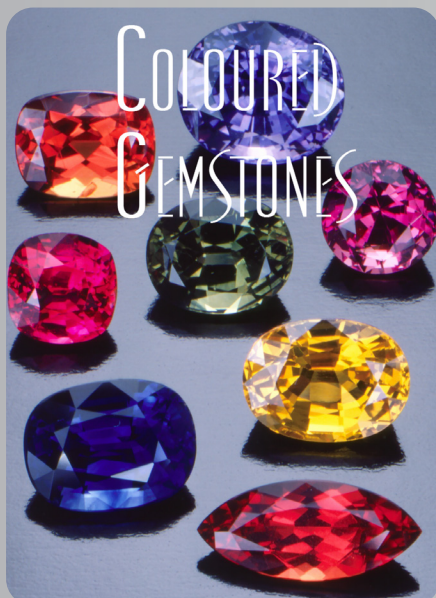


### Course Content

Physical properties, geology, localities, principle mines, crystal system, chemical composition and classification, fancy colours, causes of colour, absorption spectra, pleochroism, inclusions, fluorescence, mining, gem identification, methods of synthesis, common treatments and enhancements. You will learn all about the 4 C's (colour, clarity, cut and carat weight) and how they are measured and assessed. We will also compare the various 'Cut' criteria for the Gemological Institute of America (GIA), the American Gem Society (AGS), Hoge Raad Diamant (HRD), International Gemological Institute (IGI), the European Gemological Laboratory (EGL), and Accredited Gem Appraisers (AGA) and explain how the estimated weight of a 'mounted' gemstone is calculated.

**Course Cost:** € 225

**Prerequisites:** None

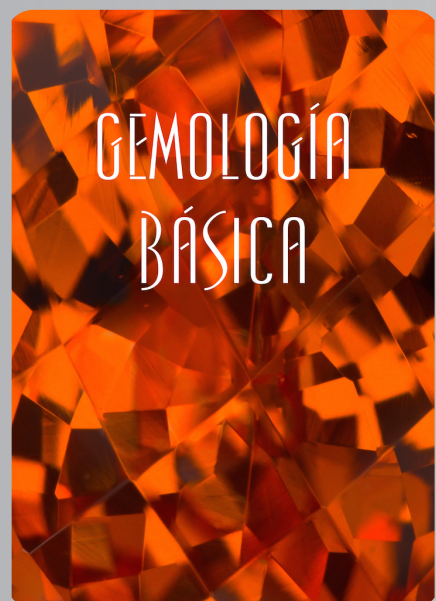


### Course Content

Physical properties, geology, localities, crystal system, chemical composition and causes of colour, varieties, absorption spectra, pleochroism, inclusions, fluorescence, gem identification, synthesis, treatments and enhancements, and care guidelines. Gemstones covered in this course include rubies and sapphires, emeralds, aquamarines and other precious beryls, alexandrite and other chrysoberyls, spinel, zircon, topaz, tourmaline, peridot, quartz, garnet, tanzanite, lapis lazuli, turquoise, kunzite, hiddenite, feldspars, iolite, andalusite, diopside, apatite, pearls, coral, jet, ivory, and amber. You will learn how to accurately describe colour, the various colour grading systems currently used by professionals, the clarity classification of gemstones based on their geological environments, how cut is assessed, and how to grade opals, jadeite and pearls.

**Course Cost:** € 500

**Prerequisites:** None

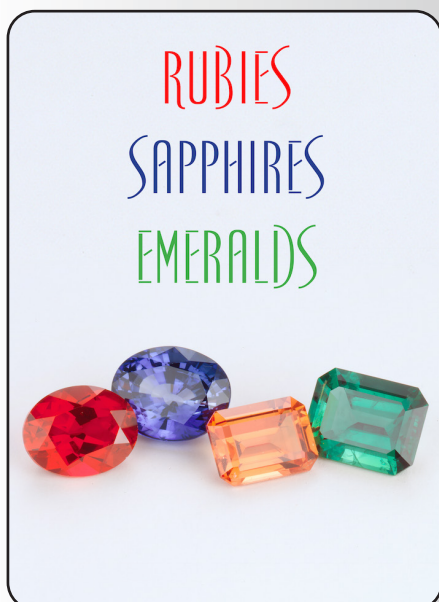


### Contenido del curso

La naturaleza química de las piedras preciosas, las propiedades físicas y ópticas, la cristalografía básica, la absorción de la luz, el espectroscopio, la refracción y la reflexión, el refractómetro, el carácter óptico y el signo, la dispersión, los medidores de reflectividad, la luz polarizada, el polariscopio, el pleocroísmo, el dicroscopio filtros de color, gravedad específica, luminiscencia, aumento y conductividad térmica.

**Costo del Curso:** € 200

**Requisitos Previos:** Ninguna



### Course Content

Topics covered include a complete overview of their physical and optical properties, principal sources, mining, how they can be identified from gemstones that can be deceptively similar in appearance and their lab-created counterparts, common treatments and enhancements, pricing guidelines, what constitutes the best quality and how to properly care for them.

**Course Cost:** € 95

**Prerequisites:** None



### Course Content

Topics covered in the course include their physical and optical properties, geological formation, crystal systems, chemical composition, varieties and classification, cause of colour, absorption spectra, common inclusions, fluorescence, mining, grading criteria, methods of synthesis, gem identification, common treatments and enhancements, cleaning and care instructions, and pricing.

**Course Cost:** € 75

**Prerequisites:** None



### Course Content

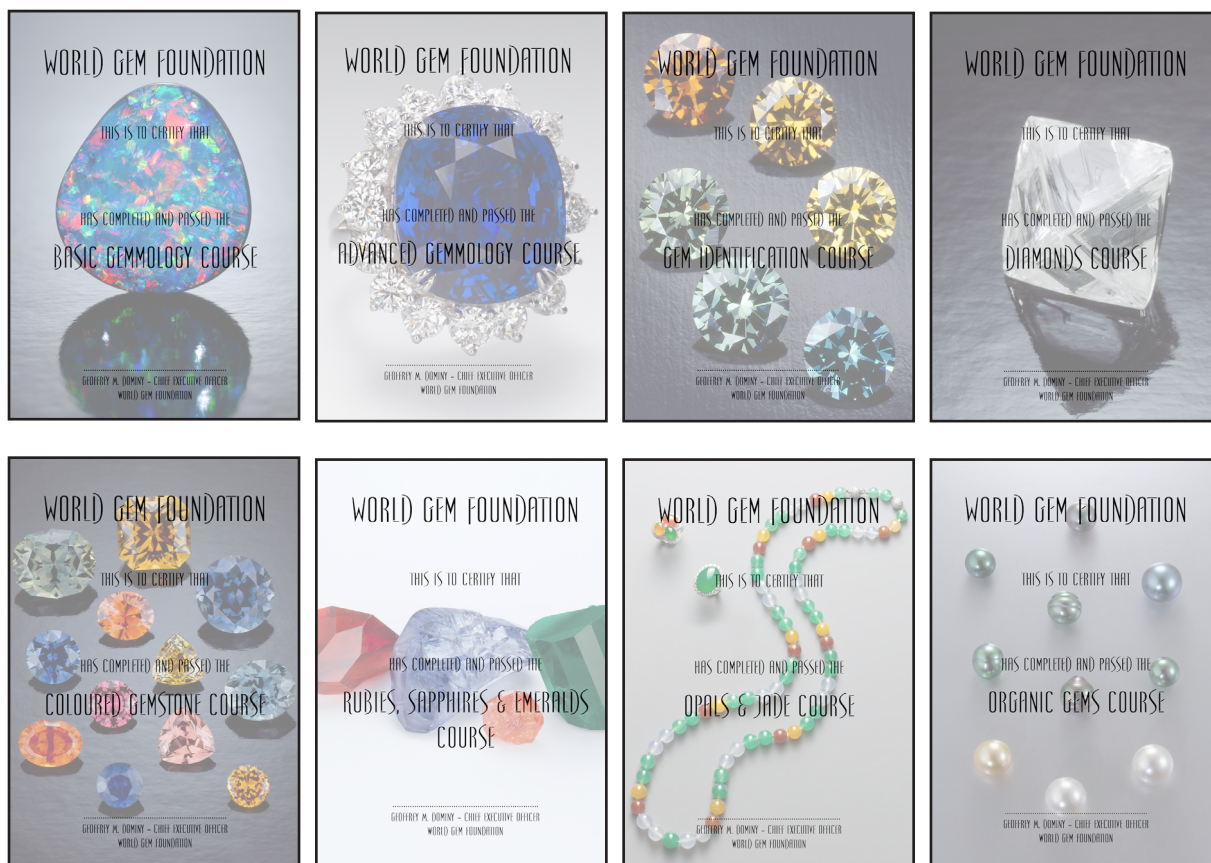
Topics covered include their physical and optical properties, geological formation, crystal systems, chemical composition, varieties and classification, cause of colour, common inclusions and internal characteristics, fluorescence, pearl grading criteria, methods of synthesis, gem identification, common treatments and enhancements, and cleaning and care instructions.

**Course Cost:** € 50

**Prerequisites:** None



## Theory Courses - Letters of Completion



## Practical Workshop - Letters of Completion





The World Gem Foundation is delighted to announce the five successful scholarship applicants.

## Tino Hammid Memorial Gemmological Scholarship



We would like to thank all those who submitted applications for the 2018 Tino Hammid Memorial Gemmological Scholarship. Sadly we could not give scholarships to everyone who applied but we would like to remind everyone that this is a yearly scholarship and you are welcome to apply again for 2019.

The five successful scholarship applicants for 2018 come from a variety of backgrounds but all share an enthusiasm for gemmology. The applicants were selected by Tino's wife Petra and his oldest daughter Evelyn who were given the mandate to select those five candidates who, in their opinion, best epitomize the spirit of Tino.

Each successful applicant will now be enrolled in their World Gem Foundations Career Gemmology (Theoretical) Course. We wish them all the best of luck.

The 2018 recipients are....



**Brandon Williams**  
(U.S.A)



**Asif Rasheed**  
(Pakistan)



**Shakeel Ahmad**  
(Pakistan)



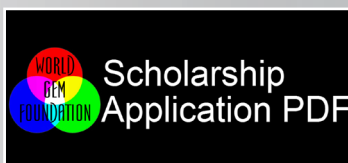
**Khawaja Muhammad Abbas**  
(Pakistan)



**Teklebrhan Teklehaymanot**  
(Ethiopia)

In 2019, the World Gem Foundation will again 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, 2018. To download the application form, please click on the image below:

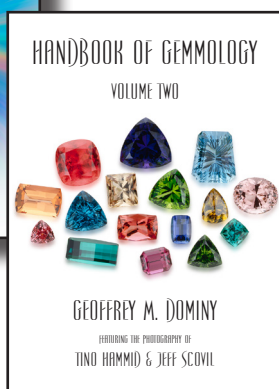
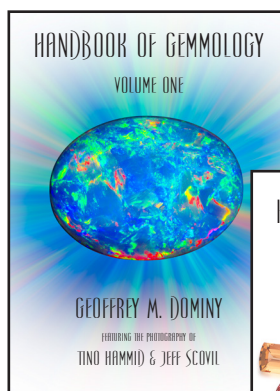






# MALLORCA GEMQUEST GEMMOLOGICAL CONFERENCE

SEPTEMBER 22 - 23, 2018



Purchase the Full Conference Package  
and receive:

Signed copy of the 5th Anniversary  
Handbook of Gemmology Printed Edition  
(Volume One & Volume Two)

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OFFER LIMITED  
TO THE FIRST  
75 REGISTRANTS

Courtesy of our Diamond Sponsor:

## The Handbook of Gemmology

For more information, [click here](#)

## Conference Schedule

**September 22nd, 2018**

### Lectures

Time	Event
9.00 - 9.15	Welcome & Introduction
9.15 - 10.15	Synthetic Diamonds - Better, Cheaper and More with Dr. Katrien de Corte
10.15 - 11.15	Spinel - Stepping out of the Shadows with Dr. Laurent Massi
11.15 - 11.45	Refreshments
11.45 - 12.45	Pushing the Polariscope with Alan Hodgkinson
12.45 - 13.45	Tanzanite - Gemstone of a Generation with Menahem Sevdemish
13.45 - 15.15	Lunch
15.15 - 16.15	Testing Times with Antoinette Matlins
16.15 - 17.15	Objective Diamond Clarity Grading with Geoff Dominy
17.30 - 18.30	5th Anniversary Printed Edition Handbook of Gemmology - Book Signing
19.30 - 21.30	Conference Dinner

**September 23rd, 2018**

### Lectures & Workshops

Time	Event
9.30 - 10.30	Rags to Riches - the Genesis of a Gemstone with Dr. Laurent Massi
10.30 - 12.00	Workshop - GeneWizard: Putting the 'U' back into Color with Menahem Sevdemish and Guy Borenstein
12.00 - 13.00	Lunch
13.00 - 14.00	Pearls of Wisdom - Making the Grade with Antoinette Matlins
14.00 - 15.30	Workshop - The Hodgkinson Blues with Alan Hodgkinson

Please check our Mallorca GemQuest Conference website for more information at:

[www.mallorcagemquest.com](http://www.mallorcagemquest.com)



## Sóller, Mallorca

The authentic town of Sóller sits in the heart of the 'Valley of Oranges' or 'Valley of Gold' as it is sometimes known, and offers much to visitors and residents.

Located in the northwest of Mallorca, Sóller became wealthy due to the valley's abundant citrus groves. In the 19th century, when the area was isolated from the rest of Mallorca by mountains, the oranges were shipped to France from the nearby Puerto de Sóller. Many locals went to work in France and returned – their fortunes duly made – to build some of the many handsome Modernista properties that grace Sóller today.

### Gran Sóller Hotel

The Gran Sóller Hotel is located in one of the most characteristic buildings in Sóller, a depiction of the architecture of the town in the XIX Century. Built by the architect Joaquín Pavía Birmingham, creator of the Diputación de Mallorca (headquarters of the Council of Majorca) and the extension works of the Cathedral of Palma de Majorca, this 5 star hotel provides an oasis of culture and relaxation; classic luxury with a hint of glamour with modern services for the comfort and enjoyment of its guests.







# Conference Packages

We are delighted to offer you three conference options:

## Full Conference Package

This conference package includes:

### September 22nd, 2018

- Six Lectures
- Coffee/Tea & Snacks
- Three Course Lunch
- Four Course Conference Dinner

### September 23rd, 2018

- Two Lectures & Two Workshops
- Three Course Lunch

**Plus:** Complimentary Signed Copy of the 5th Anniversary Handbook of Gemmology (Printed Edition) (Volumes One & Two)

**Price: € 359** (After March 31st, 2018: € 399)

## Conference A Package

This conference package includes:

### September 22nd, 2018

- Six Lectures
- Coffee/Tea & Snacks
- Three Course Lunch

**Price: € 199** (After March 31st, 2018: € 219)

## Conference B Package

This conference package includes:

### September 22nd, 2018

- Six Lectures
- Coffee/Tea & Snacks
- Three Course Lunch
- Four Course Conference Dinner

**Price: € 249** (After March 31st, 2018: € 269)

**Please Note:** Due to the conference venue, space is limited to 75 Delegates

# Presentations

## **Synthetic Diamonds - Better, Cheaper and More with Dr. Katrien de Corte**

Synthetic diamonds of top quality (D colour, loupe clean) are on the market and vary in size from 0.005ct to 3.00ct and even larger. The identification of these stones in a laboratory is based mainly on optical defects visible in photoluminescence spectroscopy and on the analyses of growth patterns. This lecture provides an overview of the growth methods, characteristics of synthetic diamonds and the screening instruments used to detect them.

## **Spinel - Stepping out of the Shadows with Dr. Laurent Massi**

For centuries, spinel has lived in the shadows of the nobler ruby and blue sapphire, often misunderstood, certainly undervalued and most definitely under appreciated. Finally, spinel is getting noticed, not only by gem collectors and connoisseurs but by jewellers who are struggling to find alternatives to fine quality rubies and blue sapphires and the stratospheric prices they are commanding. If life is all about timing, there has never been a better time for spinel to shine. Dr. Laurent Massi is passionate about spinel and he hopes by the end of his talk, you will be too!

## **Pushing the Polariscope with Alan Hodgkinson**

In an age of modern technology, renowned gemmologist Alan Hodgkinson brings us back to earth, looking at an instrument that will not only tell us if a gemstone is singly or doubly refractive but so much more! From faceted gemstones to rough, there is more to the polariscope than meets the eye.

## **Tanzanite - Gemstone of a Generation with Menahem Sevdermish**

Discovered in the 1960s and named after Tanzania by Tiffany & Co. the famous jewellery firm declared it to be the most beautiful stone discovered in the last 2,000 years. However with a very limited supply it is entirely likely that this generation will be the last one able to buy stones from the primary market before the supply is exhausted. What does the future hold for this rare and beautiful gemstone?

## **Testing Times with Antoinette Matlins**

When it comes to gem identification it's not who you know but what you know and Antoinette knows an awful lot. In 'Testing Times', Antoinette breathes new life into basic gem instruments and shows you how to get maximum mileage out of them without breaking the bank!

## **Objective Diamond Clarity Grading with Geoff Dominy**

Two of the cornerstones of diamond grading are accuracy and consistency. Pioneered by Michael D. Cowing, 'Objective Diamond Clarity Grading' alters the 'playing field' considerably by introducing a system that removes the subjectivity of diamond clarity grading. Now it is even possible for 'novice' diamond clarity graders to reach a level of consistency that up until now has only been possible after years of experience and the examination of thousands and thousands of diamonds.

## **Rags to Riches - The Genesis of a Gemstone with Dr. Laurent Massi**

Forged through heat and pressure, adorned, revered and treasured by Man, gemstones have held an esteemed position since the beginning of time. In Rags to Riches – The Genesis of a Gemstone, Dr. Laurent Massi looks at the metamorphosis of a gemstone from rough mineral to dazzling rock.

## **Workshop - GemeWizard: Putting the 'U' back into Color with Menahem Sevdermish & Guy Borenstein**

One of the challenges facing our industry is the effective communication of colour and how we assess the quality and value of coloured gemstones and fancy coloured diamonds. Test drive GemeWizard, find out how it works, why it works and why you should not leave home without it. Please Note: Participants must have a laptop or iPad to access the digital aspects of this presentation.

## **Pearls of Wisdom - Making the Grade with Antoinette Matlins**

Known as the 'Queen of Gems', pearls have aroused passion, desire and fascination since before recorded history. Symbolizing perfection, modesty and purity, their unparalleled beauty is one of nature's great treasures. In 'Pearls of Wisdom – Making the Grade', Antoinette discusses their origin and the seven factors that determine their value.

## **Workshop - The Hodgkinson Blues with Alan Hodgkinson**

Always passionate, always engaging and always full of enthusiasm, join Alan as he explores all things blue and beautiful. This workshop covers the A to Z of blue gemstones with a few surprises along the way.



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## Smart Thinking

Smart  
is good.

Kirk Feral is a man who is passionate about gemmology. He particularly likes to make it more accessible by getting back to basics. In a world of high-tech instrumentation, Captain Kirk brings us down to earth.

## Thermal Inertia - What is it and why should we care?

Thermal conductivity is a physical property of gemstones that refers to how readily heat passes through a gem. Measuring this property can be extremely useful in the identification of colored stones and minerals.

We can approximate the thermal conductivity of any gem using our sense of touch. Gems such as topaz or sapphire that feel cold when we touch them to our fingers or lips are good conductors of heat. Warmth is rapidly conducted away from the skin and into the gem, and these gems therefore have high thermal conductivity. Gems that are warm to the touch such as amber or glass are slow to conduct heat away from the skin, and these have low thermal conductivity.

Amber shows the lowest thermal conductivity of all colored gemstones, while ruby and sapphire are the colored gemstones with the highest conductivities. Far higher than ruby or sapphire is diamond, which can feel quite cold to the touch. It's no coincidence that diamonds are sometimes referred to as 'ice'. To quantitatively measure the thermal properties of gemstones, we need a thermal inertia meter.

### The Thermal Inertia Meter

More commonly known as a thermal 'conductivity' meter or diamond tester, a thermal inertia meter measures how well a gemstone is able to transfer heat at its surface. A needle-like copper probe applies heat to the surface of a gem and subsequently measures the change in temperature. This meter is simple to use, and readings take only a few seconds to obtain.



Copper Probe & Thermal Inertia Meter

Most gemologists are unaware that a thermal inertia meter with a numbered scale is one of the most effective of all the standard instruments for gem identification, second only to the refractometer. And unlike the refractometer, thermal inertia probes can be used on mineral specimens, rough stones, cabochons, gems set in jewelry, and gems whose refractive indices are over the limit of a refractometer.



Testing Rough Aquamarine

Every species and variety of gem has a characteristic range of thermal inertia. Readers can refer to the 'Thermal Inertia Index for Gemstones' provided at the end of this article.

What's amazing is that even though thermal inertia meters are widely available and have been used by gemologists for decades, they are still regarded primarily as diamond testers.

In gem identification books and courses, these meters are not included among the standard instruments used for colored stones. Why? One reason is that no reference index of colored stones has been available which provides numerical ranges for thermal inertia readings of gems as measured with a meter. For this reason, we developed our own 'Thermal Inertia Index for Gemstones' in 2017, published here for the first time.

### What's the Difference between Thermal Conductivity and Thermal Inertia?

Thermal inertia meters used to test diamonds and other gems measure how rapidly the surface temperature of a gem can be changed rather than how rapidly heat transfers through the body of a gem. Thermal inertia and thermal conductivity are directly proportional. Gems with high thermal conductivity have high thermal inertia, and gems with low thermal conductivity have low thermal inertia. Thermal inertia measurements can be mathematically converted into thermal conductivity (and vice versa), and can be represented in standard units as watts per meter kelvin (W/m.K).

## The Advantage of a Numbered Scale



Diamond Tester without a Meter Display

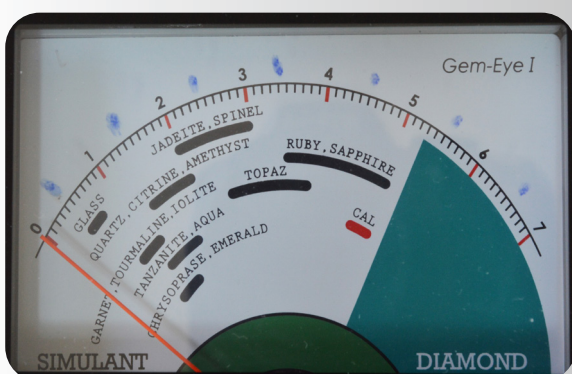
For decades, needle probe meters such as the old DiamondMaster have changed very little in design. The most obvious advancement in recent years is the addition of a detailed numbered scale that marks incremental unit increases in meter readings. But most diamond testers sold today are simply hand-held thermal probes that have no meter display attached at all.

When a detailed numbered scale is combined with a thermal probe, it becomes possible to assign specific thermal inertia ranges for specific types of gems, dramatically increasing the effectiveness of the instrument. The thermal inertia meter can then be used in the identification of all colored gemstones, not just for diamonds or a handful of colored stones.

We know of only two meters manufactured today that have numbered scales for expanded use with colored stones: the SmartPro Gem-Eye 1 Gemstone Tester from Thailand, and the Gemlogis Pistachio Colorstone Referential Meter from China. Both of these instruments graphically depict ranges for approximately a dozen colored stones directly on the dial of the meter. For reasons unknown, no numerical index of meter ranges for gemstones is published or provided to customers by the manufacturers of these meters.

The meter with the most detailed numbered scale is the SmartPro brand, which is sold online at [kassoy.com](http://kassoy.com) for \$230. The thermal inertia ranges listed on our Index were developed using a Smartpro meter.

SmartPro meters show unit markings from 0 to 70 in single unit increments, with numbers placed at 10-unit intervals. For ease of use, we added markings with a felt-tip marker onto the plastic



Gem-Eye I Read-Out & Scale

window of our meter at 5-unit intervals. A digital display would make the meter simpler to read, but for whatever reason, only mechanical dial gauges are available with these thermal inertia meters.

When we apply a thermal probe to the surface of a diamond, the SmartPro meter arm pegs all the way to 70, but actual measurements for diamond are far beyond the limit of the meter. This remarkably high thermal inertia/conductivity separates diamond from all other natural gemstones and from all diamond imitations except Moissanite. This makes thermal inertia meters particularly well-suited for testing the authenticity of diamonds.



Testing a Diamond

## Key Factors that Affect Thermal Inertia Readings

There are 3 key factors that affect the thermal conductivity and thermal inertia of gems:

- Chemical Composition
- Crystal Structure
- Temperature

## Chemical Composition

The variation in thermal conductivity we see between different species of gems is due to the unique chemistry and molecular structure of each mineral species. The extremely high thermal conductivity of diamond is an anomaly among gemstones. Diamond is the only gemstone whose chemical formula includes only one element: carbon. Synthetic gems, including synthetic diamond, generally have the same basic chemical composition and crystal structure as their natural counterparts, and consequently they show the same thermal inertia readings on a meter.



## Crystal Structure

A well-ordered crystal lattice is important to the conduction of heat. Gems that lack a crystalline structure have much lower thermal conductivity than crystalline gems. As an example, opal and glass are amorphous materials, and these have very low thermal inertia (TI) readings ranging from TI 1-3. In contrast, quartz gems such as amethyst have a much higher thermal inertia range of TI 13-20 due to their crystalline structure. Quartz, opal and glass all share the same chemical composition of silicon dioxide ( $\text{SiO}_2$ ).



Blue Glass & Amethyst Quartz (Photos by Tino Hammid)

Unique among gemstones is zircon, a single gem species that shows extreme variability in its crystal structure. Zircon shows an enormous range of thermal inertia readings from 1 to 35 on the meter scale. Using our readings as a guide, we can subdivide this species into low zircon, intermediate zircon and high zircon.



High (Blue), Intermediate (Pink) and Low (Green) Zircons  
Photo by Tino Hammid

All green zircons we tested were low zircons whose crystalline structure has been completely degraded over time by natural radiation (primarily from uranium). These are metamict gems, and they are very poor conductors of heat. Green metamict zircons have some of the lowest thermal inertia readings of any gemstone, ranging from TI 1-3, which is equivalent to the range for amorphous glass.

High zircons retain a crystal lattice that is completely intact. All blue zircons that we tested turned out to be high zircons. This is possibly a result of re-crystallization subsequent to the zircons being heated at very high temperatures to produce the blue color. High zircons are good conductors of heat, and have one of the highest thermal inertia ranges among all colored gemstones, ranging from TI 28-35.

Intermediate zircons of various colors (particularly pink zircons) have undergone various levels of crystal degradation ranging from moderate to near metamict. These gems have a thermal inertia range that is between that of low and high zircons (TI 9-25).

## Temperature

Temperature is a factor that can greatly affect thermal inertia readings. Fortunately, this is an external variable that we can control. It's important to take readings only at room temperature, with the ambient temperature near 77° Fahrenheit (25° Celsius). Cold temperatures increase thermal inertia readings, and warm temperatures lower the readings. On a winter's day, if the temperature drops into the 30's °F, a diamond tester or thermal inertia meter will mistakenly identify a cold sapphire gem as a diamond.

Heat from your fingertips will also transfer to a gem and lower the thermal inertia readings. Loose gems should not be handled with the fingers during testing unless the gem is large and can be gripped at the girdle. Otherwise, testing can be done while gripping the gem with 4-prong tweezers, taking care not to touch the probe to the metal prongs. Better still, loose gems can be placed securely in a gem tray that is made with a hard backing. The tray should be lined with a non-slip textured material such as felt or faux leather.

A factor related to temperature is gem size. Small gems under 1 carat, and small gems cut to a shallow depth, may show meter readings below the expected range simply because some of the heat from the probe reflects off the rear pavilion facets and returns to the probe at the surface. As an example, several small rubies that we tested ranging in weight from 0.50ct to 0.75ct showed anomalous low meter readings that fell within the lower range for spinel. Small gem size is generally not an issue when we test diamonds. Even tiny melee diamonds read correctly as diamond at room temperature.

## How to Use a Thermal Inertia Meter

Before testing a stone, the surface of the stone must be wiped clean with a dry cloth. Surface contamination such as oil, moisture or dust can affect readings. Also make sure there are no drafts of air in the room from fans or open windows, and avoid breathing directly onto the probe. Due to the low thermal conductivity of air, stationary air acts nicely as an insulator. But when air flows over the copper probe, the movement of air causes readings to fluctuate.

After the meter has warmed up (the notification is 2 beeps and 2 blue flashing lights), press the tip of the probe firmly onto the table facet or other point at the surface of the stone, holding the probe perpendicular to the surface. Keep it there a few seconds until the meter arm reaches its highest level and starts to fall. Take the highest reading.



Non-Slip Gem Tray

If a group of loose gems are lined up in a tray ahead of time, multiple readings can be taken quickly and consecutively without turning off the meter. If a single stone must be tested more than once, allow a minute or two in between tests to make sure all heat from the probe has dissipated from the surface of the gem.

## Some Useful Gem Separations

We can use thermal inertia meter to separate hundreds of types of gems from one another. Below are some examples of gems that can be challenging to separate using only a refractometer or some other gemology tool. The ten pairs listed here are easily separated with a thermal inertia meter.

- Feldspar from Quartz
- Feldspar from Beryl
- Scapolite from Quartz
- CZ from YAG from Zircon
- Green YAG from Green Zircon
- Red Spessartine Garnet from Red Zircon
- Natural Hematite from Man-made Hemetine
- Nephrite Jade from Jadeite Jade
- Spheue from Sphalerite
- Glass/Garnet Doublets from Non-assembled Gems

## The Index

Our 'Thermal Inertia Index for Gemstones' lists sixty (60) of the most common gemstones in ascending order, starting with the least conductive gem material and ending with the most conductive, which of course is diamond.

Synthetic gems are not noted on the Index because synthetics show essentially the same thermal inertia ranges as their natural counterparts (with the exception of flame fusion synthetic spinel). This Index represents a preliminary attempt by the author. As more samples are tested in the future, some of the thermal inertia ranges presented on this Index will no doubt be expanded, and more gem species will be added.

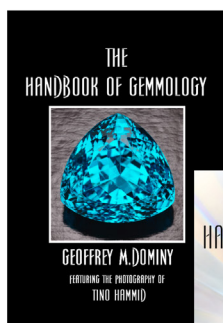
## Thermal Inertia Index for Gemstones

Gemstone	TI Range	Gemstone	TI Range
Amber	< 0.5	Zircon (Inter)	9 - 25
Plastic	0.5 - 1	Cuprite	10
Zircon (Low)	1 - 3	Manganaxinite	10
Glass	1 - 3	Spessartite	10 - 12
Opal	2 - 3	Spodumene	10 - 14
Turquoise	3 - 4	Calcite	11
Scapolite	3 - 4	Peridot	11 - 12
Apatite	4 - 5	Andradite	12 - 19
Feldspar	4 - 5	Jadeite	13 - 16
CZ	4 - 8	Grossular Garnet	13 - 18
Prehnite	5 - 7	Uvarovite	13 - 18
Serpentine	5 - 8	Quartz	13 - 20
Hydrogrossular	5 - 9	Andalusite	13 - 23
Chalcedony	5 - 12	YAG	14 - 22
Iolite	6	Fluorite	15 - 18
Tanzanite	6 - 9	Danburite	15 - 18
Idocrase	6 - 9	Sinhalite	18 - 23
Variscite	7	Hemetine	19 - 23
Pyrope	7 - 10	Spinel (Syn)	20 - 28
Nephrite	8 - 9	Sillimanite	21 - 30
Sphene	8 - 10	Sphalerite	24 - 25
Enstatite	8 - 10	Kyanite	25 - 31
Almandine	8 - 10	Zircon (High)	25 - 35
Rhodochrosite	8 - 11	Topaz	25 - 42
Tourmaline	8 - 13	Chrysoberyl	27 - 35
Beryl	8 - 14	Spinel (Nat)	28 - 40
Ferroaxinite	9	Diaspore	29 - 36
Kornerupine	9 - 11	Hematite	34 - 35
Diopside	9 - 14	Corundum	35 - 54
GGG	9 - 15	Diamond	> 70

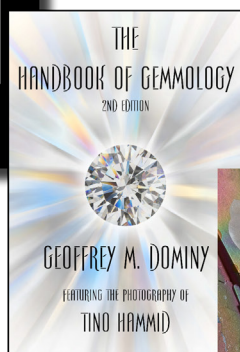
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Referenced to the SmartPro Gem-Eye 1 Gemstone Tester  
All Uncredited Photos by Kirk Feral

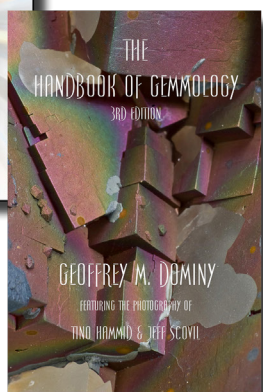




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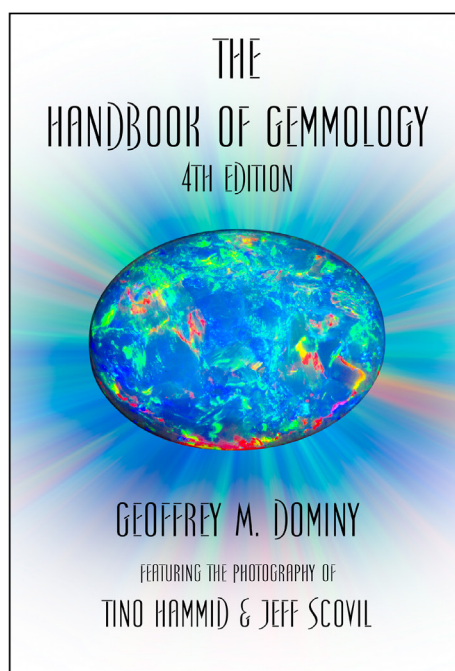


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# Meet the Team



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 fourth 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 has just announced that a 5th Anniversary Printed Edition (Two Volumes) will be available on May 15th, 2018

Geoff currently lives in Palma, 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 Yavorsky'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**  
Gem Academy of Canada

**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.



**Gérard Raphaël Quintin**  
South American Gem Academy

**Gérard Raphaël Quintin** is born in Paris France where he studied Art and Design and graduated from Ecole Boule. His taste for the diamond world may have been inherited from an uncle who worked in the diamond business.

In 1978 he took the gemology colored stone and diamond course with GIA

while he was mining diamonds in the Sewa River in Sierra Leone and where he started the first diamond cutting center in West Africa.

In Abidjan Côte d'Ivoire in 1992 Gérard founded the diamond cutting formation center with a gemmological laboratory 'Hardy's', followed by the installation of the colored stone and diamond cutting facilities in the jewelry school EIBMA.

Continuing his tour in the world of gemstones, Gérard went to Madagascar as an expert for a French Government project to develop the organization and skill of the gems sector.

Professor of Gemology in the Jean Guehenno Jewelry School in Saint-Amand-Montrond France, he then moved to Bolivia to fund and manage the 'Instituto Gemologico Boliviano' where students learn gemology and the art of gem cutting.

Since 1997 Gérard has been a member of the Organisation Internationale des Experts based in Geneva, Switzerland.



**Cristina Rzepka de Lombas**  
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 Central American and Caribbean Gem Academies.



**Kyalo Kiilu**  
Kenyan Gem Academy

**Kyalo Kiilu** is a fellow of the Gemmological Association of Great Britain (Gem-A) and an Alumnus of Birmingham City University where he obtained his BSc with honours in Gemmology and Jewellery Studies in 2017.

His passion for gemstones can be traced back forty years to his late grandmother's village in rural Kenya and the prospecting trench dug by the first British gemstone explorers in the early part of the 20th Century.

While pursuing his pharmaceutical studies, his interest in gemstones never diminished. Unfortunately in 2003 there were no colleges in Kenya offering gemmological courses so he decided to relocate to England and enrolled in Gem-A's Diamond Diploma program in 2004; the start of his gemmological journey.

Kyalo is a licenced gemstone prospector in Kenya and in 2015 made a discovery of a very unique sapphire, resembling another Kenyan sapphire marketed as 'Goldsheen Sapphire' that he will hopefully share with the gemmological community very soon.

He comes to the World Gem Foundation and specifically the Kenyan Gem Academy with a strong desire and ambition to share his knowledge of gemstones with his fellow Kenyans, particularly those involved in the production of gemstones, gemstone lovers and aspiring gemmologists, to provide support and encouragement that was so lacking in the industry when he was growing up in Kenya.



**Salomon Lutumba**  
Gem Academy of DR Congo

**Salomon Lutumba** is an alumnus of Birmingham City University where he graduated with a Bachelor in Science with honours in Gemmology and Jewellery studies in 2016. He also holds a Diamond Diploma and Gemmology certificate from Gem-A. He is originally from the Democratic Republic of Congo.

In 2002 he relocated to England where, ten years later, he found the opportunity to fulfil his dream of studying gemmology at the Birmingham City University. In 2012, he started his High National Diploma in Gemmology combined with Gem-A's Diamond and Gemmology program which led to a degree program, introduced for the first time in 2015, at the BCU.

Today, by embracing the World Gem Foundation's concept and philosophy of gemmological education, and through the Gem Academy of DR Congo, he would like to share his passion and knowledge of gems with his fellow Congolese; particularly jewellers, aspiring gemmologist and gemstone lovers.

His personal goal is to promote the science of gemmology in his country, by providing information and support to empower people in the jewellery business and those trading in stones.



**Jack Ghazalian**  
American Gem Academy  
Director of Corporate & Career  
Development

**Jack Ghazalian** has thirty-eight years of experience in the jewelry industry. He is a graduate gemologist through the Gemological Institute of America (1992), was an instructor for GIA (1993) and was officially Certified-by-the-State of California Education Code 94311(a) to teach Gemology & Jewelry Manufacturing-Arts (1993).

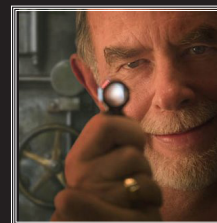
In October 2015, he was honored by the International Distinguished Scholars – Academic Honor Society as an 'International Distinguished Scholar' and in 2017 was granted membership in Kappa Delta Pi. He is currently the owner of Isometric Gemological Appraisal Services in Southern California: IsometricGems.com, speaks five languages and is passionate about education.



# In the Eye of the Beholder



**RICHARD WISE G.G.** is a respected gemmologist, journalist, lecturer and author of *Secrets Of The Gem Trade*, *The Connoisseur's Guide To Precious Gemstones* & *The French Blue*



## Connoisseurship: Color - First Among Equals

### Editor's Note:

This article is taken from Richard's book 'Secrets Of The Gem Trade, The Connoisseur's Guide To Precious Gemstones'. A must-have for any gem aficionado!

We are all familiar with the basic color wheel. Sir Isaac Newton is said to have discovered that light is composed of seven colors (red, orange, yellow, green, blue, violet and indigo) when he introduced a glass prism between a beam of sunlight and a white wall and noted the rainbow projected thereon. If you repeat Newton's experiment you may be surprised to find that the actual spectrum is composed of five colors: red, yellow, green, blue and violet. Newton himself was colorblind. He recruited a friend to break up the spectrum for him and insisted on adding orange and indigo, a dark-toned violet, to make seven because, as Newton said, 'seven corresponded to the seven intervals of our octave.'

In the 1960s a group of cultural anthropologists conducted a worldwide survey to determine how the world's cultures defined color. Representatives of each society surveyed were shown a specially prepared color chart containing all colors - some three hundred twenty-nine separate hues.

The scientists studied the color terms native to twenty languages. The most 'primitive' cultures surveyed had only two concepts, or two words they used to describe all the colors on the chart: black and white or light and dark, what we would call tones. Interestingly enough, all the cultures with two concepts had the same two concepts. Other slightly more 'advanced' societies had three words: light, dark, and red. Still more advanced cultures added a word which meant green or yellow. Those cultures that had a fifth word had a term for yellow and one for green. Languages that contained a sixth term added blue; those with seven added brown. Cultures whose language included eight or more terms contained words for purple, pink, orange, grey, or some combination of these colors.

By way of conclusion, the anthropologists determined that all human societies share (at most) just eleven basic color concepts: red, orange, yellow, green, blue, violet, purple,

white, gray, black and brown. Although we may amplify these basic color concepts in different ways, adding sophisticated variations such as umber and chartreuse to describe exotic mixed hues, the fact remains that all the gemstones discussed in my book 'Secrets Of The Gem Trade, The Connoisseur's Guide To Precious Gemstones' can and will be described using these same eleven terms.

All human beings share the same perceptual apparatus. We receive raw data through our senses, and our perceptual apparatus refines and orders this data for us. The German philosopher Immanuel Kant called this apparatus 'the faculty of apperception.' The philosopher was seeking to explain how it is that human beings perceive and understand what they see.

All that we see, feel, and taste is processed through the funnel of our sensory apparatus. Sense data, then, takes on the contours of that funnel. According to Kant, the human mind impresses certain categories or forms upon the data the senses deliver to the brain. He called these mental forms a priori categories. Space and time, for example are a priori categories which do not exist in the world at all, but only in the mind. Odd though this may seem at first, ever see an animal, aside from Alice's white rabbit with his watch, that seemed to have any concept of time? How is it that all societies share just eleven basic color concepts? It is because we share an identical perceptual apparatus and, therefore, process sensory data in the same way. The idea of color, however, is not a sensation, it is rather a concept and, in some sense, a cultural a priori category that our mind uses to filter the visual sensations that we do experience.

Blessed with color vision, humans have a somewhat unique view of the world, a view conditioned by our unique sensory apparatus. The family dog cannot perceive colors; his world exists solely in black and white. By contrast, this same dog, with his arguably superior hearing, lives in a world with a much richer soundscape. We are different species, and the machinery of our perception is different. Luckily, all humans, as members of the same species, possess a more or less identical sensory apparatus.

Some skeptics would argue that none of this can be proved. Isolated as I am within the prison of my individual consciousness, I may be seeing a color I call blue. You, on the other hand, may be receiving the identical sensation and call it red. Eventually, of course, one of us will incur so much disagreement that we will redefine the sensation. Inversely, my visual impression may be the opposite of yours even though I call it by the same name. The fact is, none of this matters very much so long as we agree on price.

Human beings differ from the family pet in other ways. We have the faculty of judgment. We make qualitative decisions about the raw data our sense organs deliver to us. The eye is a part of the brain. We see colors but are free to prefer the color blue to yellow, pink to red, etc. Because we have similar faculties, we often have similar tastes. Opinions, however, are personal and subject to change. In the gemstone marketplace, price differentials represent the current majority opinion expressed as market demand.

## The Perception of Color

Color has many interesting properties. Colors can be pure, intense, warm, dark or cool. Orange, red and yellow are warm colors; blue, green and light purple are cool. Colored objects can appear large, small, close, or distant. The brighter the color the larger the object appears. Yellow is the 'biggest', most highly saturated color, followed by orange, red, green, and blue.

In the fine arts, specifically in painting, color alone can be used to create the illusion of depth. Warm colors come forward; cool colors recede. In modern times, cubist and constructivist painters fomented an artistic revolution by using the visual laws of color to create, on their canvases, a sense of depth without the use of perspective.

Color has direct physiological and psychological effects on the viewer. Red causes the lens of the eye to thicken, blue flattens the lens. Wassily Kandinsky, the first painter to create totally abstract pictures, believed that the use of certain colors alone could induce specific emotional states in the viewer.

The fact that certain colors evoke connotations which bridge cultures and have remained constant over the centuries proves Kandinsky's thesis. Red is the hot color of blood and the color of war. To become angry is to see red. Blue is the color of the heavens. When a person is depressed he has the blues.

In art class we learned that the color wheel divides into primary and secondary colors called hues. Red, blue, and yellow are primary in the sense that they are irreducible, unmixed pure hues. Secondary colors are those created by mixing two or more primaries. For example, mixing yellow and blue makes green. However, the rules of the color wheel have to do with paint and pigments. The rules change when color, transparency and light are considered.

When two colored slides are projected on a screen, green and red light will mix and create yellow. A similar mixture of paints would yield a dirty olive brown. Colored light contains eight chromatic hues: red, orange, yellow, green, blue, violet, pink and purple. The first six hues are called primary spectral hues: the colors of the rainbow or the colors seen when white light is refracted through a prism. The last two, purple and pink, are modified spectral hues: purple is the hue that lies halfway between red and blue on the color wheel, and pink is a lighter-toned, less saturated hue of red. Any of the eight hues can play the part of the primary or secondary hue in a gemstone.

Color as it is applied to connoisseurship in gemstones requires further definition. Color is divided into three components: hue, saturation, and tone. These categories are relatively common in color science where they are variously labeled: hue, value, and chroma; or hue, intensity, and tone.

## Hue

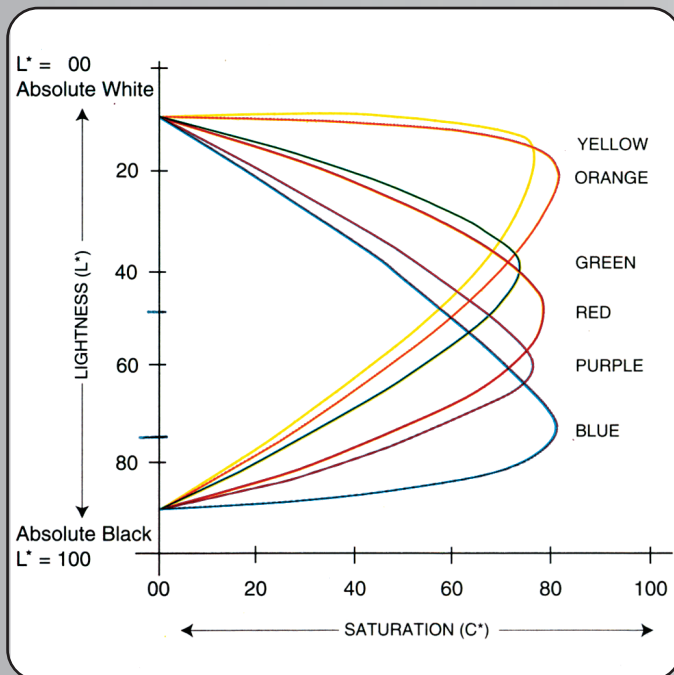
Hue is the technical equivalent of 'color' as that term is used in normal speech: What color is it? In gem grading parlance, color is a general term; red and blue are hues. Nature exhibits relatively few pure hues. The colors we see in objects are a mixture of hues. Thus, for technical precision in describing color it is necessary to divide hues into primary, secondary, and occasionally tertiary categories. Primary is used in the sense of dominant, the majority hue. A sapphire that is greenish blue has a primary hue of blue and a secondary hue of green. Just as in language, the term greenish is an adjective modifying the noun blue; green is a secondary hue modifying the primary or dominant hue, in this case blue.

A royal blue sapphire has a primary blue hue. The term royal is simply a more poetic way of describing the combination of the primary blue with the secondary hue, which in this case is purple or purplish blue. Put more precisely, the hue may be described in percentages. In the above example, royal blue sapphire is mostly blue, perhaps eighty-five percent, with an admixture of up to fifteen percent purple. The use of percentages is more useful because it is more precise.

Faceted gemstones exhibit two types of color, refracted color and transmitted color. When a beam of light is directed toward the top, or crown, of a faceted gem, some of that light will enter the gem, reflect internally, and be refracted back to the eye. The color of that refracted light is called the key color. This is the color of the sparkle or brilliance. The color of a gem is evaluated by observing the key color. This is a vital point. Body color results from light that is transmitted through the gem. The quality of these phenomena, body color and key color, almost always differ at least in darkness or lightness—the component of color that is called tone.

The key color is the color used to evaluate faceted stones, except colorless diamond, which is judged by its own unique set of rules. This distinction may be confusing at first. To





**Color Gamut Limits:** The graph illustrates the point at which saturation and tone combine to produce the most vivid hue. Stephen Hofer, *Collecting and Classifying Coloured Diamonds* © 1998 W.N. Hale, Hale Color Consultants

differentiate between key and body color, the gem is turned table or face down under or above a light source. A gemstone is designed to generate brilliance in the face-up position. Placed face down the gem will not sparkle, it will glow. The color seen is the body color. The gem can then be turned over and viewed face up. In this position the color of the sparkle may be observed and the differences in hue (key versus body color) will become apparent. Key color is often lighter in tone and paler in saturation than the gem's body color. Body color can be particularly seductive in lighter-toned highly crystalline gems such as aquamarine where the body color may be richer, more highly saturated and more prominent than the refracted color. Take care! If the eye becomes lazy, the result can be costly.

## Saturation

Saturation, the second of the three components of color, refers to the brightness of the hue or the quantity of color. The greater the quantity of color, the brighter it will be. Saturation may be described as vivid or dull or somewhere in between. Although some hues are brighter than others, pure hues are always vivid! International orange, the color used in buoys and life jackets, and the red of a stop sign are examples of particularly vivid hues. 'Day-Glo' colors are vivid hues. In this system of evaluation, the neutral, non-spectral colors gray and brown are not classified as hues; they are considered to be saturation modifiers or masks.

Like a splash of mud on a Hawaiian shirt, the addition of gray and brown dull the hue. Some gem varieties have a tendency

toward brown, some toward gray, rarely both. Blue sapphire may be grayish, but rarely brownish, whereas red tourmaline will often have a brown modifier and these modifiers may vary in intensity depending upon the type of light the gem is viewed under. A grayish greenish blue sapphire is a dull greenish blue sapphire. A brownish red tourmaline is a muddy-hued red tourmaline.

Gray or brown masks are often like a light film that is itself of low saturation and very light tone and is difficult to see. The effect - dullness or muddiness - is visible and, since pure hues are always bright, we infer from this that a gray or brown mask is present. A trained eye and careful observation are often necessary to see the mask. Another clue which may help is that brown gives the impression of warmth, whereas gray is cool. If the hue appears dull and cool, the mask present is probably gray. If the hue seems to be dull and warm, the mask is likely brown.

## Saturation Modifiers - From Minus to Plus

What good are rules if there are no exceptions? Life would be so much simpler, consistent, and boring. When gray and brown are themselves highly saturated and dark enough to be dominant, they too begin to act the part of a hue. This is particularly true of brown. Thus dark-toned gray and brown, if they are dominant, become hues, whereas grays and browns that modify, or dull a spectral hue (such as blue) are saturation modifiers or masks. Both yellow and orange, when they are dark toned, appear brown.

To sum up: brown and gray are not generally considered to be hues, but are classed as saturation modifiers or masks, unless the stone is primarily brown or gray; then either may be considered a hue, and may even have spectral hues as modifiers - for example, reddish brown. Examples of beautiful brown-hued stones include fancy color 'cognac' diamond and brown tourmaline. Gray may be dominant in diamond, moonstone and spinel.

## Tone

Tone - that is, lightness and darkness - is the third component of color. It can best be described as the addition of black or white to a hue. A dollop of black paint added to a bucket of robin's egg blue yields a darker blue. The more black is mixed in, the darker the tone: first sky blue, then royal blue, then midnight blue, and finally enough black is added to overcome the hue and the paint turns completely black. White added to a color has the opposite effect.

For the sake of analysis, tone is described as a percentage. A transparent quartz crystal or a windowpane is zero tone. No tone = no color. A lump of coal or a crow's wing is one hundred percent tone. One hundred percent tone is opaque black. Too much tone snuffs out hue, saturation and



transparency. When this occurs the stone is overcolor. Tone refers to the key color, not the body color .

In gemstones the beauty of the color is a certain balance of hue, saturation, and tone. For each color the optimum percentages differ. If the tonal levels are too high the stone is described as being overcolor, or too dark. If the key color is too light in tone the hue appears - pale and washed out.

The two attributes of saturation and tone are abstractions, which, in gemstones function together to define the beauty of the hue. Color scientists have long recognized that there is an optimum combination of saturation and tone for each hue. This is the point at which saturation and tone produce the most vivid hue. These points are called gamut limits. For example, the most vivid tone for yellow is twenty percent, while the most vivid tone in blue is about eighty-five percent, red eighty percent, and green seventy-five percent. Beyond these limits, as the hue darkens, it loses saturation and moves from vivid towards dull.

Not surprisingly, market desirability closely parallels these gamut limits for gems occurring in the basic spectral hues. The optimum tone for ruby is eighty percent, sapphire and tanzanite eighty to eighty-five percent, and emerald and tsavorite seventy-five percent. Reduced to simplest terms, the brighter, the more saturated the hue, the better the hue. The rule must be applied somewhat gingerly because a gemstone rarely exhibits an absolutely pure hue. Changing taste also plays a role. Purple gems deviate from this norm. Amethyst reaches the peak of beauty and market desirability at seventy five to eighty percent tone. The gamut limit graph demonstrates that the hue purple achieves its gamut limit at a much lighter sixty percent tone. In the case of amethyst this means that a richer hue is generally preferred over a brighter hue. This is also true of red, yellow, orange and green gems.

The color of a gemstone can be accurately described using this terminology. For example, a fine bright, dark, purplish red ruby is better described as a ruby with a ninety percent vivid primary red hue, and a ten percent purple secondary hue of eighty percent tone (with little or no gray mask present).



Tonal Range of Purple Hue. From right to left, tonal percentages graduate in approximately ten percent increments from ten to eighty percent tone. Darker tone yields a richer and more vivid hue. (Photo by Tino Hammid)



# The Spice of Life

## Coloured Gemstones



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



## Turkish Delight - Diaspore

The mineral diaspore was first discovered in 1801 in Mramorskoi, Kossobrod, in the Ural Mountains of Russia. Today, diaspore can be found in a variety of localities including the U.S (Pennsylvania), New Zealand, Brazil, Argentina, Russia, the United Kingdom and China. However at present, the only gem quality stones are found associated with bauxite in the Anatolian Mountains of Central Turkey (Mugla), at heights of more than 3000 feet.

Diaspore is a polymorph of aluminium hydroxide  $\text{AlO}(\text{OH})$ , and one of the three mineral components of bauxite along with boehmite and gibbsite.

Bauxite has many important industrial applications including the production of aluminium, as a refractory material, for grinding, as a constituent of calcium aluminate cement, for papermaking, water purifying, petroleum refining and as an indispensable material in the electric, airplane making, machinery and civil tool making industries.

Although coveted throughout the centuries by kings and sultans of the Byzantine and Ottoman Empires, diaspore is a relative newcomer in terms of the gemstone and jewellery industry.

Unlike other gemstones that are myth or legend associated, diaspore possesses no known mythology nor any astrological

significance or planetary energies. However in the metaphysical world where colour is very important, a gemstone that exhibits multi-colours is highly desirable.

The name diaspore is derived from the Greek 'Diaspora', which means 'to scatter', due to the way the gem sparkled in the light.

Diaspore can be found in a variety of colours including colourless, white, light grey, greenish-grey, brown, yellow, pink and lilac with some exhibiting a pronounced colour change ranging from a 'kiwi green' in sunlight to a light rose-orange or raspberry red under incandescent light. Interestingly the colour change in any particular stone is not limited to two colours with some stones exhibiting khaki greens, cognac pinks, canary yellows, pinkish champagnes, sage greens, subtle-pinks and vibrant gingers under a variety of different light sources. This is perhaps the most unique and endearing quality of gem quality colour change diaspore.

In general, the larger the stone, the better the colour change, as the colour saturation will be greater when the stone is larger. While it can be found in fairly large crystals, very few are transparent and cuttable. Diaspore is also found exhibiting chatoyancy (cat's eye effect).



Colour Change Diaspore (Courtesy of Milenyum Mining Ltd)





Pink Diaspore (Photo by Tino Hammid)



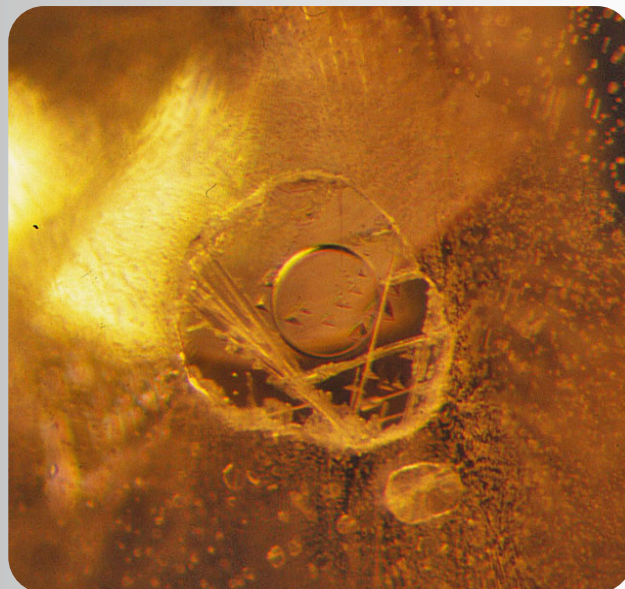
## Physical & Optical Properties

Crystal System	Orthorhombic
Chemical Composition	$\text{AlO}(\text{OH})$
Refractive Index	1.702 – 1.750
Birefringence	0.048
Optic Character	Biaxial
Optic Nature	Positive
Fracture	Conchoidal
Lustre	Adamantine, vitreous, pearly on cleavage faces
Cleavage	Pronounced
Pleochroism	Pronounced
Specific Gravity	3.30 - 3.39
Hardness	6 ½ – 7

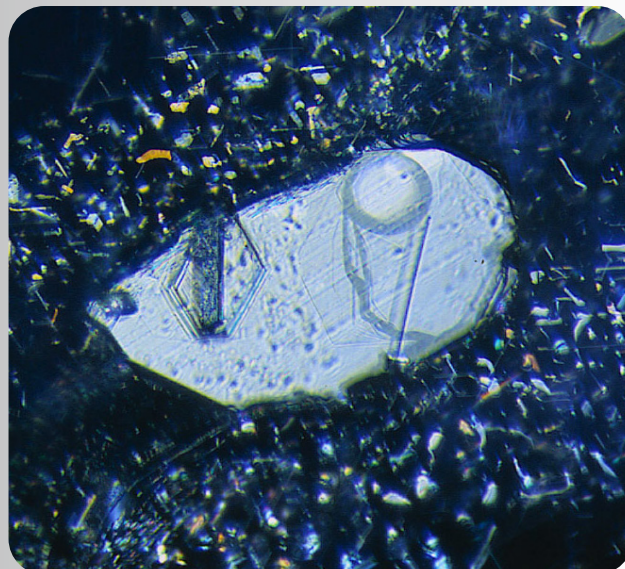
Diaspore is an aluminium hydroxide with traces of manganese and belongs to the orthorhombic crystal system. Typically it occurs as small thin prismatic and tabular crystal plates and bladed aggregates. Crystals from Turkey are unique in habit, being relatively large and usually thin prismatic or columnar, sometimes elongated, and often twinned in interesting v-shaped (and occasionally even w-shaped) twins. Diaspore crystals are often striated.

Its pronounced cleavage in one direction, makes cutting quite a challenge. As a consequence of this, large clean well-cut diaspore gems are very rare and can be extremely expensive.

Under UV light, colour change diaspore can show a 'Kiwi green' to 'yellowish' colour however gems that do not exhibit a colour change are inert.



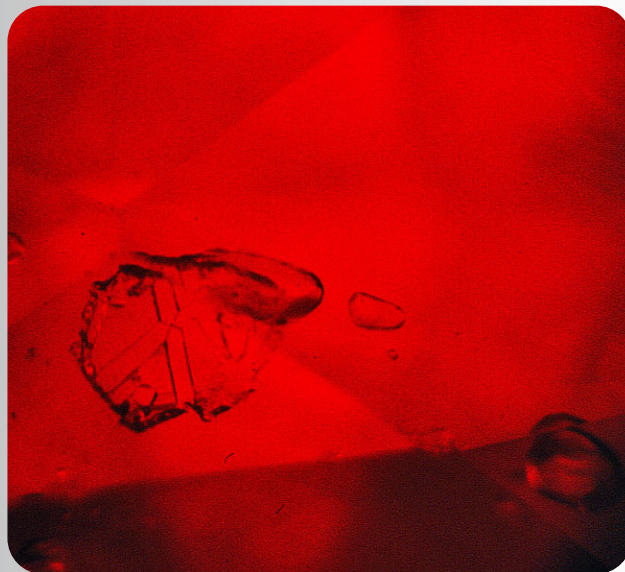
Diaspore Inclusion in Sri Lankan Yellow Sapphire  
(Photo courtesy of Dr. H. Hänni)



Diaspore Inclusion in Madagascan Blue Sapphire  
(Photo courtesy of Dr. H. Hänni)



Cleavage plane that appeared during polishing  
(Photo by Stephen Kotlowski)



Diaspore Inclusion in Burmese Ruby  
(Photo courtesy of Dr. H. Hänni)

## Identifying Diaspore

While colour change diaspore can be confused with a variety of doubly refractive gemstones (see chart below), fortunately two key factors aid in its identification; the pronounced birefringence (0.048) and the fact that only two other biaxial positive gemstones (tanzanite and chrysoberyl) have refractive indices that fall within the same range. This underlines the importance of being proficient with a refractometer and being able to determine the optical character and sign of a gemstone. In this case, the R.I. and birefringence of diaspore is significantly different from either tanzanite or chrysoberyl. While it can be confused superficially with andalusite, the R.I. and optical sign of andalusite, if properly determined, will eliminate it immediately. The colour change effects seen in diaspore are also more varied than alexandrite.

Diaspore that does not exhibit a colour change can be confused with spodumene, chrysoberyl or even scapolite however if close attention is taken recording the refractive index and the optical character of diaspore, separation is relatively straightforward.

While a majority of gemstones are treated, diaspore is not, making it appealing to buyers who are looking for stones that are natural and unenhanced. While imitations including alexite (a cheap glass stone, made in India using vanadium, chromium, manganese and iron to mimic the colour change properties) and zandrite can be found in tourist markets, diaspore is not synthetically produced.

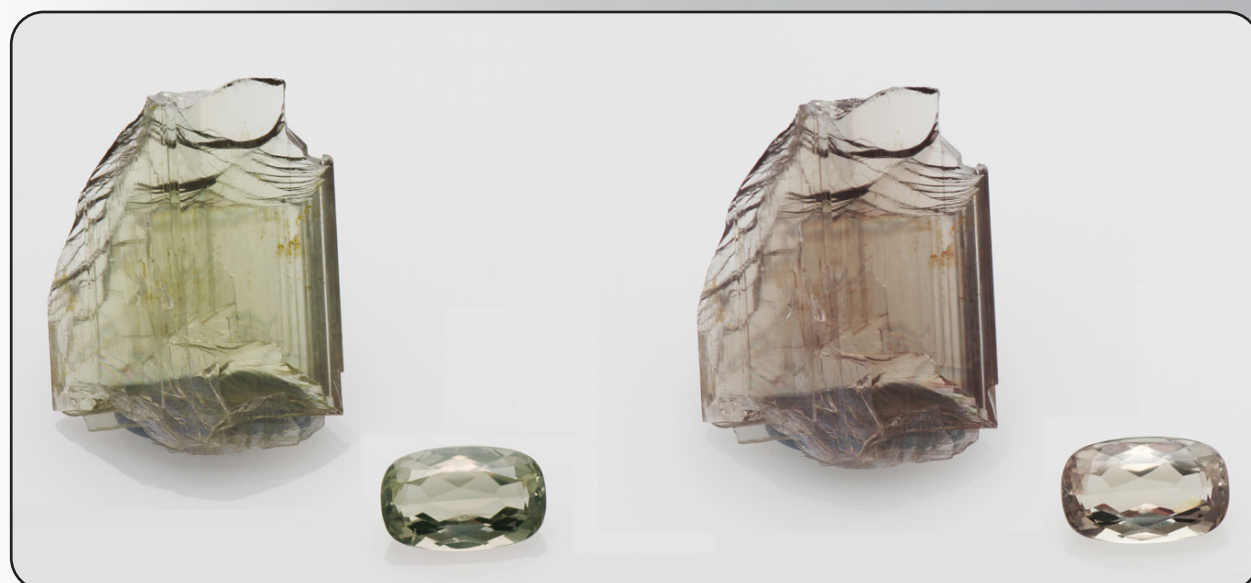
## Conclusion

Clearly the exquisite colour change of Turkish diaspore and its exceptional beauty makes it highly desirable and marketable not just to gem collectors but to those gem aficionados who want to travel a path less travelled. This is one delight that is exclusively Turkish.

## References:

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Gemmologie DGG prof. H. Hänni 6-2017  
Milenyum Mining Ltd.  
Minerals.net

Gemstone	R.I. Range	D.R.	D	O/S	S.G.	H
Sapphire (Colour Change)	1.762 – 1.778	.008	.018	U-	4.00	9
Benitoite	1.757 – 1.804	.047	.046	U+	3.64 – 3.68	6 – 6 ½
Chrysoberyl	1.746 – 1.763	.007 – .011	.015	B+	3.70 – 3.78	8 ½
Tanzanite (Bi-Colour)	1.691 – 1.700	.009	.030	B+	3.35	6 ½ – 7
Spodumene	1.660 – 1.681	.014 – .016	–	B+	3.15 – 3.21	6 ½ – 7
Andalusite	1.627 – 1.649	.007 – .013	.016	B-	3.05 – 3.20	7 ½
Tourmaline	1.614 – 1.666	.014 – .032	.017	U-	2.82 – 3.32	7 – 7 ½
Topaz	1.609 – 1.643	.008 – .016	.014	B+	3.49 – 3.57	8
Scapolite	1.540 – 1.579	.006 – .037	.017	U-	2.57 – 2.74	5 ½ – 6



Diaspore under Daylight & Incandescent Light (Photo courtesy of Dr. H. Hänni)





Colour Change Diaspore (Daylight)



Colour Change Diaspore (Incandescent Light)



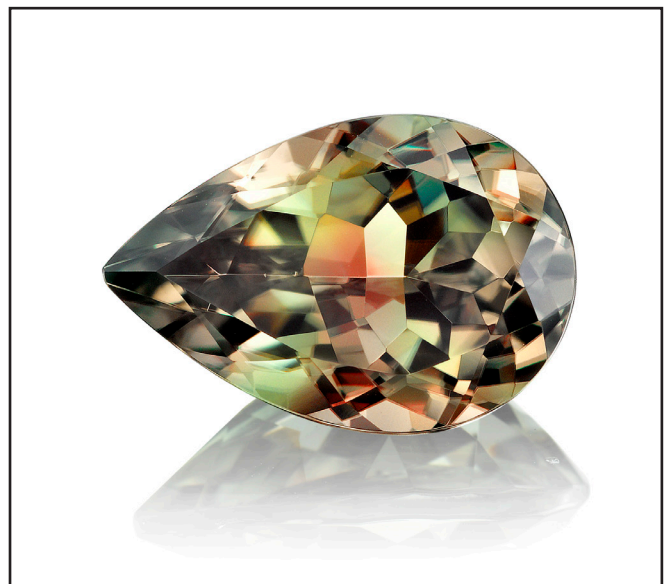
Diaspore exhibiting Strong Birefringence



Diaspore exhibiting Chatoyancy

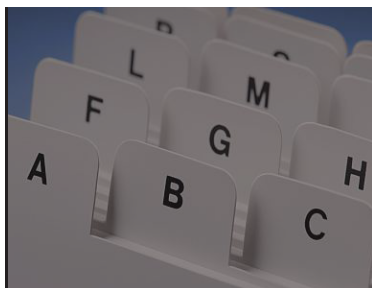


Diaspore

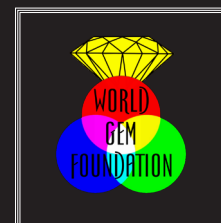


Diaspore

(Photographs Courtesy of Milenyum Mining Ltd)



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DR Congo	<a href="http://www.gemacademyofdrcongo.com">www.gemacademyofdrcongo.com</a>	<a href="mailto:information@gemacademyofdrcongo.com">information@gemacademyofdrcongo.com</a>
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## World Gem Foundation

Plaça de Quadrado 1, 4B  
Palma, Mallorca 07001  
Spain



