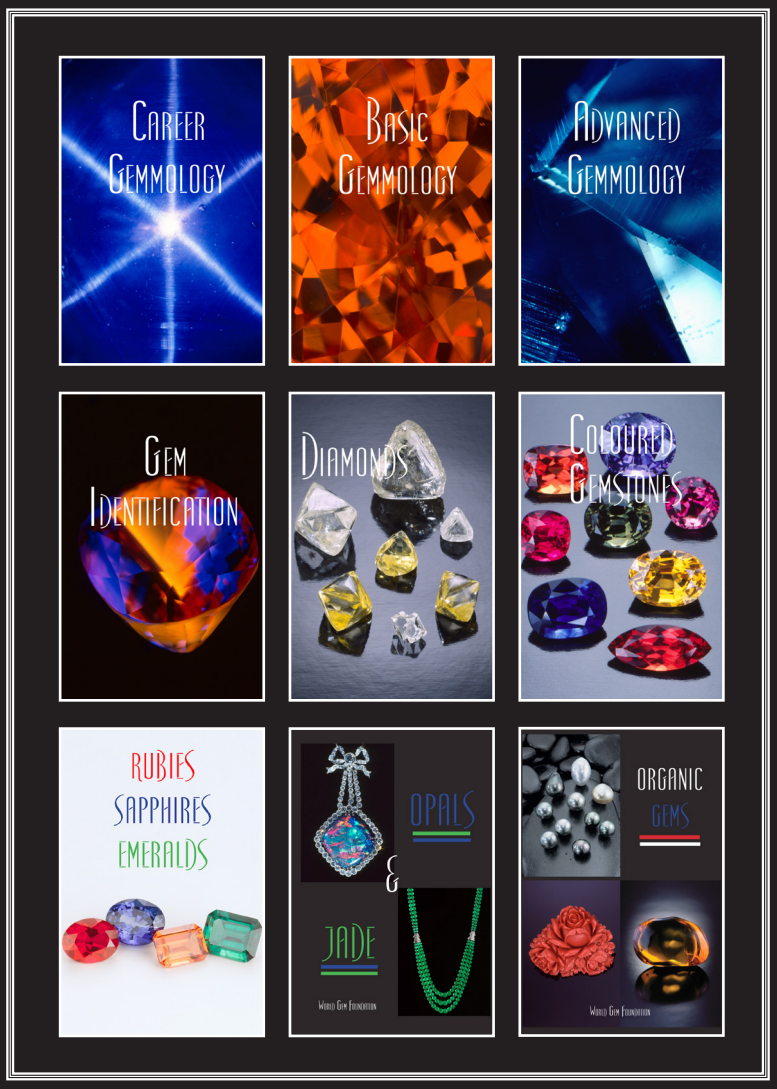
Gemmology Today

March 2022
Quarterly Publication

Shangri Lanka



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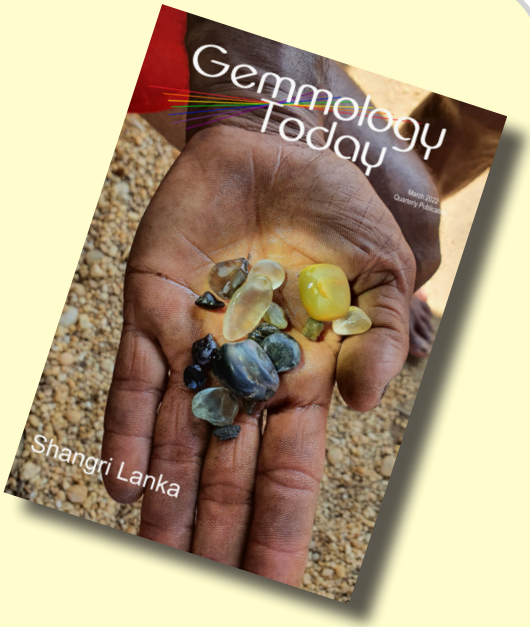

Gems from Sri Lanka (Photo by Cecilia Chiappai)

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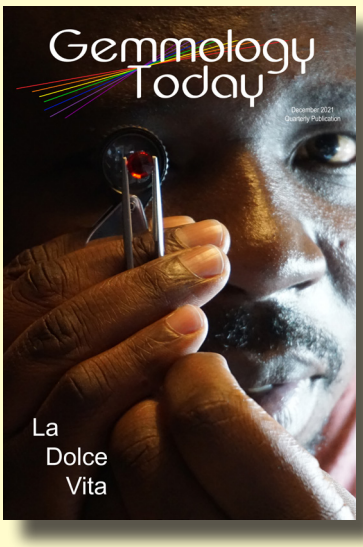

December 2021 Issue

Editor at Work

Geoffrey M. Dominy is the author and creator of the 'The Handbook of Gemmology' and 'Gemología Para Todos', founder of the World Gem Foundation and editor of Gemmology Today.

I feel very fortunate to have had the opportunity to visit many fascinating places in my life. I admit that I am a travel romantic. I love everything about travelling, seeing new places, meeting different people from different cultures and tasting the unique foods that define their culture. For me, it is not the material things we own but the 'memories' we accumulate from these 'life experiences'. They will stay with us for the rest of our lives.

While travelling helps us appreciate what we have, it also teaches us valuable lessons about what should be important in our lives and what should not. Even in the poorest countries, I have seen smiling faces. Why? Well I suppose it is all about priorities. In Europe, we have completely different expectations. We expect more and when we cannot have it, it makes us unhappy. In most parts of the world, the level of expectations are much lower. Their priorities are different and so are the factors that determine their level of happiness. A person can have very little but still find happiness while others may have far more and yet happiness will elude them. You cannot fully appreciate this unless you experience it first hand.

Unbelievably, the last time I visited Sri Lanka was 1996. At that time, the country was in turmoil. It's undeniable beauty was stained by the violence. My heart would beat much faster whenever we arrived at a police checkpoint since these were the 'hotspots' for suicide bombers. A week after I returned to Canada, the bank I had exchanged money in was demolished by a truck loaded with explosives.

Somehow, Sri Lanka survived. Once again the human spirit prevailed.

Twenty-six years later, I found a very different Sri Lanka. A country that is moving forward, a country that abounds with beauty, with a unique and vibrant culture, with people who are so gracious and beautiful. A country with a culture that is diverse and yet totally captivating, a country that is a gem mecca for anyone even remotely interested in gemstones. It is a 'Gem Paradise', one of the most beautiful places on the planet!

I am thrilled and delighted that we now have an academy there and that Gamini Zoysa is part of the World Gem Foundation family.

Gamini is well known in the industry but for those of you who do not know him, he is incredibly gracious. His busy schedule would leave most people gasping for air, yet he is always able to find the time to make sure that every last detail is timed to perfection. Gamini is a man who knows the importance of dotting your i's and crossing your t's. When I arrived he had just orchestrated his daughters wedding with 200 guests arriving from all over the world. He never missed a beat! I know we are going to do great things in Sri Lanka. It is the perfect place to visit if you want to experience the unique culture and to study gemmology.

So what's in this issue?

Our feature interview is with Wimon Manorotkul, a lab gemologist, instructor, and expert gem photographer with over 35 years' experience in the gem trade, in 'Lab Talk', I look at two gemstones that recently crossed my desk that are polar opposites to each other, Richard Wise looks at Sapphire: A Celebration of Colour by Joanna Hardy, the third volume in a series that also includes Emerald and Ruby, Richard Hughes looks at the complexities of describing padparadscha sapphires and why it is hard to find a consensus on what constitutes a 'Pad', Gamini Zoysa examines the huge 510 kilogram, water-worn boulder of

corundum aggregate that was unearthed in ‘Kahawatta’ village situated about 28 kms south east of Ratnapura, in Sri Lanka, The Coloured Gemstones Working Group explores how the mining sector in Sri Lanka can develop in line with rising expectations for responsible sourcing, Gemstone Detective Kim Rix looks at the Navaratna Ring, what it means and why even today it has cultural and spiritual significance, Michael Cowing resumes his series on light performance by investigating the history of various intsruments that have been used to analyze gemstone reflection patterns, Leone Langeslag continues her ‘Spice of Life’ series, this time she looks at Lapis Lazuli and Nina Gold looks at the challenges of testing cabochon gemstones.

I hope you enjoy this issue and that you will add Sri Lanka to your ‘bucket list’! It is an absolute must see destination!

For the June 2022 issue, we have some exciting design changes coming. Lots of work but we hope you will like the ‘New Look’ as much as the ‘Old Look’.

Stay safe.....

Photo by Cecilia Chiappai

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GT Feature

Wimon Manorotkul has been involved with gems and gemology since 1979. She is an Accredited Gemologist from Bangkok's Asian Institute of Gemological Sciences, an FGA with honors, a skilled gemstone and inclusion photographer and co-founder of Lotus Gemology with her husband, Richard Hughes, and daughter, E. Billie Hughes.

Meet Wimon Manorotkul

Wimon Manorotkul

GT: Who is Wimon Manorotkul? Tell us about yourself.

WM: I am a gemologist, gem photographer and a photomicrographer. My husband, Richard Hughes, our daughter, Billie Hughes and I started Lotus Gemology, a gem lab in Bangkok since 2014.

In 1980, right after graduating from business school I got a job at a AIGS in Bangkok. While working as a registrar at the school I was willingly dragged into learning about gems. Why not? It is learning and deals with something interesting and beautiful at the same time. Moreover, students started asking me questions about gems' properties, how to differentiate quartz from glass, how to tell if you are seeing curve striations in synthetic ruby or polish lines. I told myself I better start reading or I would look dumb sitting next to the classrooms. And, that's how I started.

GT: When did you first develop a passion for gemstone and inclusion photography? Was there a defining moment when you realized this was an area you wanted to specialize in?

WM: I can't say it was initially my passion; it was more of a teaching tool for me when I started. After some time helping in the classroom I had a chance to work in the lab and then became a gemological instructor teaching how to identify natural/synthetic stones and treatments of gems. I often used Koivula & Gübelin's PhotoAtlas of Inclusions in Gemstones to help with my teaching. Then, using just those photos was not enough for me. I thought I should do my own photos. From just taking snap shots, it became more – something I really enjoyed doing and wanted to do it well. I would spend times after work hours learning and practicing and, of course, wanting to take good photos like I saw in the PhotoAtlas. I learned by looking at those photos, observed and guessed what kind of light they might have used and what directions those lights should be coming from. You have to be observative and detail oriented.

GT: What is the one gemstone or inclusion photograph that sticks in your mind the most, either through its sheer beauty or the challenge you had capturing it on film?

WM: All inclusions amaze me. From "Saturn" inclusions in heat treated Thai/Cambodian ruby to fingerprints, rutile silk, growth features in spinel, petroleum in quartz, moving bubbles in negative crystals in corundum; every inclusion is unique, every inclusion is the history of a gem. Inclusions tell you something about the stone.

GT: What advice would you offer to a woman thinking of studying gemmology and entering our industry?

WM: I don't think this is a gender issue. Whether you are a man or a woman makes no difference; you have to be interested in the subject. If you are interested in something you will want to know more and learn more. I got a tiny ruby ring as a gift from my mother when I was a teenager. It was

a cute little ruby that turned out to be a synthetic, though. But that really started my interest in gems. Years later, when I found that there was a school teaching about gems and they were hiring I didn't hesitate to apply, even though the starting position was just as a registrar.

GT: Do you feel there is equality for women in the jewellery and gem industry?

WM: I don't see it as an issue to me personally. I got valuable advice and support from experts around me, like John Koivula, Jeff Scovil, my husband Richard Hughes, my ex-boss Bill Larson at Pala and learned a lot from photos done by other veteran photographers like the Van Pelts, Tino Hamid and Robert Weldon. Knowing or unknowingly these famous people all taught me something. They make you think. Listen to their lectures, read their articles, look at their work; you will find something, learn something, and apply it to improve your work.

GT: With software such as Photoshop, many photographers are finding it easier to create stunning imagery. Are you a purist or have you embraced this new technology?

WM: I started as a purist and learned photography the hard and expensive way by shooting film. When technology helps making your job easier, why not use it. Saying that though, I always try to limit retouching using Photoshop to the minimum.

GT: Talk us through a typical photo shoot (if there is such a thing).

WM: In field photography you have very limited time to think. You may plan to shoot miners, people in the market, cutter, dealers during negotiations, but when you are in the action you usually have only a blink of an eye to push the button.

We always try to plan ahead of time, walk around, try to find the right position, the right angle. Anticipate what is going to happen next so you have a split of a second to prepare to shoot. Gem and inclusion photos are different. You arrange the object of interest to what you want. You have to think about what you want to communicate with your audience, how you want them to see what you have to offer. In all of this, lighting is the key.

GT: Guitarists are always asked about the equipment they use and the ones they most prefer. What are the 'essentials' in your photographic arsenal?

WM: Your own eyes. The rest you can adjust, tweak and make some changes. People make some great photos with their phone.

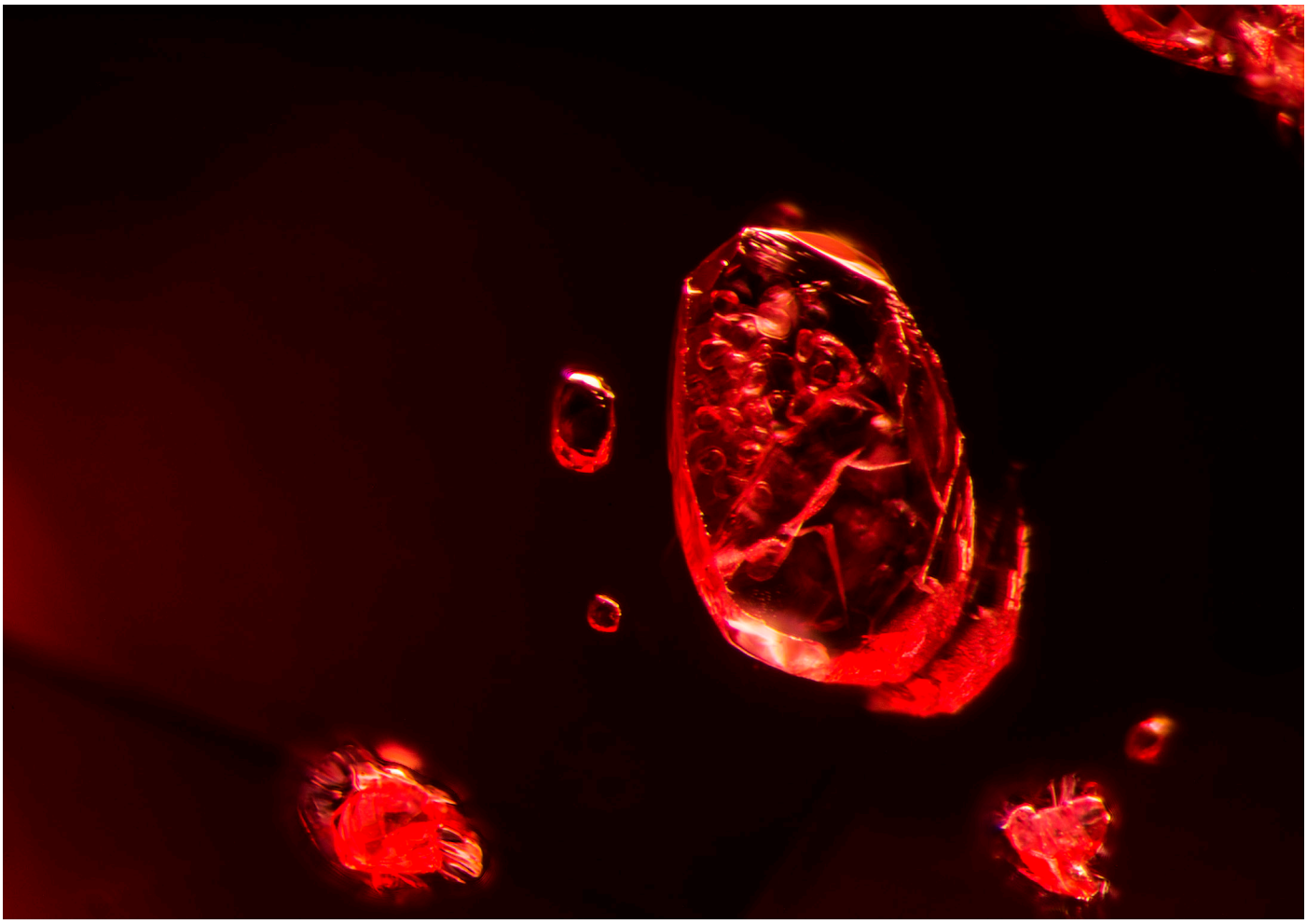
GT: Where do you see the future of gemmology ten years from now?

WM: I think the industry will depend more and more on advanced instruments. Treater never stop working. They are always trying new techniques, more sophisticated treatments and ways to avoid being caught. These are making it tougher and tougher for gemologists. Some treatment like low-temperature heating may not be detected even by using advanced instruments. Basic gemological instrument may not be enough to detect some treatments. I think ten years from now it will be the same – gemologists playing catch up.

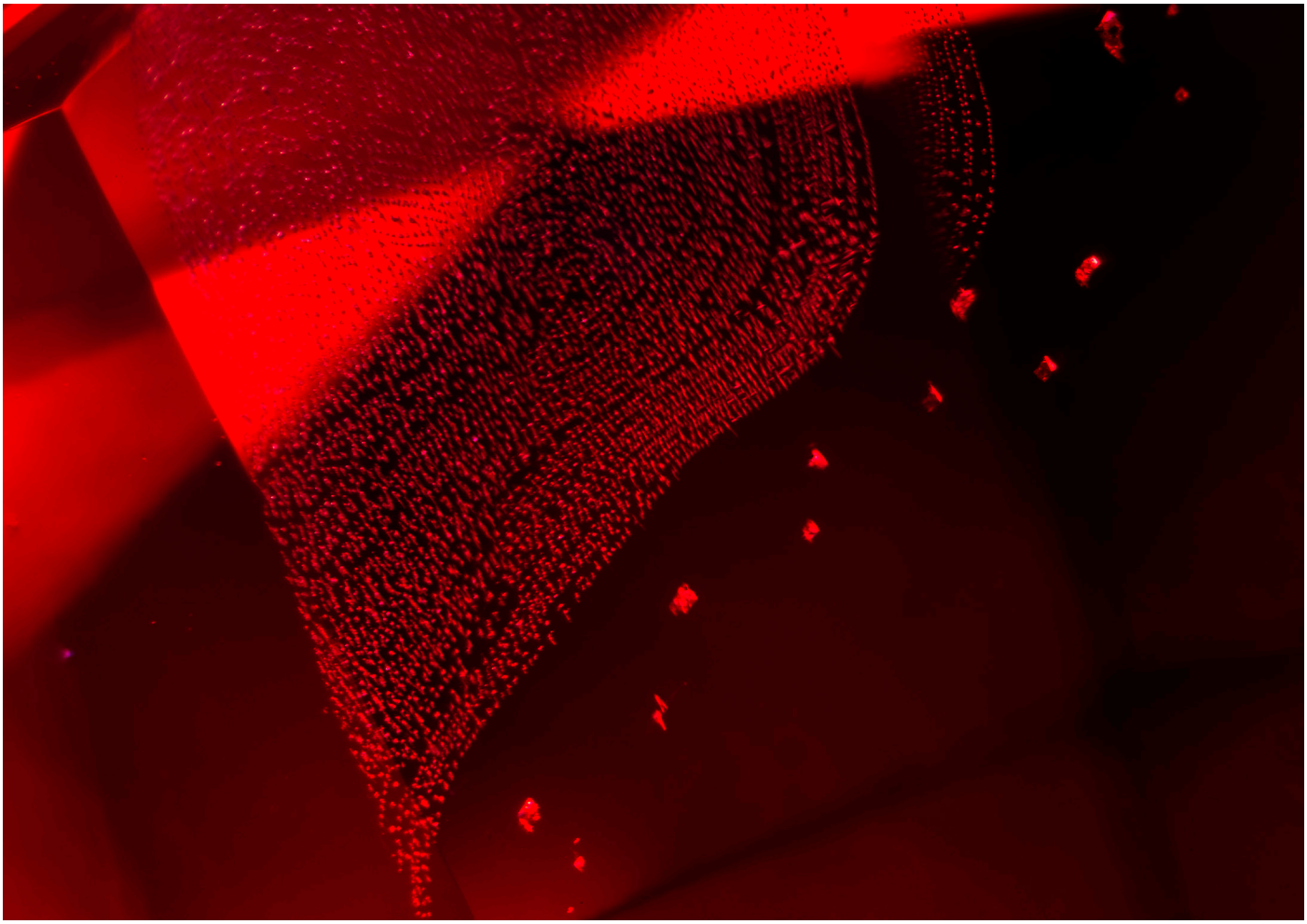
GT: If we were sitting here a year from now celebrating what a great year it's been for Wimon Manorotkul professionally, what would you say was the reason?

WM: You're kidding, right? I'm not Jeff Bezos.

A large negative crystal in an untreated Sapphire from Sri Lanka (Photo by Wimon Manorotkul)



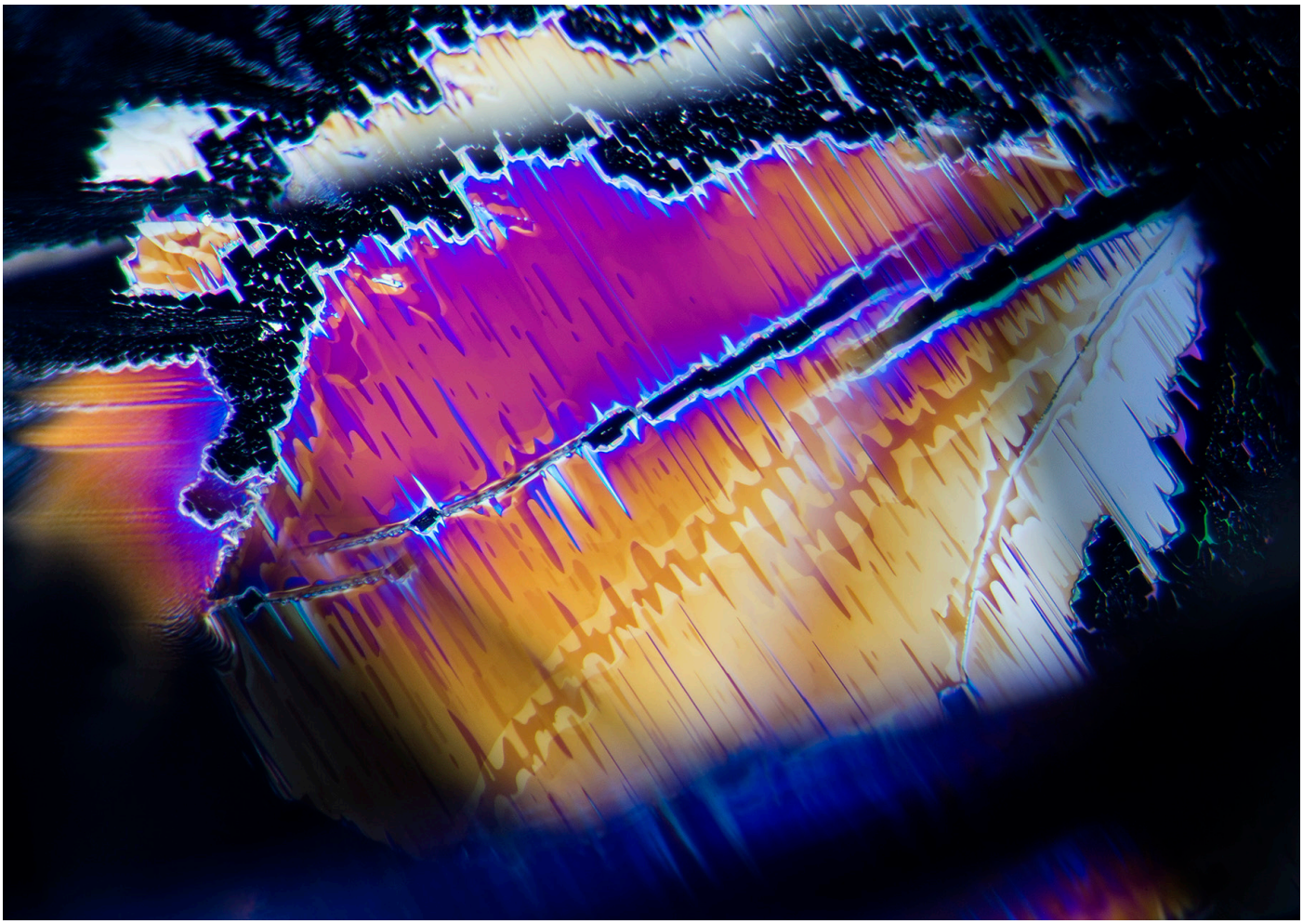
Crystals in natural Spinel (Mogok/Namya) (Photo by Wimon Manorotkul)



Tiny octahedral negative crystals in Spinel (Photo by Wimon Manorotkul)

Iridescence on multiple planes of unknown composition in a cobalt Blue Spinel (Photo by Wimon Manorotkul)

Rutile silk in natural untreated Ruby (Mogok/Mayanmar) (Photo by Wimon Manorotkul)



Secondary healing inclusion in a natural Sapphire from Sri Lanka (Photo by Wimon Manorotkul)

Blue Sapphire (Madagascar) with rough Sapphire crystals from Kashmir (Photo by Wimon Manorotkul)

Padparadascha Sapphire (Photo by Wimon Manorotkul)

Spessartite Garnet and pink Spinel pendant & Spessartite Garnet & Diamond ring (Photo by Wimon Manorotkul)

10.58 carat emerald cut Spessartite Garnet with two Grossular and one Malaia Garnet rough (Photo by Wimon Manorotkul)

Tanzanite crystal (Photo by Wimon Manorotkul)

Child labor in Mogok market (Myanmar) (Photo by Wimon Manorotkul)

Jade merchant (Photo by Wimon Manorotkul)

15.42 carat blue Sapphire (Photo by Wimon Manorotkul)

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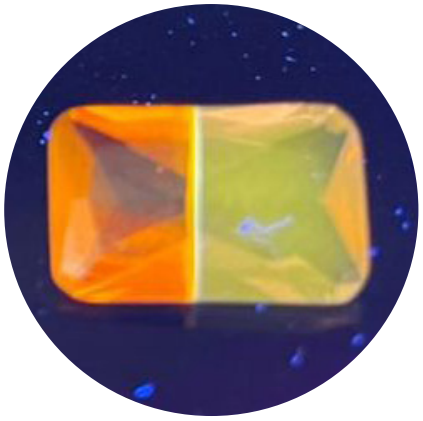
Lab Talk

Two very interesting stones recently passed through my hands, polar opposites of each other, in terms of value, but both equally fascinating. What is remarkable is that I have never seen either of these stones before in the forty-two years I have worked in this industry. Life is never boring!

The Tale of Two Stones

Glass Assembled 'Ametrine Quartz' imitation



Under LW UV Light

Data	Observation
Colour	Orange/Purple
Transparency	Transparent
Visual Features	Join line mid-stone
R.I. Crown / Pavilion	1.512
Optic Character	Singly Refractive
Uniaxial or Biaxial (+/-)	-
Magnetic Response	Slight Drag Response (Float)
Dichroscope	-
Diffraction Spectroscope	-
Chelsea Filter Reaction	Slight Red (Purple Side)
U.V LW Response	Bright Orange / Chalky Green
Microscopic Analysis	Gas bubble in orange section
Gemstone Identity	Glass-assembled Stone

Ametrine is a colour-zoned variety of macrocrystalline quartz and is a natural bi-colour combination of amethyst and citrine. Colour band combinations in ametrine can range from pale-violet to deep-purple and from pale-yellow to gold-brown. Both the violet and yellow colours found in ametrine are from traces of iron. The only difference between amethyst, citrine and ametrine is the level of oxidized iron impurities in the visible colour-zone bands. All three gemstones obtain their colour from iron and all three varieties have a silicon dioxide chemical composition.

Although amethyst is very abundant, natural citrine is considered rare and since citrine is rare, deposits of natural ametrine are very limited. While the most desirable ametrine stones are those cut with an even 50/50 split of colour, many cutters are now cutting stones where the colours intermingle giving them a unique appearance.

Natural ametrine will wholesale for anywhere from $ 2.00 a carat USD (Commercial) to $ 42.00 a carat USD (Extra Fine) for a 5 carat stone while a search of the Internet identified a 5.35 carat lab-created ametrine retailing for $ 13.00 per carat USD.

What aroused our suspicions about this stone? The 'heft' of the stone (it felt light), the warmth of it to the touch, the straight plane of colour, the gas bubble in the orange portion and the fact it was singly refractive. In natural ametrine, there is no fluorescence due to iron, however in the glass-assembled doublet, it was very strong.

The million dollar question is why go to all the trouble of producing a glass-assembled ametrine quartz look-alike when there are more realistic options, such as lab-created ametrine, available? In the latter case, it is not easy to differentiate lab-created from natural ametrine yet this assembled stone screams 'imitation'? As a study stone, it's got it all but we know this was not the intended use for this stone so again, I ask the question why?

Unusual Bi-Colour Sapphire (Sri Lanka)

Data	Observation
Colour	Blue/Orange
Transparency	Transparent
Visual Features	-
R.I. Crown	1.758 - 1.773
Optic Character	Doubly Refractive
Uniaxial or Biaxial (+/-)	U -
Magnetic Response	Moderately Strong
Dichroscope	-
Diffraction Spectroscope	-
Chelsea Filter Reaction	-
U.V LW Response	Pale Orange
Microscopic Analysis	Silk, Included Crystal, Liquid feather, clouds
Gemstone Identity	Bi-Colour Sapphire

The polar opposite of the glass-assembled doublet is this unusual bi-colour sapphire that was recently purchased in Sri Lanka. It has a colour combination that I have never personally seen before.

Microscopically the presence of silk, an included crystal and clouds confirm that it is a natural stone and that it has not been heat-treated.

Value wise? It's tricky. While it is relatively small (.90 carats), it is the uniqueness of this stone that makes it appealing to collectors and hard to price. To establish value, you need to use known comparables, but in this case, they are not readily available. That makes this corundum a conundrum

In the space of two weeks, two bi-colour stones that I have never personally seen before, one the product of Man's ingenuity, the other the product of Mother Nature. Both with completely different values and cut/produced for two completely different markets. Living proof that you never know what to expect next! What's not to love about gemmology?

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 introduced two new 'Diploma' programs (Diamond Professional and Coloured Gemstone Professional) in 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 (5 modules - 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 60 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, HPHT, CVD, Detonation, Ultrasonic Cavitation Skull Crucible, Zone Melt, Horizontally Oriented Crystallization, the Sublimation Method, and the Modified Stöber 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 module looks specifically at diamonds, their physical and optical properties, geology, localities, principle mines, crystal system, chemical composition and classification, causes of colour (fancy coloured diamonds), absorption spectra, inclusions, fluorescence, diamond cutting and mining 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, pricing 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 our online / practical Coloured Gemstone Grading #2 course where you will work with the Gemewizard and ColourWise Colour Grading systems.

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 60 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 Coloured Gemstone Professional 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 online / practical Coloured Gemstone Grading #2 course.

Residency Programs

We are delighted to announce that our Career Gemmologist, Diamond Professional and Coloured Gemstone Professional Diploma Programs are now available as a full-time residency program through the Gem Academy of Canada in Montreal, Canada.

Integrating the theoretical and practical components of these programs, students can earn their Career Gemmologist Diploma in six-months, their Diamond Professional in one month and their Coloured Gemstone Professional Diploma in five months.

Courses in Other Languages

All of our diploma and general interest courses are now available in English, Spanish & French. We are currently translating all the courses into Russian. These will be available in 2022.

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 five theoretical courses (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). Students taking any of the three 'General Interest' courses will receive a credit equal to the cost of the course if they upgrade to our Coloured Gemstones course.

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 world 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 in a classroom or 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 outlines the number of online tutoring hours that are included in our courses. If you require additional tutoring, you can talk to your tutor 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

Once a Student, Always a Student

We appreciate that the science of gemmology is constantly evolving. Every year new lab-created gemstones and treatments and enhancements are emerging in the market place along with new techniques and advanced technology to detect them. While your knowledge in certain areas may be relevant today, it may be obsolete tomorrow.

To meet this challenge, the World Gem Foundation has introduced our 'One a Student, Always a Student' policy, an innovative program that is unique to the World Gem Foundation and our affiliated gem academies.

Once you register for one of our courses or programs, we provide you with lifetime access to your student page so that every two years when we update our courses, you will receive the latest digital course notes free of charge.

Flexible Study Schedules

Benjamin Franklin once said 'An investment in knowledge pays the best interest' and this is as true today as it was back then. But how can we achieve this when we all lead such busy lives?

At the World Gem Foundation, we appreciate that we all have responsibilities and commitments that can make studying a challenge.

To meet this challenge, we offer a flexible study schedule that allows you to register at any time and study at your own pace.

Enrol in one of our three diploma programs, take the theory and practical diploma courses separately and receive course credits or take our general interest courses. The choice is yours! Our goal is to help you devise a study schedule that works for you!

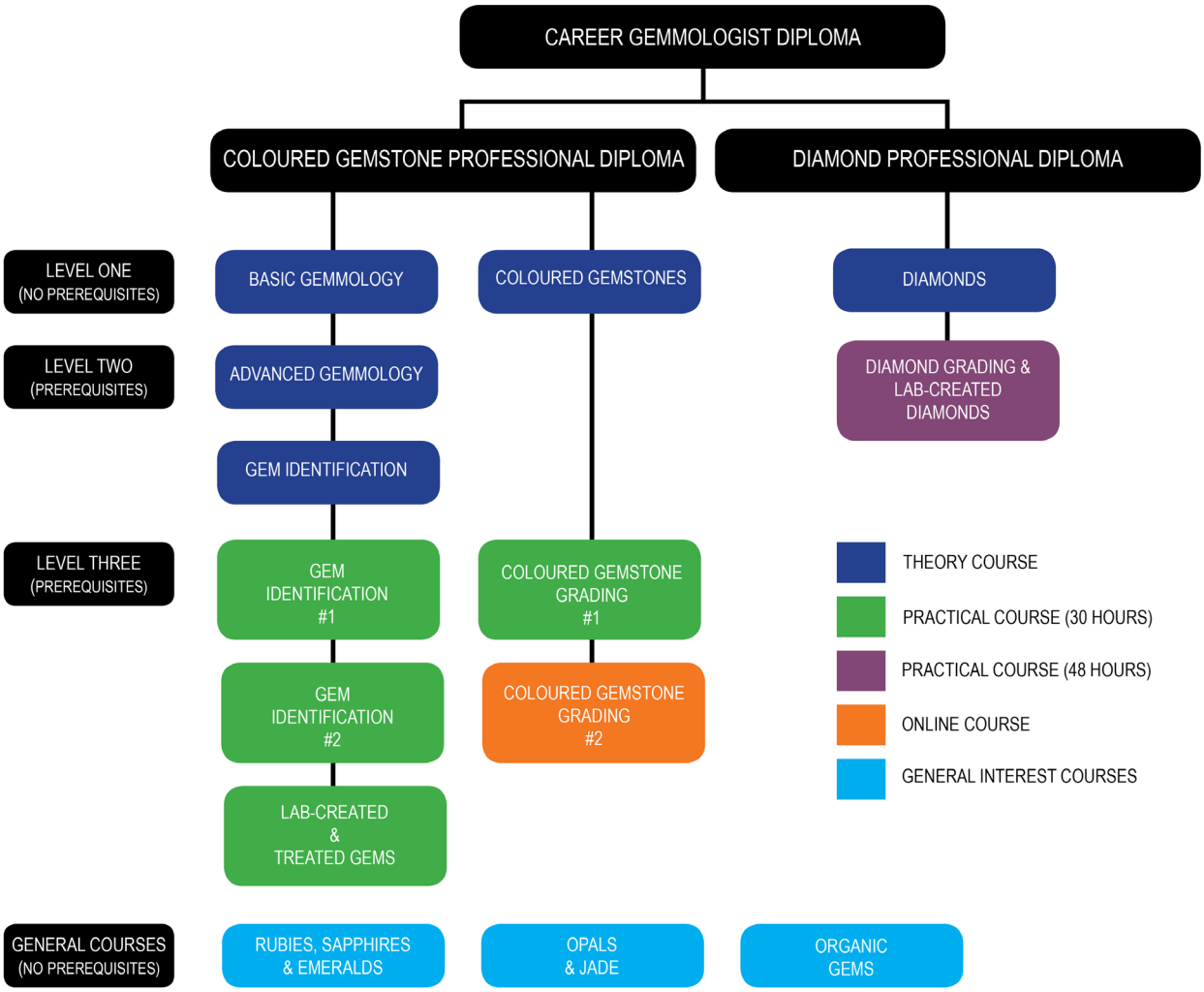
Whether you are taking our online tests, writing our final theoretical examinations or taking a practical test, we provide you with the flexibility to make it possible. Our students are our major stakeholders and we believe it is our responsibility to offer them every opportunity to achieve their educational goals.

Available in Print

All our diploma theoretical courses are available in print.

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.



GEMMOLOGY SEVEN PROGRAM

Career Gemmology
5 Modules - 78 Lessons

Gem Identification #1
5 Days

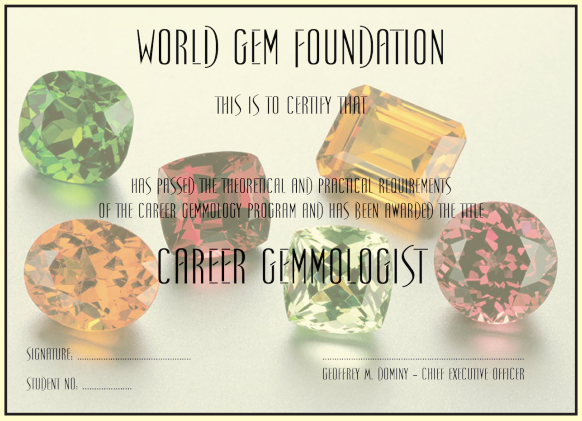
Gem Identification #2
5 Days

Lab-created & Treated Gems
5 Days

Diamond Grading & Lab-created Diamonds
8 Days

Coloured Gemstone Grading #1
5 Days

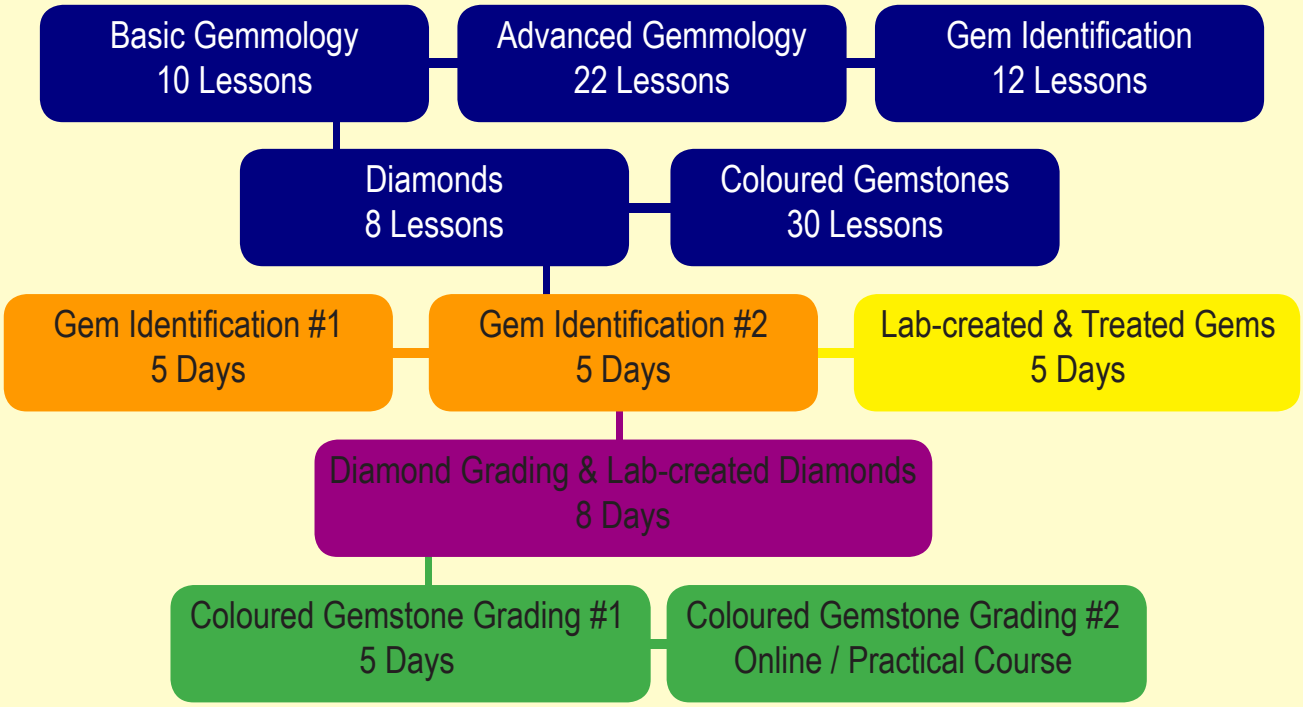
Coloured Gemstone Grading #2
Online / Practical Course



Career Gemmology Seven — Digital Fees

Course Name	Euros	Pounds Sterling	USD
Career Gemmology (Theory)	1400	1250	1600
Gem Identification #1	500	450	550
Gem Identification #2	500	450	550
Coloured Gemstone Grading #1	500	450	550
Coloured Gemstone Grading #2	1000	900	1150
Diamond Grading/Lab-created Diamonds	1750	1575	2000
Lab-created & Treated Gems	500	450	550
Examinations Fees (Final Exam)	250	225	280
Total Cost	6400	5750	7230

GEMMOLOGY ELEVEN PROGRAM

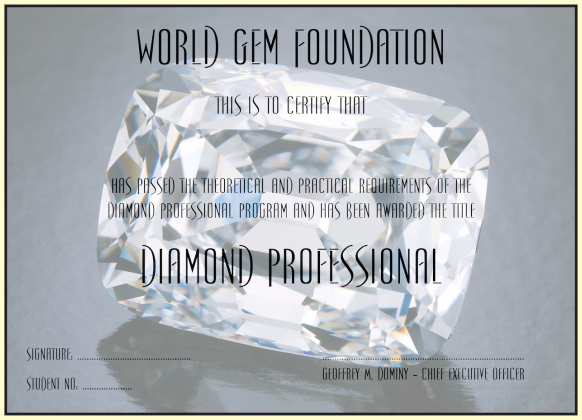


Career Gemmology Eleven	Digital Fees		
Course Name	**Euros**	**Pounds Sterling**	**USD**
Basic Gemmology (Theory)	200	180	225
Advanced Gemmology (Theory)	400	360	450
Gem Identification (Theory)	225	200	250
Diamonds (Theory)	225	200	250
Coloured Gemstones (Theory)	500	450	550
Gem Identification #1	500	450	550
Gem Identification #2	500	450	550
Coloured Gemstone Grading #1	500	450	550
Coloured Gemstone Grading #2	1000	900	1150
Diamond Grading/Lab-created Diamonds	1750	1575	2000
Lab-created & Treated Gems	500	450	550
Examinations Fees (Final Exam)	250	225	280
Total Cost	6550	5890	7355

DIAMOND PROFESSIONAL

Diamonds
Theory
8 Lessons

Diamond Grading & Lab-created Diamonds
Practical Workshop
8 Days



Diamond Professional	Digital Fees		
Course Name	**Euros**	**Pounds Sterling**	**USD**
Diamonds (Theory)	225	200	250
Diamond Grading/Lab-created Diamonds	1750	1575	2000
Examinations Fees (Final Exam)	250	225	280
Total Cost	2225	2000	2530

COLOURED GEMSTONE PROFESSIONAL

Basic Gemmology
10 Lessons

Advanced Gemmology
22 Lessons

Gem Identification
12 Lessons

Coloured Gemstones
30 Lessons

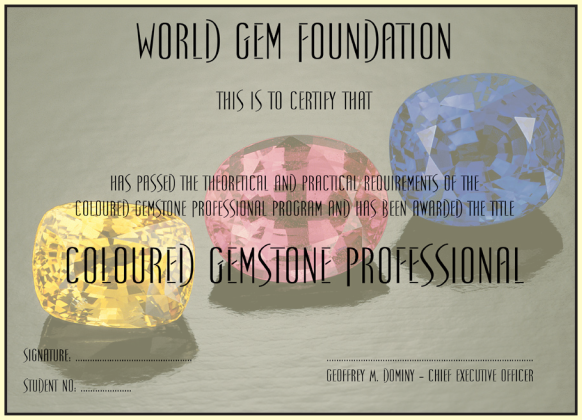
Gem Identification #1
5 Days

Gem Identification #2
5 Days

Lab-created & Treated Gems
5 Days

Coloured Gemstone Grading #1
5 Days

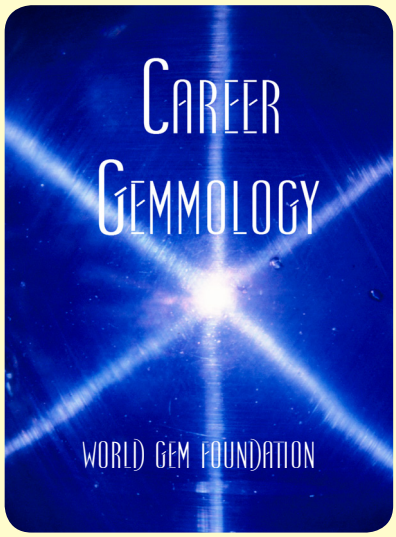
Coloured Gemstone Grading #2
Online / Practical Course

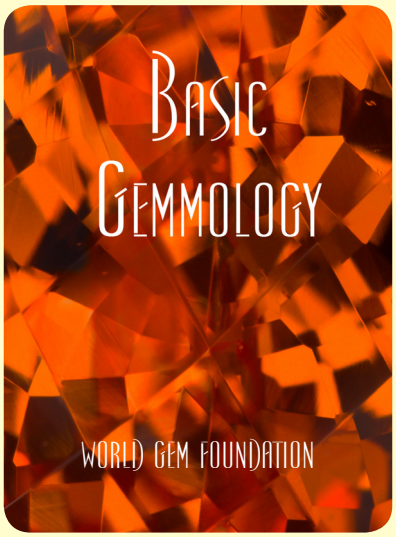


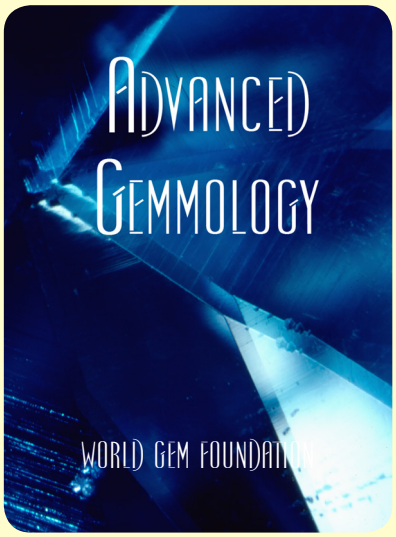
Coloured Gemstone Professional **Digital Fees**

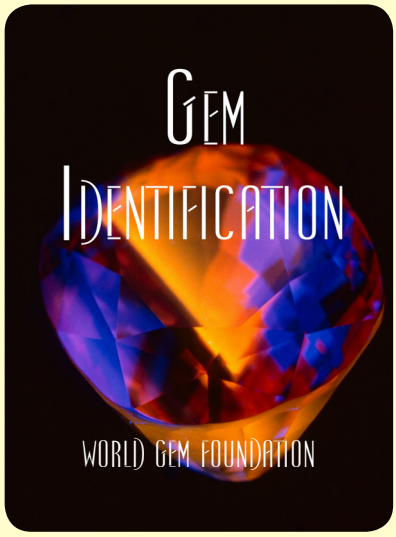
Course Name	Euros	Pounds Sterling	USD
Basic Gemmology (Theory)	200	180	225
Advanced Gemmology (Theory)	400	360	450
Gem Identification (Theory)	225	200	250
Coloured Gemstones (Theory)	500	450	550
Gem Identification #1	500	450	550
Gem Identification #2	500	450	550
Coloured Gemstone Grading #1	500	450	550
Coloured Gemstone Grading #2	1000	900	1150
Lab-created & Treated Gems	500	450	550
Examinations Fees (Final Exam)	250	225	280
Total Cost	4575	4115	5105

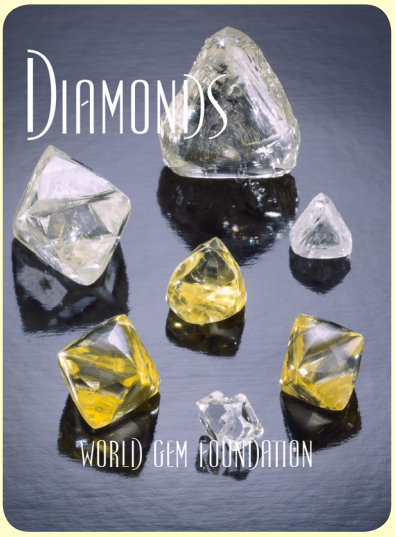
Diploma Courses

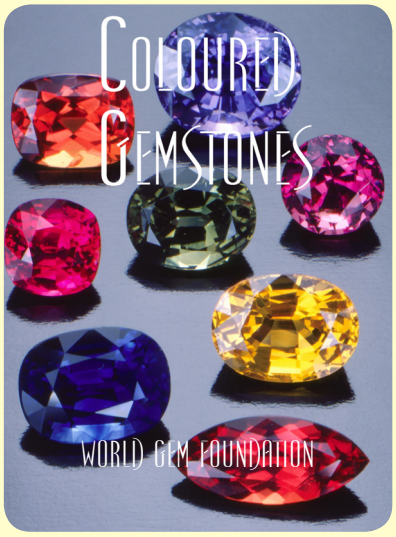




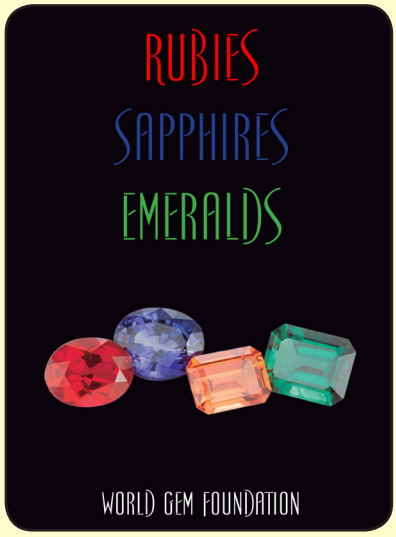


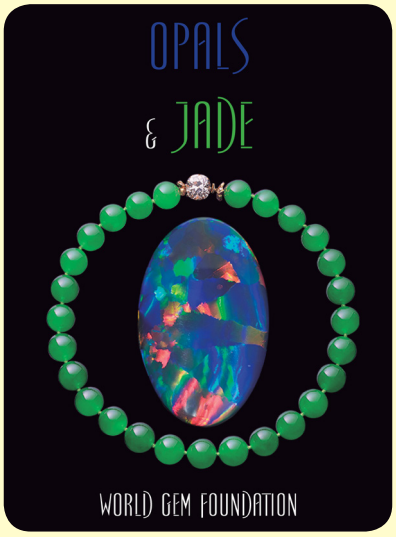


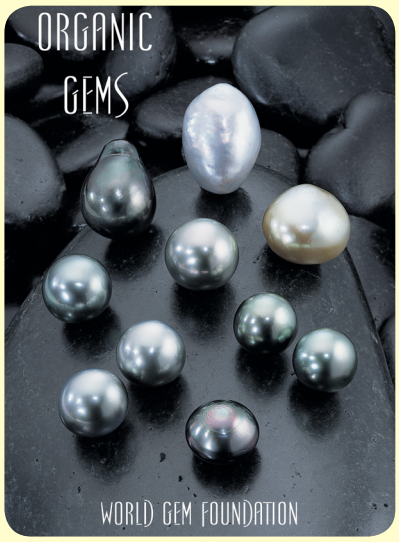




General Interest Courses

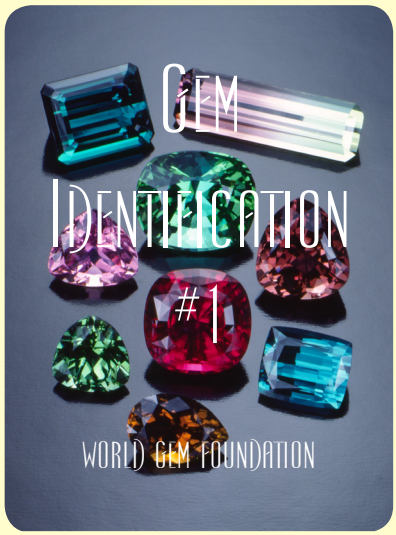


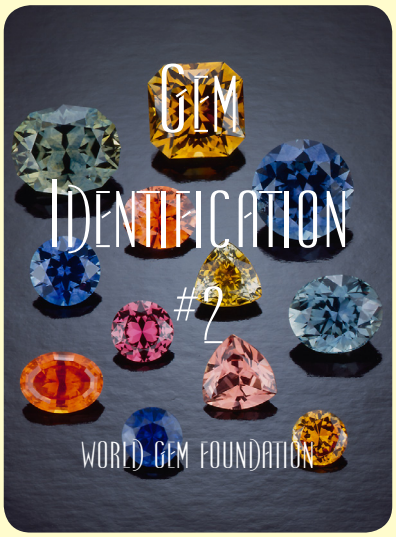


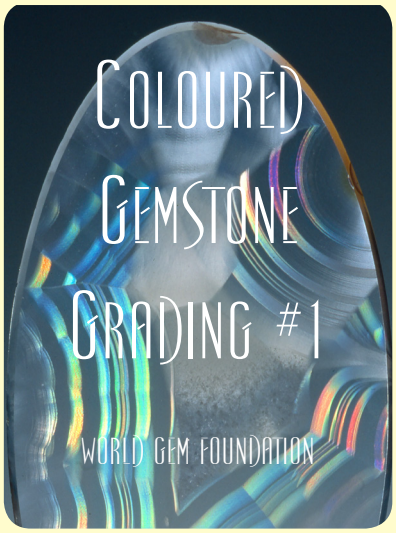


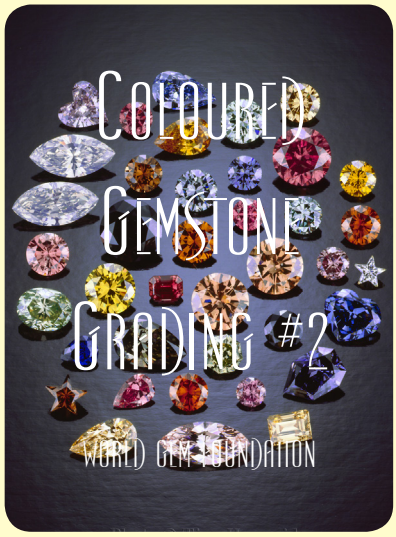
To learn more about our Diploma and General Interest courses, please click on the course icons above.
All of our diploma courses are available in English, Spanish & French.
Currently Rubies, Sapphires & Emeralds, Opals & Jade and Organic Gems are available in English & French.

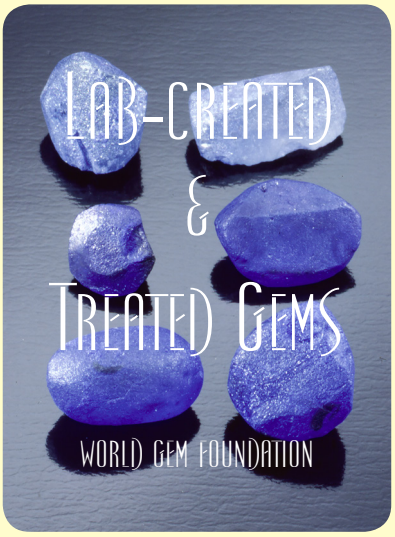
Practical Workshops

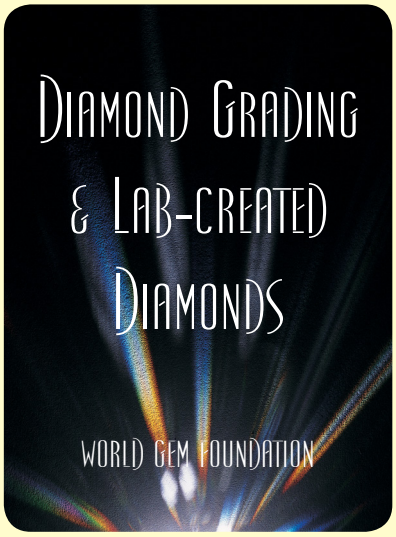












To learn more about our practical workshops, please click on the course icons above

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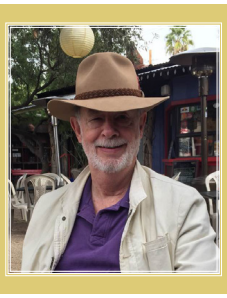
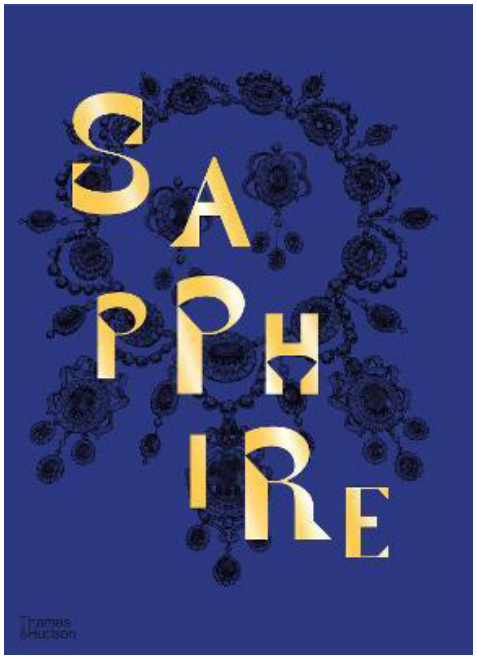
Once you register for one of our courses or programs, we provide you with lifetime access to your student page so that every two years when we update our courses, you will receive the latest digital course notes free of charge.

This is one more reason to choose the World Gem Foundation, because to us, you should never stop learning!

Literary Speaking

In this issue Richard W. Wise looks at Sapphire: A Celebration of Colour by Joanna Hardy, the third volume in a series that also includes Emerald and Ruby.





Sapphire is the third volume in a series on precious gemstones written by Joanna Hardy, produced by Thames & Hudson and edited by Robert Violette. The other two are appropriately titled Emerald and Ruby.

What strikes the reviewer immediately is the book's size. At 10.3 x 1.6 x 13.8 inches, it qualifies as an elephant portfolio, weighing in at a whopping 7.4 lbs. (3.36 kilos)

Hardy's depth of scholarship is impressive, though the book would be more appropriately titled "Sapphire Jewellery" as that is the focus of the discussion throughout. Hardy begins with an impressive historical introduction followed by an opening chapter on Early Trade, which contains much of interest. For example, I had assumed that most sapphires, even those in early European jewelry, came from Sri Lanka. I was totally unaware of the existence of a source in the Auvergne region of France. This chapter is followed by Medicine and Magic.

Gemstones, up until quite recently, were valued as much for their supposed medicinal and talismanic qualities as they were for their beauty. Hardy provides a comprehensive overview of the arcane qualities which have been attributed to sapphire.

The third chapter, Profiles & Portraits, is similarly enlightening. As far back as the Babylonians (6,000 BCE) seals and other glyptic gemstones, tiny historical artifacts, tell us much about artistic styles, mythology and religions of ancient cultures. Hardy catalogues a number of existent intaglios and cameos carved in sapphire dating as early as the Ptolemaic Period (323-30 BCE).

The book's proportions are troublesome. The primary raison d'etre of a folio of this size would be the presentation of a series of large, exquisite images of heart-stopping jewels. However, this is, generally speaking, not the case. The Introduction and final chapter of the book (written by Georgina Izzard) do indeed include a series of magnificent, full-page, photomicrographs of sapphire inclusions taken by Christopher P. Smith and Bilil Mahmood, but these high-quality contemporary images only serve as a contrast to the many technologically dated images found throughout the volume.

The publisher seems to have chosen to rely on older images produced by dated technology. In some cases, this is to be expected. Permission to photograph items in major collections can be difficult to obtain and some of these jewels simply disappear into private hands. The problem is in the internal design and layout. For example, Hardy's enlightening discussion of carved gemstones in chapter three is illustrated by images of the jewels placed in the margins surrounding the text. These are so small—and, in some cases, so out of focus—that it is impossible to make out any of the details of the carvings described—often tiny portraits. Photoshop or another editing tool would have been useful here.

The photo captions are problematic. The images are unnumbered. The present whereabouts of the jewel depicted is rarely stated and the single page entitled Picture Credits (at the back of the book), is organized by source rather than page number, which this reviewer found confusing and of little use.

One thing this volume truly lacks is an in-depth discussion of the quality criteria which separates the fine from the merely pedestrian examples of the gemstone and defines the characteristics of gems from specific localities. The chapter titled Sapphire Discoveries, which covers the

major geographic sources of sapphire, suffers from a lack of relevant images which leads this reviewer to wonder if the editor ever bothered to read the text. Instead of the tiny images of source areas, the chapter could have been more profitably illustrated with larger images of relevant examples taken by skilled gem photographers using up to date techniques. This would have brought the aesthetic characteristics typical of these areas into sharp focus.

Sapphire, A Celebration of Colour, is a sumptuously produced coffee table book. The text contains much information of interest. However, technically dated images, poor layout and inconsistent captioning, together with the lack of a comprehensive index, is a disappointment, substantially reducing the book's usefulness to the historical researcher or the gem and jewelry professional.

Sapphire: A Celebration of Colour
By Joanna Hardy
Edited by Robert Violette
Thames & Hudson, 2021
978-0-500-024775 $125.00

Grade School

During a recent trip to Sri Lanka, I was amazed how many non-padparadschas were offered as 'Pads'. Considering the difference in price, it is not surprising. In this article Richard Hughes looks at the complexities of describing 'Pads' and why it is hard to find a consensus.

Padparadscha Sapphire & the Ownership of Words

A discussion of the definition of padparadscha sapphire, from early to modern times, along with the difficulty in standardizing such definitions.

"Om mani padme hum – Hail the jewel in the heart of the lotus *— Buddhist mantra*

Padparadscha sapphire is a special variety of gem corundum, featuring an often delicate color that is a mixture of red and yellow – a marriage between ruby and yellow sapphire. The question of just what qualifies for the princely kiss of "padparadscha" is a matter of hot debate, even among experts.

The original locality for padparadscha was Sri Lanka (Ceylon) and many purists today believe the term should be restricted only to stones from Ceylon. However, fine stones have also been found in Vietnam's Quy Chau district, Tanzania's Tunduru district, and Madagascar. Stones from each of these areas are often heat-treated and this is done at fairly low temperatures (1200°C and below) and such heat treatment is not always detectable.

Padparadscha sapphires are considered among the most beautiful and valuable of the corundum gems. Prices for padparadschas vary greatly according to size and quality. At the top end, they may reach as much as US$50,000 per carat or more.

For many years now, padparadscha has been narrowly defined by Western gemologists as a Sri Lankan sapphire of delicate pinkish orange color. The term *padparadscha* is actually a corruption of the Sanskrit/Singhalese *padmaraga* (*padma* = lotus; *raga* = color), a color akin to the lotus flower (Nelumbo Nucifera 'Speciosa').

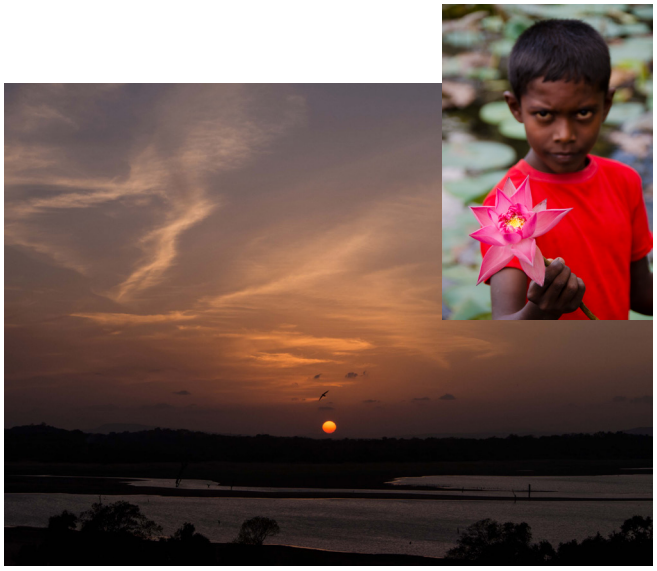


Figure 1. A marriage made in heaven. The ideal color of a padparadscha has been described by some as the marriage between a lotus flower and a sunset, each shown above in Sri Lanka. Photos © Wimon Manorotkul (L) & Richard W. Hughes (R).

Wojtilla provides the following from a Sanskrit source under his description of ruby:

> Arthasastra [an ancient Sanskrit book] knows the following names: saugandhika (lotus-coloured), padmaraga (the same)…
>
> – G.Y. Wojtilla, 1973

Ever look at a lotus? I've stuffed my snout into blossoms all the way from Beruwala to Badulla and have come up with only one conclusion – they are far more red than orange. Indeed, in ancient times padma raga was a sub-variety of ruby, as indicated by the Garuda Purana:

> 10. Some of the rubies have the colour of vermillion, red lotus and Saffron; some have the colour of Laksa juice; although the red colour is uniform throughout; their centre has a special manifest brilliance; the rubies are self-luminous.
>
> 32. He who is mentally and bodily pure and wears Padmaraga whose crimson colour is heightened by its good qualities is never sullied by any sort of evil.
>
> – J.L. Shastri (ed.), *The Garuda Purana* (400–1000 AD)

While virtually every writer on the subject makes the lotus comparison, certain others also add the concept of fire or sunset, almost an aurora (sunrise) red-orange. Here is an early definition from the Indian subcontinent, dating from about 1200–1300 AD:

> **Varieties of Ruby**
> That which spreads its rays like the sun, is glossy, soft to the touch (komala?), resembling the fire, like molten gold and not worn off is paümaraya [padmaraga].
>
> – Sarma, 1984, *Thakkura Pheru's Rayanaparikkha – A Medieval Prakit text on Gemmology*

Molten gold? That sounds nothing like a lotus color.

Figure 2. Vermilion and saffron. Some early definitions of padmaraga include references to vermilion (above; Pushkar, India) and saffron (inset; 'Ispanya Saffron'). Photos: Wikipedia.

A number of important Arab accounts of gems from the Indian subcontinent exist, but perhaps none are better than that of al-Beruni, who had this to say in regard to ruby:

> Al-Kindi has described the wardi (rose-colored) variety first. It is rose-colored with a little whiteness, but he has accorded preference to the khayri (Hollyhock-hued), kind over the wardi. Above this is the *ahmar 'usfuri* (red-saffron-coloured) kind which has the colour of bright saffron with a tinge of yellow. Then there is the *bahramani 'usfuri* kind which is pure, and is devoid of any starchy colour. The yellow kind becomes progressively precious as the red colour becomes dominant until it reaches full redness.
>
> – al-Beruni, ca. 11th century (Beruni, 1989)

The range of padparadscha here definitely includes everything from yellow-orange through red-orange into red.

Moving on to Sri Lanka itself, we have a more modern account from 1855:

> The Topaz (*puspa raga*, Singhalese) claims notice next. There are two varieties of it: the "ratu puspa raga" and "kaha puspa raga." The former is of a bright yellow color, with a reddish tinge and is the more valued. The latter is pure bright yellow. The first variety is scarce, and the second is comparatively plentiful. The topaz and the sapphire seem to be species of the same stone differing only in color – it is not unfrequent to find a piece of stone partly yellow and partly blue. This stone is not much sought after by Europeans, but it is prized among the Singhalese. It is said to sell well at the Presidencies of India and in Arabia.
>
> – J.F. Stewart, Gems and Gem Searching in Saffragam *Ceylon Observer*, June 11, 1855, (from Ferguson, 1888)

And a more recent reference from Sri Lanka:

> A sapphire of orange-red or pink colour, is locally referred to as padmaraga (padma – lotus flower; raga – colour). Many scholars call this variety padmarascha, which is a musical rhythm and pollen; therefore, the name for the lotus-flower coloured corundum should be padmaraga, and not padmarascha. However, lotus flowers are also found in white, but in this instance the colour referred to is the orange-red or pink lotus flower, growing in Shri Lanka.
>
> There is also the yellow sapphire of Shri Lanka, commonly called pushparaga in Singhalese. The term pushpa means flower; as raga is colour and also means pollen, hence pushparaga is the "colour of pollen." Although pollen can be brownish yellow or yellow in colour, the Shri Lankan gem trade from ancient times to

the present, has always referred to pushparaga as a yellow variety of corundum.

The important words to consider in the latter example are flower, colour and pollen, in the origin of the name, pushparaga. However, in both examples of padmaraga and pushparaga, the term raga refers to the colour. Therefore, the word padmaraga also confirms that the correct term for the orange-red or pink sapphire should be accepted as padmaraga and not padmarascha.

– D.H. Ariyaratna, 1993

Yet still another modern Sri Lankan reference:

The term pathmaraga is applicable to a corundum of an exceptionally pleasing colour which is a result of a combination of colours producing a colour similar to a beautiful sunset red (p. 86) …. The term pathmaraga is a Singhalese term applied to a very special colour variety of corundum, so named after the lotus flower as its colour is sometimes akin to a variety of this flower…. The colour combination produces the rare and beautiful colour of a sunset red at its best as seen across a tropical sky.… The colour of pathmaraga is apparently a combination of yellow, pink and red, with mildly conspicuous flashes of orange (p. 94)….

– Gunaratne and Dissanayake, 1995

There is a reasonable continuity in the Eastern literature. Padmaraga is a blend between yellow sapphire and ruby. No where is the term defined simply in terms of pastel colors.

Figure 3. This 1126 carat crystal was cited by Robert Crowningshield as representing the ideal color of padparadscha. Photo © Tino Hammid

Connecting the plots

So how did we get from padmaraga (a blend of yellow sapphire and ruby) to padparadscha (narrowly defined as a pastel pink-orange sapphire)?

The tightening of the padparadscha definition can be largely traced to a 1983 article by the GIA's Robert Crowningshield. In it, Crowningshield provided an excellent summary of the origin of the term and what many considered to be ideal examples. Unfortunately, however, the GIA Library at the time did not include many Indian or Arab lapidaries. Thus Crowningshield was forced to rely on Occidental descriptions. Of those he did quote, at least two (Keferstein, Holland) were not even listed in the references at the end of the article, bringing into question whether Crowningshield actually saw them or simply quoted via third parties. Whatever occurred, the final definition he produced was in the opinion of this author truncated, completely missing the early references to the color being a blend of a lotus flower and sunset as well as the many references to rich colors in the definition that he himself cited.

Crowningshield concluded with these words:

It is clear that the term padparadscha was applied initially to fancy sapphires of a range of colors in stones found in what is now Sri Lanka. If the term is to have merit today, it will have to be limited to those colors historically attributed to padparadscha and found as typical colors in Sri Lanka. It is the GIA's opinion that this color range should be limited to light to medium tones of pinkish orange to orange-pink hues. Lacking delicacy, the dark brownish orange or even medium brownish orange tones of corundum from East Africa would not qualify under this definition. Deep orangy red sapphires, likewise, would not qualify as fitting the term padparadscha.

– Robert Crowningshield, 1983

In the article, a pink-orange crystal and cut stone (Figures 3 and 12) were held out as prime examples of padparadscha. And they certainly were lovely specimens. But it was a mistake to suggest that they encompassed the full range of possibilities. Excluding "deep orangy red sapphires" is in no way supported by either the historic or contemporary sources in Sri Lanka.

During my many trips to the Island of Gems, I've witnessed virtually any ruby/sapphire containing a mixture of red/pink and yellow described as padparadscha, regardless of tone or saturation. Clearly, locals do not limit their palette to only the pastel colors and, from the historic definitions I've quoted, nor did the ancients.

Enter the LMHC

On June 16–18 2005, members of the Laboratory Manual Harmonisation Committee (LMHC) met in Milan, Italy to consider a standardized definition of padparadscha.

According to their website...

> The goal of the Laboratory Manual Harmonisation Committee is to achieve the harmonisation of gemmological report language and thereafter the revision of this harmonised report language as used by LMHC members. The LMHC meets several times a year to update or add to the contents of a manual. When they are relevant to the trade, parts of this manual are released in the form of Information Sheets. The opinions or findings in these documents are based on the state of knowledge at the time of the latest publication and may change as new information becomes available.
>
> The LMHC is a group of the world's major laboratories For more than a decade, representatives of these laboratories have met to discuss the harmonization of identification procedures and wording on gemstone reports.

The core of the LMHC padparadscha definition at the time of writing (2013) is as follows:

> Padparadscha sapphire is a variety of corundum from any geographical origin whose colour is a subtle mixture of pinkish orange to orangey pink with pastel tones and low to medium saturations when viewed in standard daylight.
>
> The name 'padparadscha sapphire' shall not be applied in the following cases:
>
> – If the stone has any colour modifier other than pink or orange.
> – If the stone has major uneven colour distribution when viewed with the unaided eye and the table up +/- 30°.
> – The presence of yellow or orange epigenetic material in fissure(s) affecting the overall colour of the stone.
> – If the stone has been treated as described in Information Sheets #2 and #3.
> – If the stone has been treated by irradiation.
> – If the stone has been dyed, coated, painted, varnished or sputtered.

I believe most of these criteria are reasonable. You want the color to be from the stone itself, not a stain in a fissure; similarly, you don't want the stone to be irradiated, dyed or coated.

However where I differ is in the realm of tone and saturation. I do believe that padparadschas can and do have saturations that go well beyond "low to medium." Indeed, the finest (and most expensive) padparadschas I have seen are richly saturated. If they were diamonds, they would certainly be described as vivid.

The Christie's padparadscha

Let's take this definition and apply it to a major padparadscha. At Christie's June 7 2005 New York sale, a magnificent 20.84-carat padparadscha sapphire fetched a pretty price, a stunning $374,400 ($18,000 per carat). Mounted in a ring by Henry Dunay (Figure 4), this sale is evidence of the increasing demand for high-quality untreated gemstones. Unfortunately, it is also evidence of the difficulties in defining padparadscha. It featured a 2005 report from one of the LMHC labs.

Figure 4. Simply magnificent. In 2005, this 20.84 carat padparadscha sapphire fetched US$18,000 per carat at auction. Photo © 2005 Christie's Images Ltd.

Using the image of this gem from Christie's, I analyzed the color ranges using the Gemewizard, a most interesting tool developed by Menahem Sevdermish. This tool will take any image and break it up into its component colors. In order to do this test on the above image, it was first necessary to digitally remove the mounting, which I did in Photoshop. The results are found in Figure 5 below.

One can clearly see from the images that, if the picture of the 20.84-ct. pad is representative of the appearance of the actual stone, many of its colors fall outside the range defined by the LMHC, being darker in tone and too rich in saturation. Even if the photo is not representative, I have seen gems with the color as shown. If these do not qualify under the LMHC system, my opinion is that the LMHC should revisit their definition with a view towards making it more broad on the high saturation end.

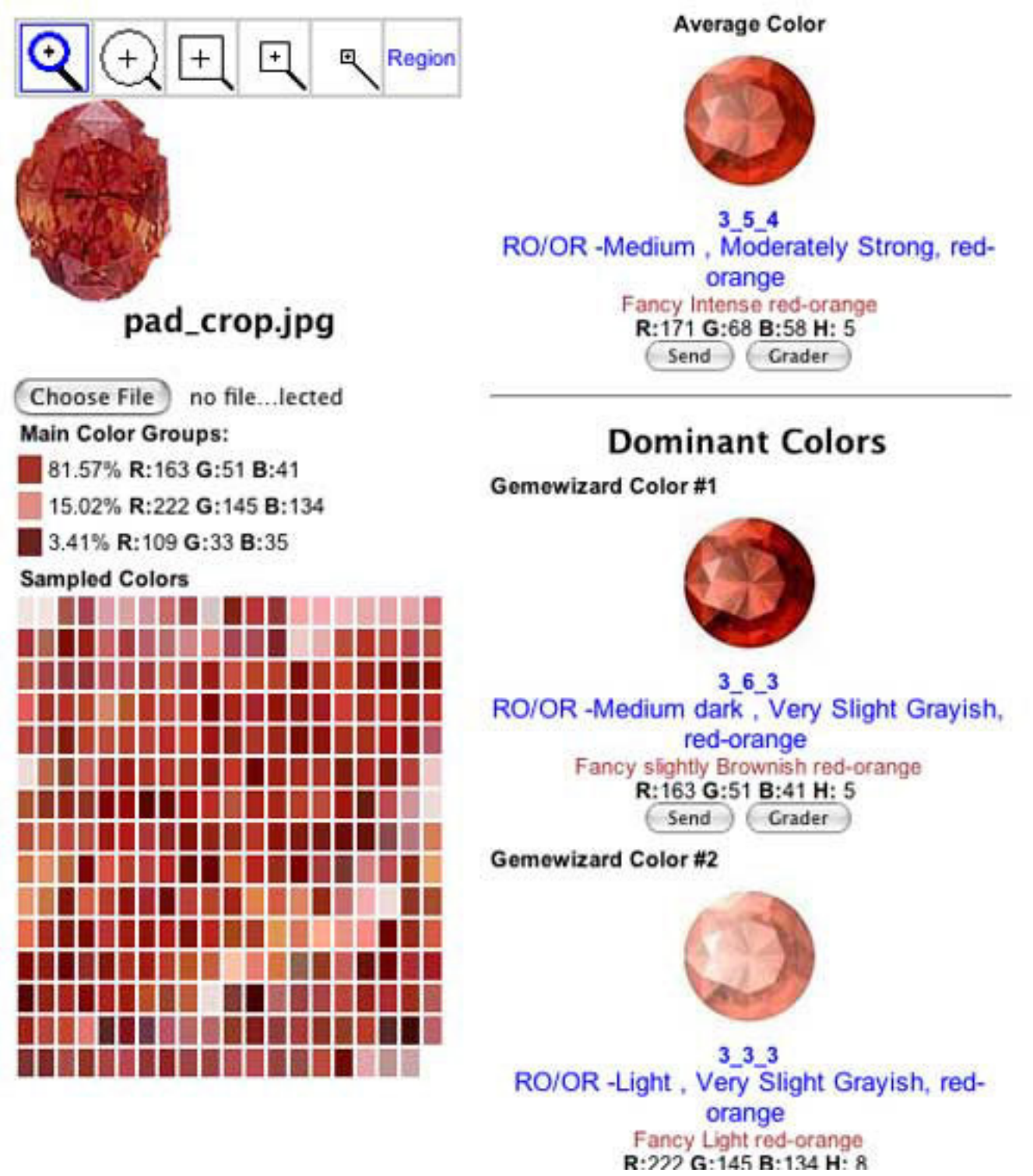


Figure 5. The 20.84 carat padparadscha sold in 2005 at Christie's, also analyzed by the Gemewizard. If the photo is an accurate representation, it is clear the gem would fall outside of the proposed LMHC color range for padparadscha (the irregular shape of the gem is because the mounting was removed in Photoshop)

Padparadscha survey

In order to better answer the question of what dealers today think of padparadscha, the author conducted a brief survey in August–September 2012, both in Sri Lanka and Hong Kong. Nine experienced colored stone dealers took part.

Participants were asked a series of questions concerning the definition of padparadscha, starting with a single sentence that would sum up their definition of padparadscha.

The responses were as follows:

- A sapphire with two colored hues, pink & orange.
- Color of the sunset is the perfect color of the padparadscha. A mix of pink & orange.
- A mix of pure orange and pink hues, creating a vivid and pure uniform color.
- A deep pink sapphire with generous orange hue.
- A true balance of pink & orange or orange & pink.
- A balance of pink and orange creating a color similar to a sunset looking west combined with the last hints of orange from the setting sun just after it settles below the horizon.
- Pinkish orange 50-50. Americans prefer a sunset color; lotus color for Japanese.
- A sapphire that is mixture of orange and pink. I prefer one that is 55% orange and 45% pink.
- Orangish pink.

From these responses it is clear that padparadscha is considered by these dealers to be a mixture of pink and orange. Notably absent was any mention of "pastel" in their definitions. Indeed the terms "deep" and "vivid" were mentioned by two of those surveyed.

Figure 6. Padparadscha survey Sri Lankan gem expert, Gamini Zoysa (left) taking the padparadscha survey as the author looks on. Photo: Wimon Manorotkul.

Following this, respondents were questioned regarding the numbers of pads they typically see in a year, the color terms they associate with padparadscha, whether or not color zoning, origin or treatment should affect the padparadscha definition, and if yes, whether those features should also affect the definitions of ruby and blue sapphire. The results from those questions are found in Figures 7–10.

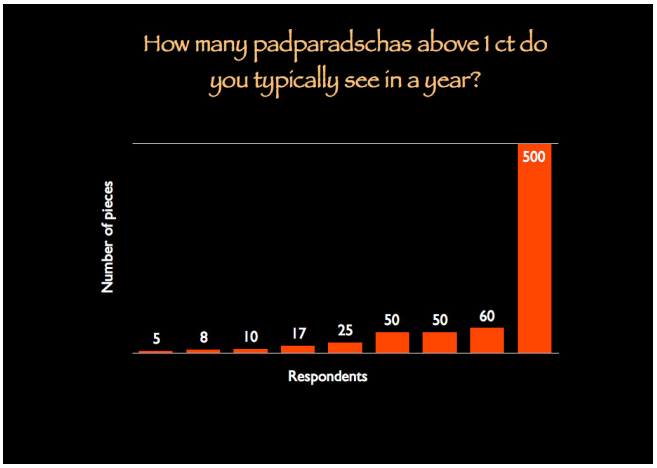


Figure 7. Number of padparadscha sapphires seen in a year In your work, how many padparadscha sapphires above 1.00 carat do you typically encounter in a year?

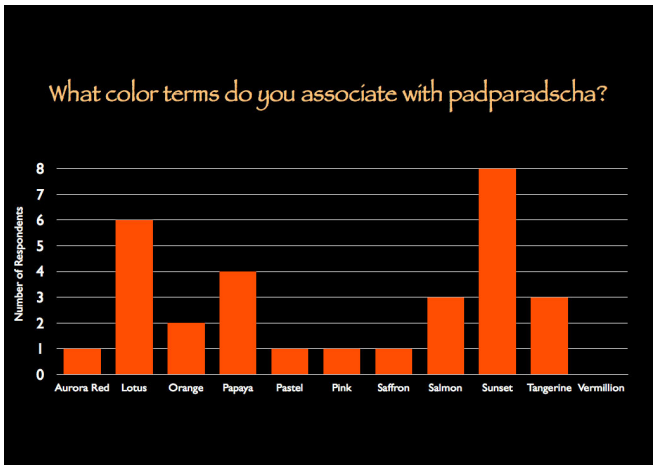


Figure 8. Colors of padparadscha. Which of the following terms do you believe describe the color of a padparadscha sapphire (check all that apply)?

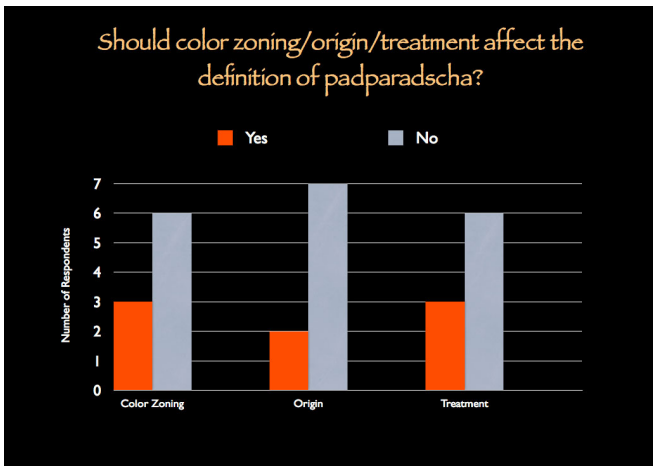


Figure 9. Should color zoning, origin or treatment affect the definition of padparadscha?

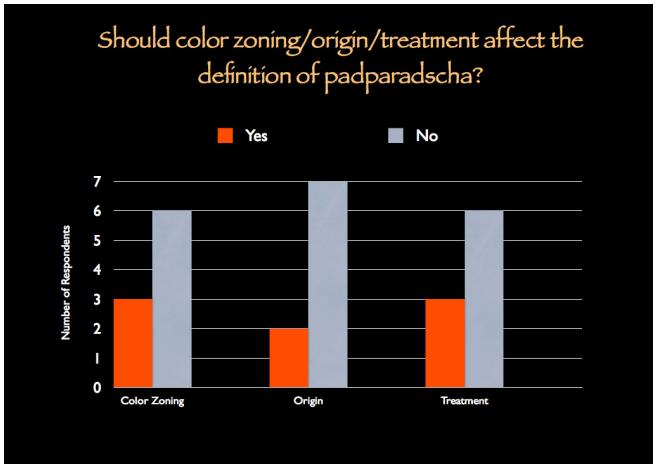


Figure 10. If yes, should color zoning, origin or treatment affect the definition of ruby or blue sapphire?

The final feature of the survey was a series of color chips ranging in the horizontal axis from reddish through orange to yellowish, with the vertical axis encompassing increasing tones/saturations. This was similar to the LMHC color chart, but encompassing a wider range of hues and saturations. Participants were asked to draw a line around the region on the chart that they felt best represented the hue and tone/saturation range of padparadscha sapphire. The results are shown in Figure 11.

Admittedly this survey was far too small to be meaningful. However two things were clear from the responses. Experienced sapphire dealers do not agree on the color range of padparadscha and they do not include only pastel colors. This makes the crafting of a definition by a group such as the LMHC devilishly difficult.

The ownership of words

Daydream for a moment. Imagine if you will a meeting of international wine makers where standards are discussed. After much debate, a consensus is reached on the definition of “champagne.”

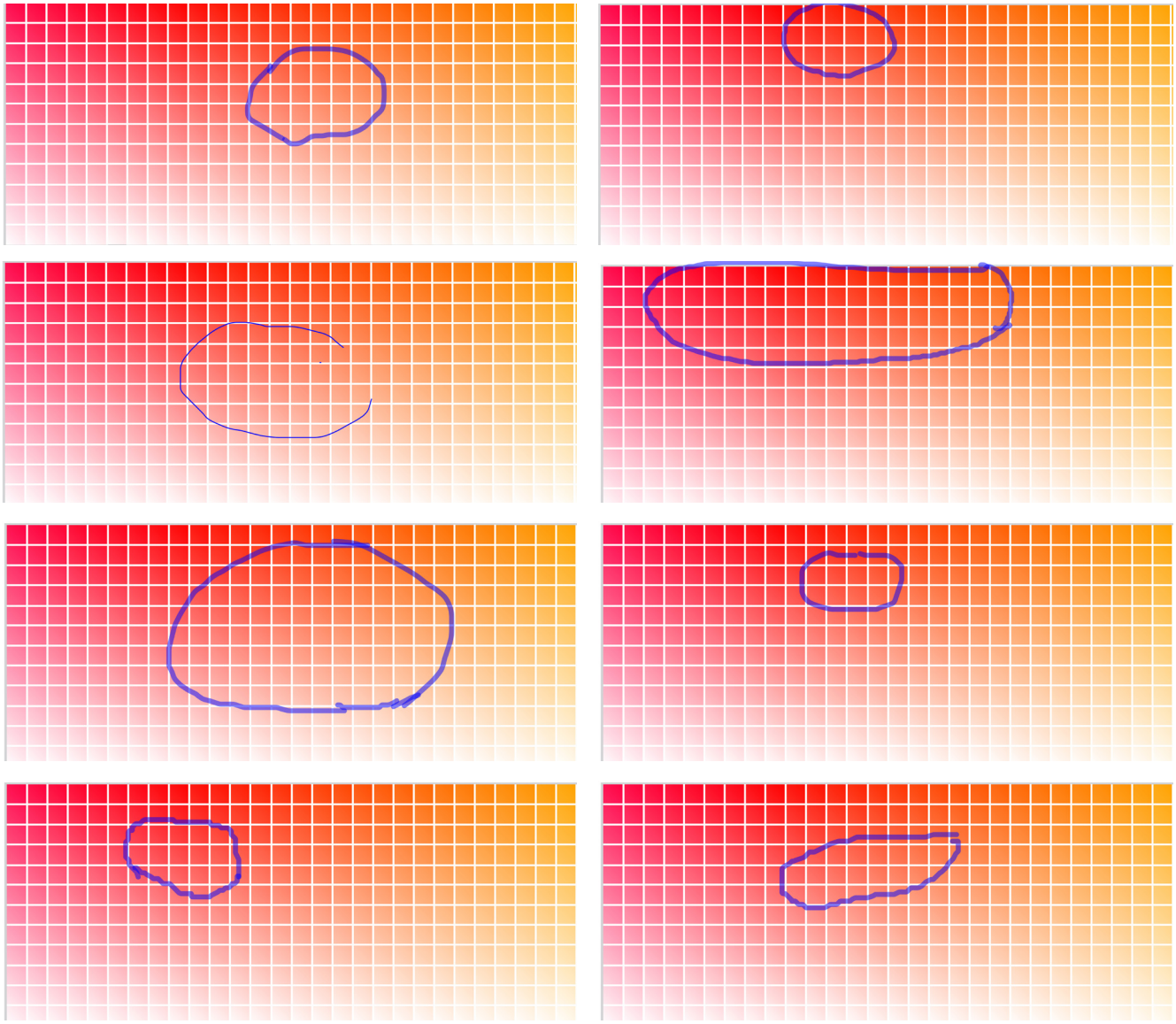


Figure 11. Padparadscha color range survey results. As part of the padparadscha survey, participants were asked to circle the region which they felt best represented the padparadscha color range. Judging from the results above, it is clear that even among experienced observers there is little agreement as to the color range of this gem variety.

A noble goal, I think we will all agree. But also imagine the situation if that meeting did not include a voting member from France? And what if the definition agreed upon was so narrow that it excluded the finest vintages from France's Champagne district?

We have a similar situation today with the rare and lovely sapphire variety of padparadscha, where not a single representative from Sri Lanka was present while a Sri Lankan word was being defined. This begs the question of who owns a word. Is it those from whose tongue it originates, or the collective masses around the world? Can we really define a word while not allowing a vote to those from whose language it has sprung?

Coincidentally, as I was pondering this issue back in 2005, I chanced upon an essay in the New York Times discussing the English dictionary of Samuel Johnson published some 250 years ago. The essay's author Jack Lynch had this to say:

Figure 12. Along with the crystal in Figure 3, this 30 carat. padparadscha from Sri Lanka was cited by Robert Crowningshield as the epitome of the variety. Photo © Tino Hammid.

> Johnson approached each entry with the same overarching question: What does a word mean? You can answer this question many ways. You can turn to Latin roots, consult a committee of authoritative scholars, or follow logical principles about things like double negatives.
>
> But Johnson's answer was simpler: a word means whatever the best writers say it means. He was convinced that no one — no emperor, no king and certainly no dictionary writer — had the authority to rule on meanings. Our language is the common property of all who have used it, and meanings come not from fiat but from precedent.
>
> So before writing his definitions, Johnson spent years reading the great authors of the English tradition. And it is these (mostly) men who did the real work: they told him what the words meant, and he in turn told us. They are the ones who "fixed" the language, and what is often called a tremendous act of egotism on Johnson's part in fact becomes one of humility.
>
> – Jack Lynch, Dr. Johnson's Revolution, *New York Times*, 2 July, 2005

In the previous passages, I have cited a number of Sri Lankan and Indian sources, both historic and contemporary, giving a definition of padparadscha that differs in important respects with that developed by Robert Crowningshield (and followed today in modified form by the LMHC).

Which brings me back to the original question. Who owns a word?

Language is a vital part of any culture. While the efforts of bodies such as the LMHC are to be lauded, before they dive into the sun-kissed waters of padparadscha, I believe it would behoove them to do as Samuel Johnson. Read the great authors of the past. And consult the great minds of the present. There is a vast body of Eastern gem literature that has hardly been touched by gemology, along with a number of fine Sri Lankan scholars, gem dealers and gemologists that would be delighted to help us. Let's dip into it.

At the same time, all of us in the gem trade, both gemologists and dealers, need to understand that words like padparadscha and pigeon's blood were never precisely defined in the past and nor is there general agreement in the present. Thus we need to ask the question: Is a consumer better served by a precise, but arbitrary definition of something as nebulous as padparadscha? Or should we do as we have already done with the definitions of ruby, blue sapphire and emerald and literally let a thousand flowers bloom? Is anyone harmed by embracing a wonderful linguistic artifact in the greatest possible way?

Think about it. The definition of blue sapphire encompasses a huge space. From the lightest of blues, through the most vivid, to stones that are effectively black. Not a single lab in the world has ever refused to call a sapphire a sapphire because of its color zoning, tone or saturation. So why is padparadscha singled out for special treatment? Has their

been a rash of consumers cheated by this? We have good blue sapphires and not so good ones. Why shouldn't the gem world be allowed both good and bad padparadschas? In examining this question, I believe we will better understand how to define words like ruby, sapphire, emerald and, dare I say it, paraíba. And in the process, we might just give the Sri Lankans back the ownership of their word. I know they will thank us.

Figure 13. The variety of nature with both lotus flowers and sunsets, there is a range of possibilities. Since padparadscha is defined by these colors, thus it seems logical that padparadscha might also cover a range of possibilities. Sunset photo at Bagan, Myanmar: Richard W. Hughes; lotus photo: iStockphoto.com

Acknowledgments

The author would like to thank all those who participated in the padparadscha survey. Special thanks to Bill Larson and John Emmett for discussions on the subject and review of the manuscript, along with Sheriff Rahuman for pointing out the difference between tumeric and true saffron and Gamini Zoysa for introductions in Sri Lanka. And a big thanks to my wife, Wimon Manorotkul, my daughter Billie, my niece Pin Manorotkul and my friend, Julie Poli, for putting up with the frequent lotus stops throughout our 2012 travels through Serendib. I still don't have the perfect Sri Lankan lotus photo, but I'm a lot closer than before.

Keferstein's Mineralogia Polyglota

b. Unser Rubin.
Unser Rubin der Juweliere, e. i. unser edler, rother Korund oder Sapphir der Mineralogen, ist der rothe Jakut der Orientalen. An Abänderungen kann man unterscheiden: rosenkarmesin - koschenille - karminroth, ferner dunkelgefärbte und blasse, welcheletztere auch als Balais, Rubinbalais, Rubicell, Rubacel, Rubasse bezeichnet werden; die koschenille oder morgenrothe Abänderung nennen die Juweliere auch wohl hyacinthe oder vermeille orientale, die bläuliche aber amethyste orientale; der halb rothe, halb blaue heisst sapphir rubis.

Der Name Rubin kommt nicht im Alterthume und Orients vor; erst im Mittelalter, (um das Jahr 1300) findet sich der Name rubinsus, rubies, Robins; woher derselbe stammt, ist zweifelhaft, ob von dem persischen rutbi, der eine Art des benefch war (s. diesen), oder von der rotten Farbe (euer im Lateinischen, rudhir im Sanskrit, rhudd im Keltischen und ähnlich in den meisten Sprachen). Der Name balais, Rubinbalais stammt von balaschsch der Araber (s. balchasch), der unser Spinell gewesen sein wird.

Po-ma-lo-kia im Chinesischen; moey heissen di rotten Edelsteine im Allgemeinen.

manikja im Sanskrit, auch padmaraga (d. i. lotosfarbig, rosenrot), mahamulga (kostbarer Stein, patalopala (blassrother Edelstein), arunopala (dunkelroter), conitopala (Rother), lohito (der Rothe), conaratna, tanariratna (Sonnenwedelstein), kuruwilla, kuruwila, kuruwinda, lakshmipusha; alle diese — meist wohl dichterische — Namen übersetzt Wilson in seinem Wörterbuch mit Rubin, doch mögen auch hierunter andere Rothe Edelsteine begriffen seyn, die mit kuru anfangenden Namen erinnern an Korund, korundun in Indien.

Im Tibetanischen finde ich im Wörterbuche von Körös keinen Namen für Rubin angeführt, obwohl man den Stein sehr wohl kennen muss; vielleicht gehört hierher mani (Edelstein), wegen des Zusammenhanges mit manik, auch mya-mena-phyena ein rother Edelstein.

manik, manika, auch tokes im Hindu; — manika, manikük, manikür, auch maha mülya (d. i. von hohem Werte), padmaraga, padmaragamani im Bengalischen; — manikan, padma, padam im Malaiischen; — pata-mra im Malabarischen, auch kyaokoi (d. i. Rotstein) und eiliges chogeppi; — lankaratte im Ceylonesischen.

– Christian Keferstein, Mineralogia polyglota, 1849

References and further reading

While doing research for my first book (Hughes, 1990), the late, great John Sinkankas gave me a valuable bit of advice, suggesting I concentrate on first-person accounts, rather than those whose knowledge of a subject came via distant sources. Since that day I have spent great effort (and more than a little coin) in locating Asian sources of information on this most Asian of precious stones – corundum. Below are a few gems of early corundum literature, along with other works of interest on padparadscha.

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Rock On

The ‘Queen of Asia’ weighs 510 kilos and is the largest natural blue sapphire (corundum) ever found. In this article, Thanong Leelawathanasuk, Supparat Promwongnan, Pornsawat Wathanakul, Visut Pisutha-Arnond, Wilawan Atichat and Gamini Zoysa explain why it has sent shock waves through the industry and why it is a discovery of epic proportions.

New giant gem corundum boulder from Sri Lanka

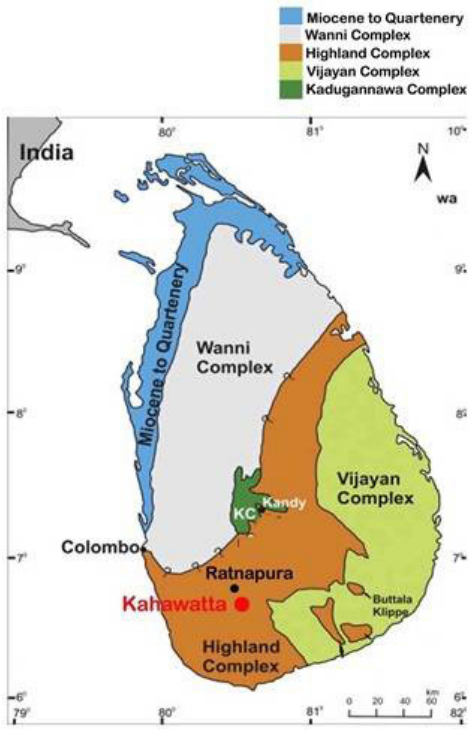

Figure 1. Geologic Map of Sri Lanka showing the location of Kahawatta mining area where the giant boulder was unearthed. The area is situated in the Highland Complex. Map modified after Prof. P.G. Cooray 1984

Recently a very large (100 cm x 75 cm x 50 cm, 510 kilogram) water-worn boulder of corundum aggregate (see Figure 2) was unearthed in ‘Kahawatta’ village situated about 28 kms south east of Ratnapura (Figure 1). The specimen was mined at a depth around 50-60 feet below the surface in an alluvial gem mine. Kahawatta is a well known gem mining area which has produced several large sapphires previously. One of the biggest stones was a 43 kilogram single corundum crystal found in 1983 - 1984.

The mining area belongs to the Highland Complex of Sri Lanka which consists predominantly of quartzite, dolomitic marble and calcsilicate gneiss (and quartzitic Schists) The country rocks exposed near the mining area are granulite and garnet gneiss.

Samples and Methods

A few crystals extracted from the giant boulder were cut as cabochon by the owner; they display a good asterism. Some crystals were also heat-treated by the traditional method to enhance the colour and clarity. Two samples, untreated and heated, were then recorded for the gemmological properties at the GIT lab in Bangkok (Figure 2 Left).

The untreated sample is an irregular-shaped rough (97.71 carats, 31.6 mm x 23.8 mm), exhibiting milky and very light grayish blue colour, and the heated sample is a polished piece (8.00 carats, 14.5 mm x 11.8 mm) showing medium blue colour (Figure 2 Right).Standard gemological instruments were used for obtaining the stone’s properties. External and internal features were observed using a gemological microscope. Fluorescence effects of the stones were observed under the long-wave (365 nm) and short-wave (254 nm) UV. Fluorescence images were taken using the Diamond View™.

The inclusions were identified using Raman Renishaw in Viaspectromicroscope. The chemical compositions were analysed by EDXRF. The UV-Vis-NIR spectra were also recorded.

Gemological Properties

The untreated and heated samples showed an R.I. of 1.76 (distance vision technique) and 1.760-1.770 (birefringence = 0.010), respectively. The specific gravity (SG) values of both samples were measured hydrostatically as 3.98-4.02. These values fall well within the range of corundum. The untreated sample was inert under long and short-wave UV while the heated one fluoresced strong whitish blue under short-wave UV, and inert to long-wave UV light.

Microscopic Features

The internal features found in the untreated sample were fingerprints, minute particles, and dark crystals which were identified as uraninite by Raman spectroscopy (Figures 3a and 3b). In addition, very dense regularly orientated needle-like inclusions intersecting at approximately 60°/120° were identified as rutile (Figures 3c and 3d), which were responsible for the star effect when the stone was cut en cabochon.

Figure 2. Left photo: A very large (100 cm x 75 cm x 50 cm, 510 kilograms) water-worn boulder of corundum aggregate from the Kahawatta mining area, Ratnapura, Sri Lanka. Right photo: an untreated,milky and very light greyish blue sapphire rough (97.71 carat, upper left) and a heated and polished blue sapphire piece (8.00 carat, lower right).

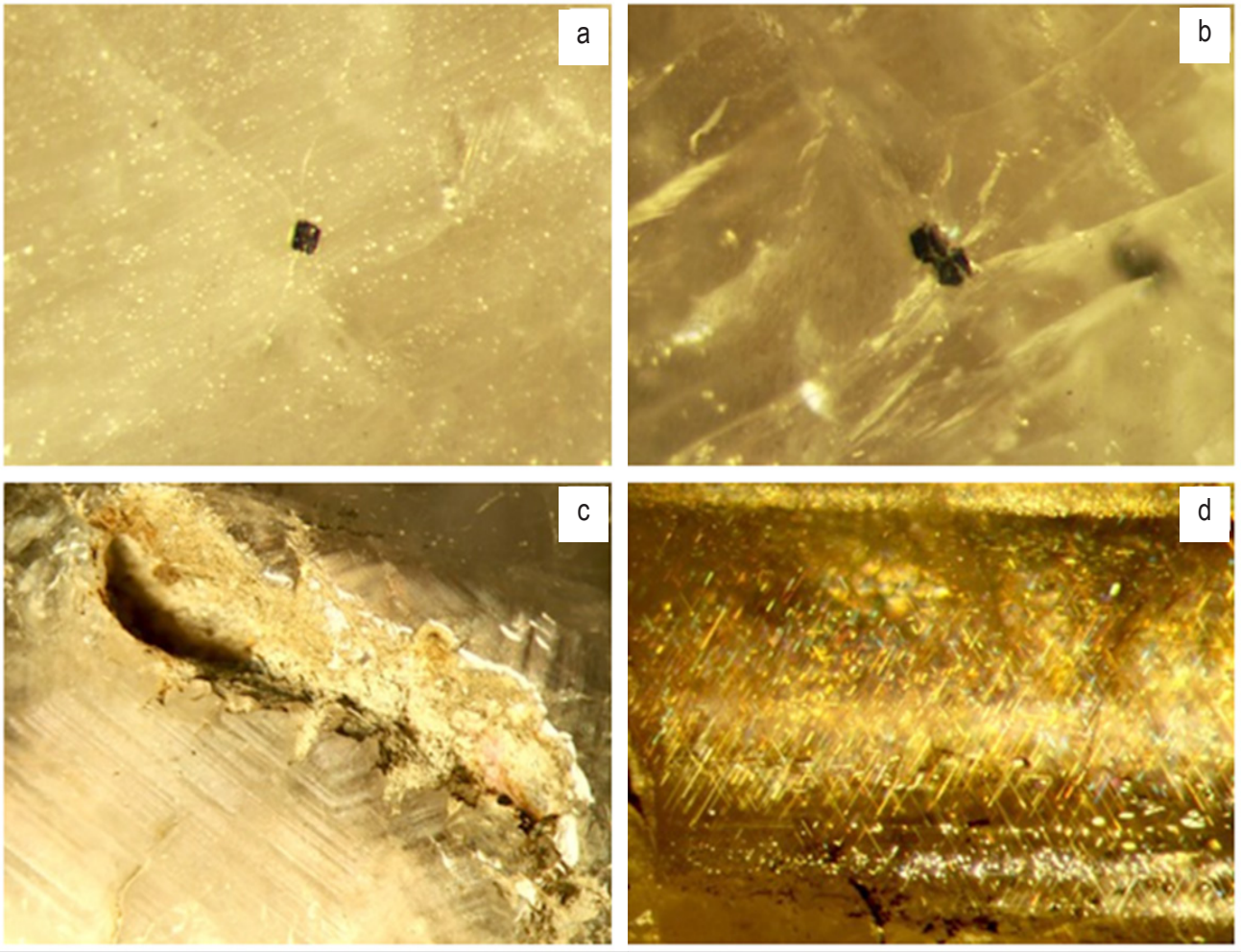

Figure 3. Oblique fiber-optic illumination showing some internal features observed in the untreated sapphire sample. (a) a cubic dark crystal of probably uraninite and (b) Subhedral dark crystals of uraninite (identified by Raman spectroscopy) accompanied by small liquid feathers (c) Nearly hexagonal growth zones with abundant minute particles (d) Very dense needle-like inclusions intersecting each other at ~60°. Photomicrographs by S. Promwongnan; Field of View 0.7, 0.9, 5.0 and 1.0 mm, respectively.

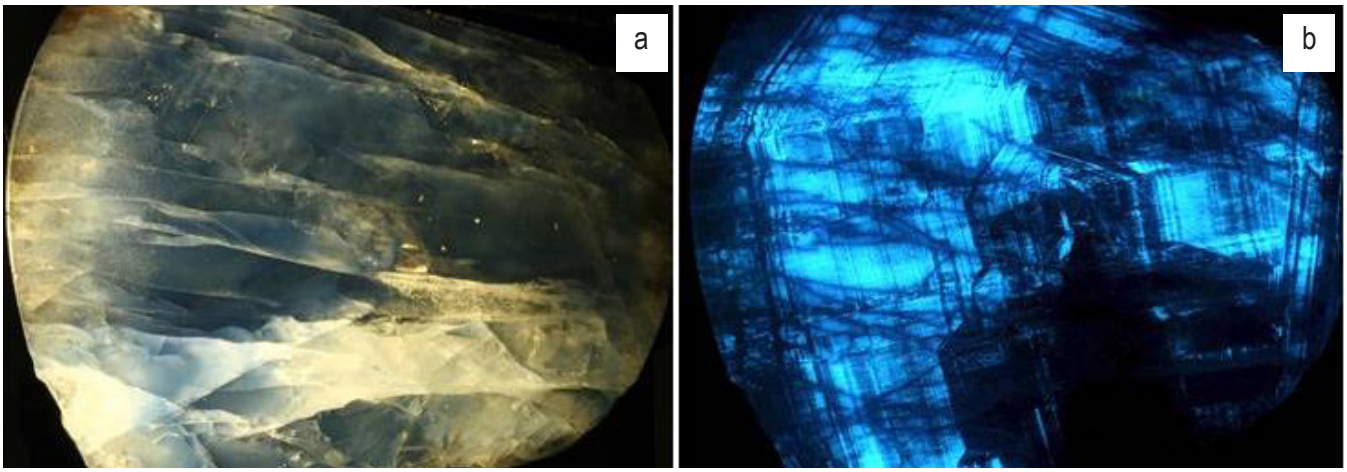

Figure 4. (a) When illuminated through the side, this heated sample shows uneven blue and white colour zoning (b) Strong internal growth zoning can be observed clearly under Diamond View. Photomicrographs by S. Promwongnan; Field of View 14.3 mm.

The heated stone showed uneven colour zoning (Figure 4a), fingerprints, melted crystals, and tube-like inclusions. Growth zone of this sample was obviously seen as fluorescence image under Diamond View™ (Figure 4b).

UV-Vis-NIR Absorption Spectra

The non-polarized UV-Vis-NIR spectrum (Figure 5) of the treated sample showed strong Fe^{2+} /Ti^{4+} Intervalent Charge Transfer (IVCT) absorption bands (combination of e- and o-rays) peaked at ~580nm, typical of blue sapphire from metamorphic origin. The untreated stone, however, revealed rather similar but much weaker Fe^{2+} /Ti^{4+} IVCT bands as compared with the treated one. The strong blue body coloration of the treated sample is likely to be due to the dissolution of minute (rutile) particles and the bleeding (internal diffusion) of rutile needles into the host lattices.

Chemical Composition (EDXRF)

Semi-quantitative chemical analyses of the untreated sample gave 0.12 wt % Fe_2O_3, 0.01 wt % Cr_2O3, 0.05 wt % TiO_2, 0.02 wt % V_2O_5, up to 0.02 wt % Ga_2O_3. The heated stone, however, showed rather similar amount of trace elements, except TiO_2 content (0.13 wt % Fe_2O_3, 0.01 wt % Cr_2O_3, 0.12 wt % TiO_2, 0.03 wt % V_2O_5, up to 0.02 wt % Ga_2O_3), probably due to the dissolution of Ti into the host lattice by heat treatment. More over these chemical fingerprints match very well with the GIT database of sapphire samples from Sri Lanka.

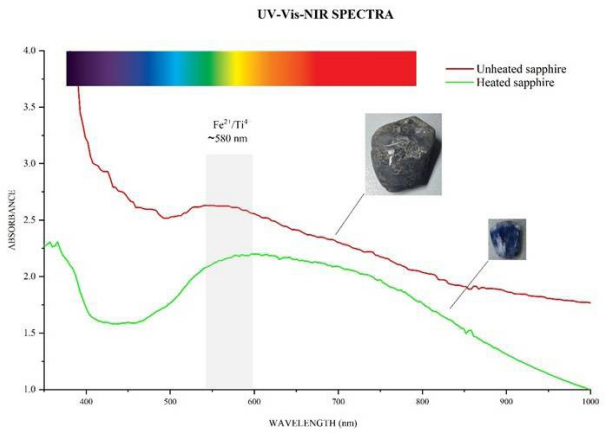

Figure 5. Non-polarized UV-Vis-NIR absorption spectra of the sapphire samples from Sri Lanka. The spectrum of the heated sample (green) shows much stronger Fe^{2+}/Ti^{4+} IVCT bands than the untreated one (red).

Final Remarks

Lithologically, the original specimen is indeed a huge, poorly sorted, water-worn boulder of homogeneous corundum crystal aggregate. The acid drop testing showed effusive bubbles, indicating the probably in filling carbonate matrix. Uraninite and rutile inclusions are still not enough for interpretation of the origin of the corundum crystals. The source of the stones can be both metamorphic or contact intrusive rock types. Further advanced analyses are required. However, a specimen of this size should not have travelled far from its primary deposit. The nearby alluvial deposits could be the prospected area for this type of star sapphire. This analyzed data can be used as representative characteristics of the Kahawatta star sapphires from Sri Lanka.

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B.B.C - News release, August 2021 IN COLOR (ICA Journal) - The Serendipity Sapphire, September 2021

Think Tank

The Coloured Gemstones Working Group, is a collection of leading luxury brands and large-scale mining companies, commissioned to demystify the complex, traditional and skill-rich coloured gemstone sector, and to explore how the sector can develop in line with rising expectations for responsible sourcing. In this excerpt, they discuss Sri Lanka.

Letting It Shine: Governance for Equitable Coloured Gemstone Supply Chains

River Gems (Photo by Deborah Craig)

Sri Lanka has produced coloured gemstones for centuries. It is most famous for its sapphires, and it also produces rubies, cat's-eye chrysoberyl, spinel, garnet, beryl, tourmaline, topaz, quartz and many more gemstones besides. The island's geological journey was uniquely well suited to the formation of coloured stones, so modern Sri Lanka is rich with alluvial gravels containing precious gems.

The alluvial nature of the deposits makes them easily accessible to artisanal and small-scale miners. The vast majority are mined by small groups using open-pit methods and basic tools, often as a form of seasonal income that supplements agricultural work. Mechanised mining and river mining also take place, but only in a few locations. Out of 6,500 mining licences issued in 2013, over 6,000 were for pit-mining operations.[1]

This preponderance of licence awards to small-scale mines is not through lack of interest from mechanised operations. Mechanised licences are highly restricted. They are typically only issued when traditional methods are unsuitable for the deposit, the concentration of stones makes traditional methods economically unviable or if the deposit needs to be mined quickly due to the threat of illegal mining.

Many trade and regulatory bodies in Sri Lanka disfavour large-scale mining. In addition to the livelihoods benefits that artisanal and small-scale mining can bring, and the knock-on benefits for local traders and gemstone manufacturers, whom the government is keen to protect economically, some consider artisanal and small-scale mining a more environmentally-friendly method of extraction. The Sri Lankan authorities implement relatively strict environmental controls for small miners, including holding a deposit for each pit mine to ensure that it is filled in again once it has been exhausted. According to an article by GIA, this measure has ensured that a relatively small number of old Sri Lankan mining pits are left unfulfilled and the end of their lives, compared to the situation in many African countries.

Sri Lanka also sets clear parameters for how gemstone mining revenues should be shared. 35% of gemstone income goes to miners, 35% goes to financiers, 20% goes to landowners and 10% goes to licence holders.[2]

Sri Lanka's focus on small-scale local mining enjoys political support at the highest level, as the Sri Lanka Gem and Jewellery Association attests. It states prominently on the welcome page of its website: "President's strict directive to the government officials: Keep foreign companies out of the local gem mining industry".[3]

Open Pit Mining
(Photo by Geoff Dominy - Copyright World Gem Foundation)

Open Pit Mining - Ratnapura (Photo by Cecilia Chiappai - Copyright World Gem Foundation)

Shaft Mining (Photo by Cecilia Chiappai - Copyright World Gem Foundation)

Looks can be deceiving. (Photo by Cecilia Chiappai - Copyright World Gem Foundation)

Washing the illam (Photo by Cecilia Chiappai - Copyright World Gem Foundation)

Washing the illam (Photo by Cecilia Chiappai - Copyright World Gem Foundation)

Sorting (Photo by Cecilia Chiappai - Copyright World Gem Foundation)

Political support for the local gemstone industry is reflected in government policy toward the sector. Gem and jewellery products do not incur import and export taxes, and cutters, polishers and jewellers do not have to pay income tax. The government has supported local cutters and polishers with training over many years, so the country now boasts 20,000 skilled craftspeople in the sector.[4] Through these measures, the government prioritises the health and growth of the industry over its potential to support the national budget – choosing economic vitality first and foremost. It also promotes Sri Lankan gemstones in overseas markets, through the National Gems and Jewellery Authority and the Export Development Board. Partially as a result of this wide-ranging government support, Sri Lanka today is one of the world's foremost hubs for gemstone processing. The country cuts and polishes stones from East Africa and many other sourcing locations worldwide, alongside its domestically-mined stock.

Governance in the Sri Lankan gemstone sector is praised by many observers, and the information presented above suggests that it works well because each entity affected by the coloured gemstone sector is adequately incentivised to abide by the governance mechanisms that are in place. The miners, financiers, landowners, and licence holders at mining pits all receive an agreeable share of income for their participation, and traders, cutters and polishers are not overly burdened by taxes and red tape that would otherwise entice them into smuggling.

Gem Cutting
(Photo by Cecilia Chiappai - Copyright World Gem Foundation)

However, the benefits of Sri Lanka's gemstone policies are not felt universally. The country's 'light touch' bureaucracy and taxation systems incentivise East Africa traders to ship rough stones to Sri Lanka for processing, rather than to attempt to have them cut and polished locally. In Madagascar, for example, virtually all sapphires are shipped – usually smuggled – to Sri Lanka and to Thailand. Thailand has a similar policy environment to Sri Lanka. Because stones typically leave Madagascar rough and uncut, most of the value of Malagasy stones flows to craftspeople overseas.[5]

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Excerpt from Letting It Shine: Governance for Equitable Coloured Gemstone Supply Chains

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Culture Club

In ‘Culture Club’, Gemstone Detective Kim Rix looks at the Navaratna Ring, what it means and why even today it has cultural and spiritual significance.

Nine Gems - Navaratna

Navaratna Ring (Photo by Kim Rix)

On your visit to Sri Lanka, you will almost certainly come across the term ‘Navaratna’ – a Sanskrit word meaning ‘nine gems.’ Navaratna is a piece of jewellery set with a combination of nine gemstones, which ancient astrology connects with nine astronomical bodies.

Though the origins of Navaratna jewellery are uncertain, the association of gemstones with the stars, moons and planets is found in ancient Hindu texts.

The Navaratna has cultural significance across India and south-east Asia, where its gems are believed to harness the positive characteristics and ward off the negative energies of the nine major celestial bodies in Hindu astrology. Belief in the power of the Navaratna is common to many religions, including Hinduism, Buddhism, Jainism and Sikhism.

Astrologists believe that the position of the stars and planets at our birth affects the course of our life. Because of this, the arrangement of the gemstones in each piece of Navaratna jewellery is significant. Ruby, which represents the sun, tends to be found at the centre of the arrangement, though in Sri Lanka, the central gem is often pearl – the moon.

Many people who wear the Navaratna will consult an astrologer before having the stones set in an arrangement that is considered particularly lucky for them.

Traditionally, gems used in the Navaratna should have good clarity. Gemstones that are cracked or significantly flawed are thought to block the passage of light through the gemstones and so weaken – or even reverse – their positive effects.

The gemstones of the Navaratna can vary depending on the country. In Sri Lanka, the gems and the planets associated with them are as follows:

Gem Planet Characteristics

Data	Planet	Characteristics
Padparadscha Sapphire	Sun	Power and success (or ruby)
Pearl	Moon	Spirit and emotion (or moonstone)
Ruby	Mars	Strength and Courage
Diamond	Venus	Beauty and harmony (or white sapphire)
Yellow Sapphire	Jupiter	Knowledge
Blue Sapphire	Saturn	Prosperity, good health and fame
Emerald	Mercury	Intelligence, (or green tourmaline) communication and humour
Hessonite Garnet	Rahu	Fearlessness, clarity and spiritual growth
Cat’s Eye Chrysoberyl	Ketu	Liberation, enlightenment and spirituality

* Rahu and Ketu are spirits or demons who appear in Hindu, Buddhist and Jain texts. Rahu embodies the solar eclipse and Ketu the lunar (or in astronomical terms, the ascending and descending lunar nodes).

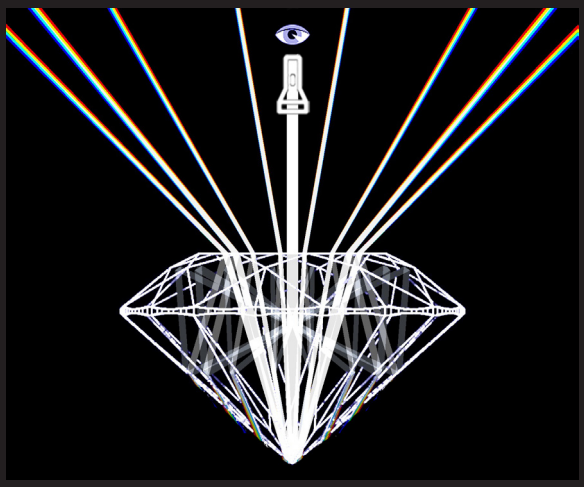
Upon Reflection

MICHAEL COWING continues his series on light performance by investigating the history of various instruments that have been used to analyze gemstone reflection patterns and their connection to reverse ray tracing.

History and Utility of Gemstone Reflection Pattern Generation and Analysis

ABSTRACT

The greater utility of a gemstone's spectral reflection pattern and its significance is realized with the observation that its generation is the same process as reverse ray tracing from the eye of an observer viewing the gem face-up. In the process of reverse ray tracing, the same ray/beam light source is sent into the gem from the observer's eye, along the gem's axis and perpendicular to its table resulting in the same spectral pattern radiating from the gem onto a flat screen or hemisphere.



A gemstone's reflection pattern is produced by illuminating it with a narrow beam of light entering through a hole in a white card (or other flat screen). The beam enters parallel to the gem's axis, and perpendicular to its table. After two or more internal reflections the beam emerges as a pattern of many tiny spectrums reflected and refracted back onto the white card.

In the third part of the round brilliant light performance trilogy, titled 'Diamond's Spectral Constellation', the diamond's spectral reflection pattern was utilized to complete the analysis of features of brilliant cut diamond light performance.

The features of best/ideal diamond cutting were studied and analyzed in 'Round Brilliant Cut Beauty and Light Performance Parts 1 and 2'. That study and analysis employed 'reverse ray/beam tracing' through the crown's many 'virtual facets', that are the tiny windows, much more numerous than actual facets, from which radiate the diamond's brilliance, fire and sparkle, which are reflected to the observer from points in the diamond's surrounding illumination.

The spectral reflection pattern of Figure 2 was generated by the setup of Figure 1, which utilized the narrow beam of light from the sun projected through a hole in a white board. The many emerging spectra, one from each virtual facet in the crown, are projected back on the white board, producing the diamond's spectral reflection pattern.

Study and analysis of gem beauty/optical performance, employing various versions of instruments that generate a gem's reflection pattern in all faceted gemstones, not only in diamond, is to be found in faceting and gem cutting literature going back at least to 1916.

This article investigates the history of methods of gemstone reflection pattern generation. It examines their usefulness in judging and analyzing gem cut design and cut quality. A central question addressed is: 'Using a gemstones reflection pattern, what conclusions and determinations have been made or can be made about gem cut design and cut quality?' This question is answered in new and greater depth made possible by recognition that the spectral reflection pattern is the same pattern produced by a ray/beam sent in reverse of normal light travel, from an overhead observer's

Figure 1. Setup to generate and photograph a diamond's Spectral Reflection Pattern utilizing a beam of light from the sun

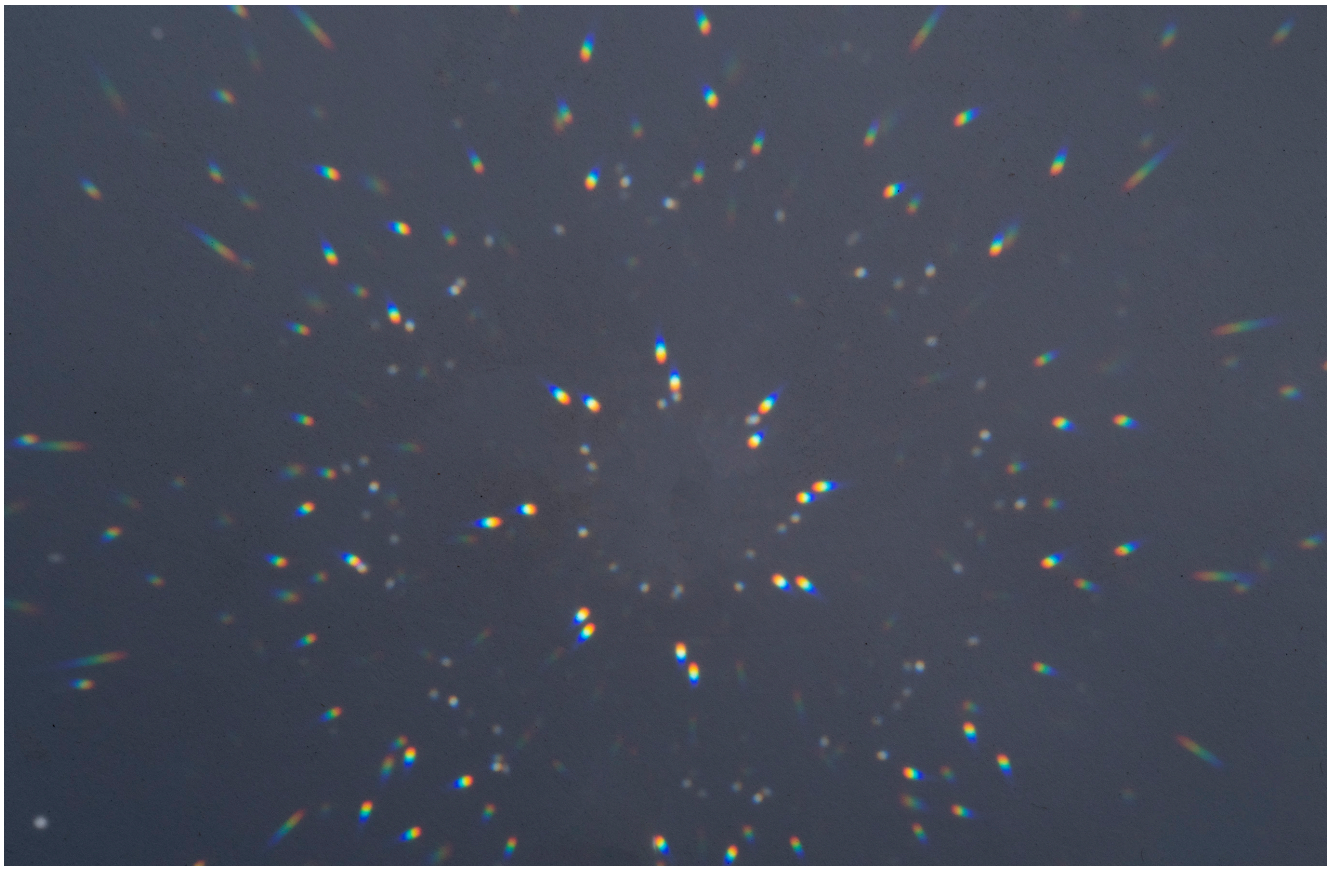


Figure 2. Spectral reflection pattern of a GIA Excellent and AGS Ideal Brilliant Cut Diamond.

eye, along the gem's axis, and entering perpendicular to its table. This results in the same spectral reflection pattern radiating from the gem onto a flat or hemispherical white surface. Thus, the spectral reflection pattern, and the reverse ray trace reflection pattern from an overhead viewer's eye are seen to be one and the same.

In his 1916 book, 'Diamonds: A Study of the Factors that Govern their Value', we find Frank Wade discussing comparing the 'fineness' of diamonds through their constellation of prismatic (spectral) colors. He recommended holding two diamonds in direct sunlight and throwing 'the prismatic colours from each onto the same opaque white card held in the direction of the sun' in order to ascertain the diamond with 'the most attractive group of coloured images'.

A similar version of spectral reflection pattern generation, also using the sun's rays, is discussed by Marcel Tolkowsky in his famous treatise from 1919, 'Diamond Design'. There he says: 'that the diamond owes its extraordinary 'fire' to its very high dispersion (the greatest of all colourless gem-stones). The effect of refraction in a diamond can be shown very interestingly as follows :-- A piece of white cardboard or fairly stiff paper with a hole about half an inch in diameter in its centre is placed in the direct rays of the sun or another source of light. The stone is held behind the paper and facing it in the ray of light which passes through the hole. A great number of spots of the most diverse colours appear then upon the paper, and with the slightest motion of the stone some vanish, others appear, and all change their position and their colour. '

Discussion of later versions of gem reflection pattern analysis that were used to examine light performance, not only in diamond, but in all faceted gemstones, appears fourteen years later in the German gem literature in the book published in Leipzig, Germany in 1933 by Dr. W. Fr. Eppler titled 'The Diamond and its Processing'. There in the section titled 'The theory of the diamond cut', Eppler describes a gem reflection analysis instrument by Siegfried Rosch constructed to test gem brilliance. According to Eppler, the apparatus, called the 'reflectograph' (Figure 3) 'is based on the principle of reflectography.'

The spectral reflection pattern is recorded with the reflectograph by one of two methods shown in the schematic diagrams Figures 4 and 5. Figure 4 illustrates use of the reflectograph to record the spectral constellation pattern on photographic paper in the flat plate cassette labeled P. Eppler says 'the light from the lighting tube L passes through the plate P from behind through a hole and hits the stone in the direction of axis A to reflect the reflection pattern back on the plate.' Figure 5 illustrates use of the reflectograph to record the reflection pattern on photographic paper in the removable cylinder Z, in which photographic paper is lying. 'The choice between both methods is optional, and the change can be done easily.'

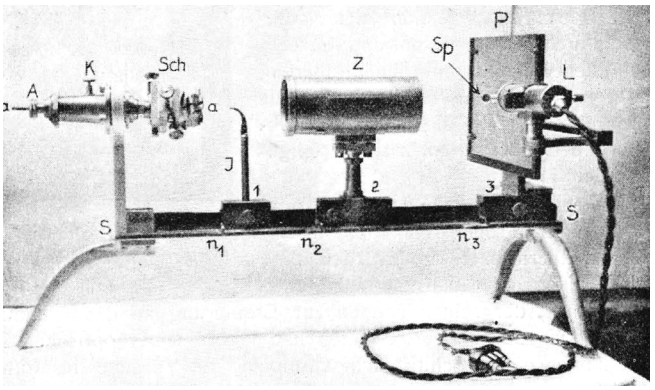


Figure 3. Van S. Rosch reflectograph for measuring brilliance.

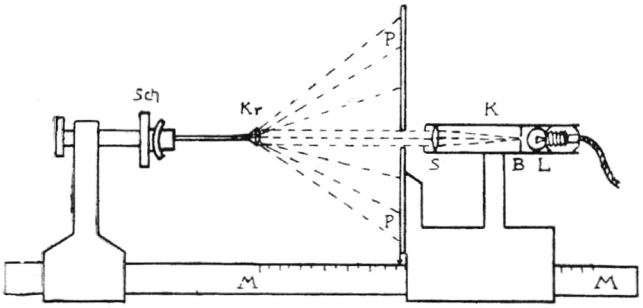


Figure 4. Schematic of the reflectograph. In this arrangement a beam of light illuminates the stone through an aperture in the photographic plate P, which records the spectral constellation reflection pattern.

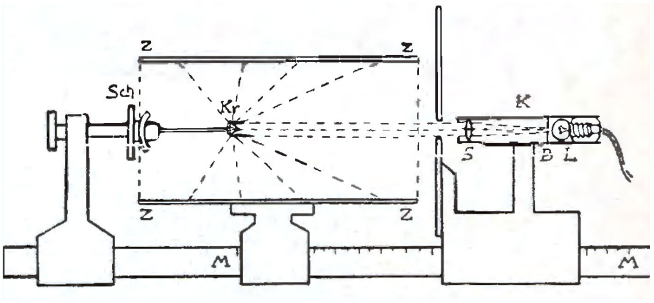


Figure 5. Schematic of the reflectograph arranged to record the spectral constellation pattern on photographic paper in the cylinder Z.

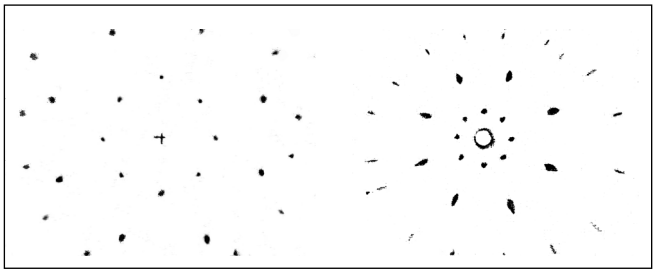


Figure 6 (L). Reflection pattern from the crown of a red garnet recorded on photographic paper in the plate P by the reflectograph in the Figure 4 configuration. Figure 7 (R). Reflection pattern of a deep blue sapphire, brilliantly ground (very regular) recorded on photographic paper in the plate P by the reflectograph also in the Figure 4 configuration.

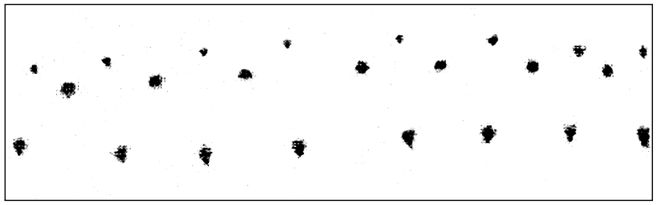


Figure 8. Reflection image from the sapphire of Figure 7. This is a cylinder projection in the reflectograph arranged in the Figure 5 configuration recording the spectral reflection pattern on photographic paper in the cylinder Z.

Figures 6 and 7 are the reflection patterns from the crowns of a red garnet and a deep blue sapphire recorded on photographic paper in the plate P by the reflectograph using the configuration diagrammed in Figure 4. Figure 8 is a cylinder projection from the reflectograph of the sapphire of Figure 7 using the Figure 5 configuration, and recording the spectral reflection pattern on photographic paper in the cylinder Z.

Eppler further says: 'There is still a second apparatus for the examination of brilliance in the trade, which ... can be used to do a simple comparison of two gemstones. This is the 'Brillantoscope' by A. Johnsen (Figure 9). The apparatus is based on the same principle as the Reflectograph from S. Rosch.' However, the 'Brillantoscope' is equipped with two hemispheres for a better side-by-side comparison of the reflection patterns of the two stones.

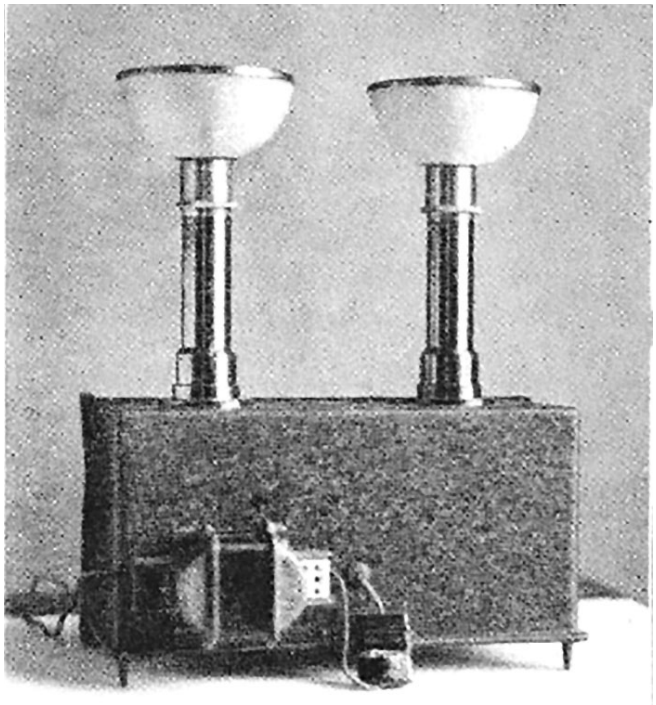


Figure 9. Brillantoscope by A. Johnsen for the examination of cut quality.

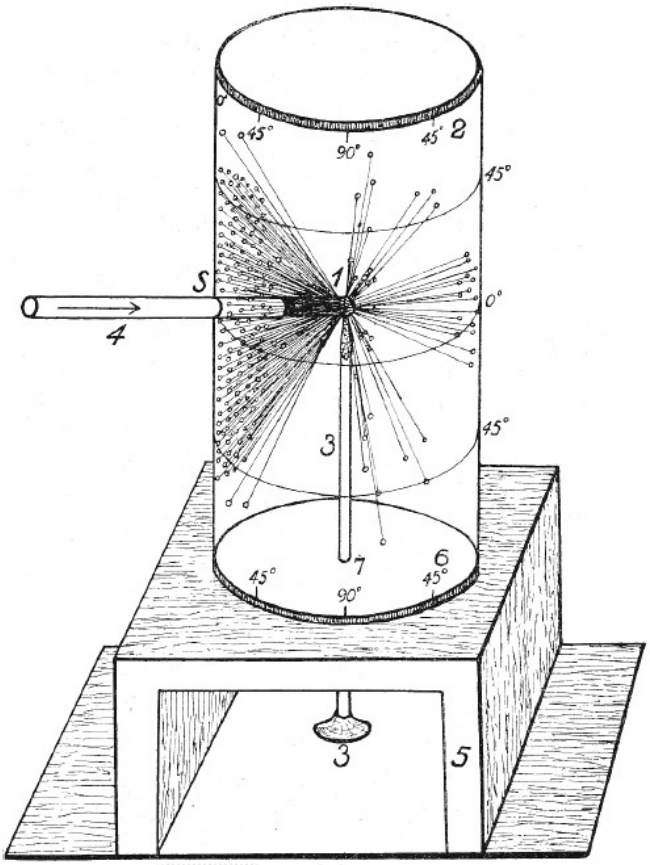


Figure 10. The 'Brillanzoskop' (trans: brilliance-scope) 1 diamond; 2 screen; 3 stone carriers; 4 radiant tube.

Sixteen years after Eppler's book, Dr. Wilhelm Maier published his treatise 'Diamonds and pearls' in 1949 in Stuttgart, Germany. In a section of his book titled, 'The Brillanzoskop' (trans: brilliance-scope), Maier says this instrument tests the diamond's brilliance. He says: 'All the brilliance scopes built up to now are based on the intention of making the external and internal reflections, produced by a bundle of light incident parallel to the axis of the gemstone cut, visible on a screen. Johnson used a frosted glass hemisphere as a screen, while Rosch, in order to be able to carry out measurements, used plates and cylinders, the axis of which is aligned with the incident light. Brilliance scopes or brilliance meters of the type Figure 10, prove to be even more suitable.'

The example reflection diagram in Figure 11 is generated by the Brillanzoskop of Figure 10. It is the reflection pattern from the crown of an imitation of the 'Star of Este' diamond.

A couple of decades later, gemstone reflection patterns were demonstrated to the gem faceting community in the United States by Bob Long, co-inventor with Norman Steele, of

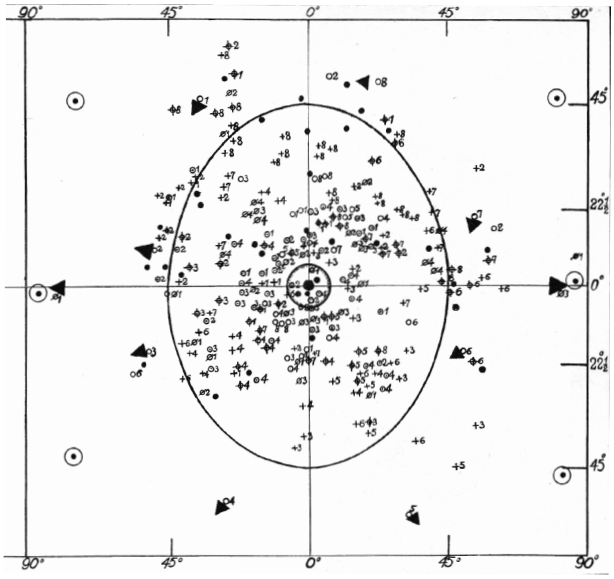


Figure 11. Drawn Brillanzoskop reflection diagram of the crown view of an imitation of the 'Star of Este' diamond.

meet point faceting, and reproducible computer aided gem facet design. Long's reflection patterns were generated in the usual manner similar to that of the Figure 4 reflectograph configuration. Bob demonstrated a version of the technique of gemstone reflection pattern generation at United States Faceters Guild meetings. His setup, which was published in the July, 1986 Seattle Facetor Design publication, is diagrammed in Figure 12.

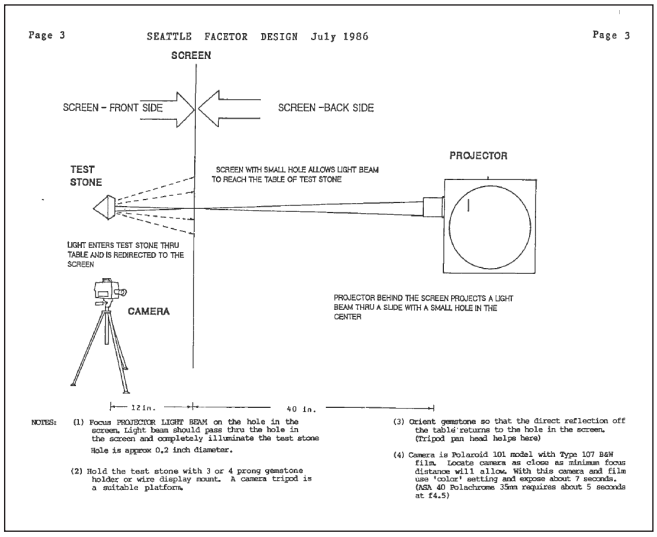
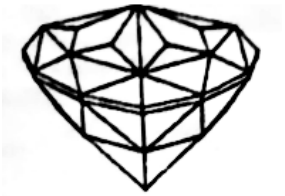


Figure 12. Bob Long's demonstration setup to generate a gemstone's on axis reflection pattern

Figure 14 is Long's computer generated reflection pattern of the shield facet cut design diagrammed in Figure 13.

Bob Long asked: 'Can we relate the Light Reflection Pattern (LRP) to observable features in gemstones?' What conclusions and determinations about gem cut design and cut quality can be or have been made from studies of a gemstone's reflection pattern?



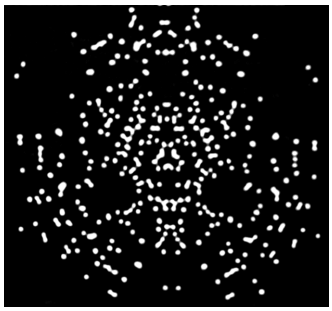


Figure 13. Shield shape, London Shield cut design. Figure 14. Computer generated reflection pattern of Figure 13 shield design.

Al Gilbertson, member of the GIA research team that studied and modeled the 'Appearance of the round brilliant cut diamond,' including 'An Analysis of Fire', responded to Bob Long saying: 'The LRP may be a representation of the fire pattern if the fire generated by a stone is strong enough in the environment to be viewed by an observer.'

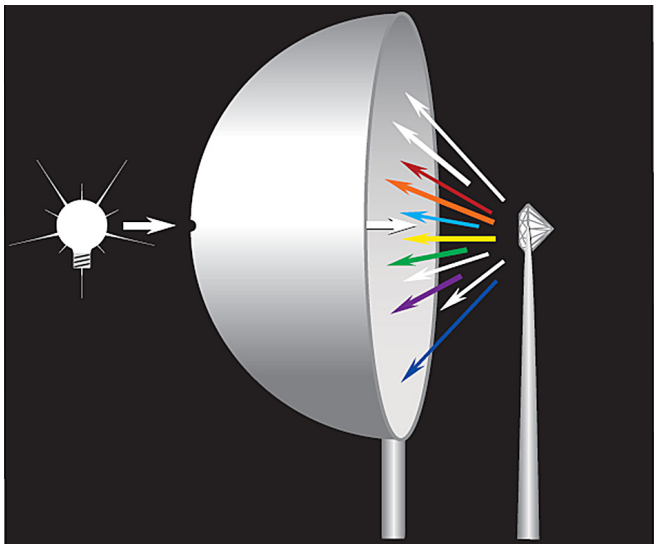


Figure 15. Setup to study fire by generating and projecting a diamond's spectral reflection pattern on a hemisphere, as A. Johnsen did with his Brilliantoscope. Courtesy of GIA

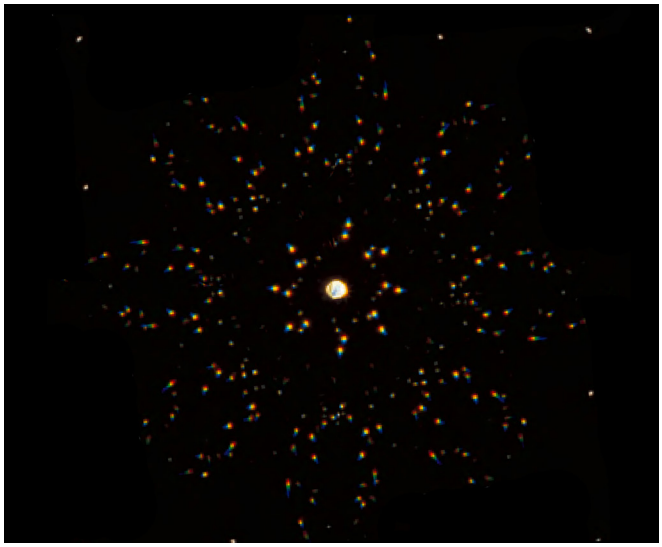


Figure 16. Spectral Reflection Pattern from a GIA Excellent cut diamond, created from a quadrant of the pattern photographed by Al Gilbertson. Courtesy of GIA

He went on to say, 'a German mineralogist, A. Johnsen, developed a Brilliantoscope, (See Figure 9) to back his findings of which angles produced the best stones. He placed a diamond in each of the two globes and their patterns were compared to determine which was better. GIA also used this approach (reflection pattern projection on a hemisphere) to study fire and develop metrics for fire in diamonds.' The experimental design (Figure 15) allowed GIA to observe dispersed light from actual diamonds. Figure 16 is the spectral reflection pattern of an Excellent/Ideal cut diamond photographed by Gilbertson in the hemisphere.

Conclusions of cut quality and beauty/light performance gained from study of spectral reflection patterns

These reflection pattern generation methods and instruments, from Wade and Tolkowsky to the present, all generate a gemstones on-axis reflection pattern.

Historically, the reflection pattern was mainly used to judge or validate the symmetry and cut perfection of a gem's design and faceting. A symmetric reflection pattern was pointed to as evidence of excellent gem symmetry and cut quality. The unique reflection pattern of each gem has also served as a form of identification, as, like a fingerprint, no two patterns are exactly the same.

Because each wavelength (spectral color) of light follows the same path in either direction, it is proven that each tiny spectrum is the location being reflected to the observer's eye from one of the many virtual facets that comprise the diamond's crown.

The optical analysis using reverse ray tracing in the three study articles provided answers to why the round brilliant Ideal cut's small range of angles and proportions are superior in beauty and light performance to diamonds cut with parameters outside these best ranges. This trilogy of articles has shown why the 'Ideal Cut's' three most important parameters; the crown and pavilion main angles and lower half length, in proper combination with the other four defining parameters, result in the best/ideal round brilliant beauty/ light performance.

Because of the equivalence of spectral pattern generation, and reverse ray tracing from the face-up viewer, both of which generate the same spectral reflection pattern, they both can be used together, furthering the analysis and evaluation of gem design and cut quality accomplished in the three previous articles. In a follow-on article, methods will be shown that augment use of the spectral reflection pattern through identification of the particular virtual facet that corresponds to each individual spectrum.

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Learning Curve

NINA ZOLOTUKHINA knows that cabochons are not the easiest gems to identify but with a little perservance and some gemmological savvy, she is confident that you too can master the art of testing cabochons!

The Challenge of the Cabochon

Rings with cabochons from Rhodonite, Moss Agate and Charoite (Photo by Nina Gold)

In this article I would like to set out basic testing methods for cabochons including certain aspects, connected to their examination that you should always keep in mind when dealing with them.

Before I start, let's look at what we mean by cabochons. According to Wikipedia, a cabochon (caboche 'head' from French language) is a gemstone that has been shaped and polished, as opposed to faceted. The resulting form is usually a convex (rounded) obverse with a flat reverse.

Cutting en cabochon (French: 'in the manner of a cabochon') is usually applied to opaque gems, while faceting is typically applied to transparent stones.

The 'Cabochon Cut' is believed to be the first and oldest method of gemstone shaping and was widely used in ancient cultures. For example, in Ancient Egypt (1330 BC), it was popular to use cabochons made from turquoise, lapis lazuli and carnelian. Assyrians used agates, carnelian, coral, and turquoise in their jewelry, while the Mughal dynasty that existed more than 5000 years earlier, used a wide variety of gemstones in their jewelry, such as – emerald, ruby, turquoise, coral, lapis lazuli, amber and carnelian.

Fast forward to modern times and cabochons are still fashionable and in demand. While typically associated with lesser valued gemstones (what used to be termed semi-precious) such as turquoise, charoite, rhodonite, agate, rose quartz, moss agate, lapis lazuli, coral, amber, larimar, moonstone, jasper and others), we now find magnificent cabochons in the latest collections of Bvlgary, Cartier, Van Cleef & Arpels, Graff, Tiffany and other high jewelry brands.

Cabochons in Tutanhamun's Pectoral (Museum of Cairo, Egypt)

Cabochons in Assyrians jewelry (British Museum)

Cabochon cut Labradorite and Adular called Moonstone
(Photo by Nina Gold)

These include aquamarine, kunzite, prehnite, kyanite, ruby, sapphire, emerald, tourmalines and richly colored garnets.

While in ancient times oval and round shaped cabochons were most common, today we see a wide variety of shapes that include more complicated fantasy shapes.

Although the cabochon cut is usually used to emphasize the color of a gemstone, it can also be used to highlight various optical effects, such as asterism or chatoyancy, to minimize the appearance of unsightly inclusions or to accentuate interesting inclusions such as rutile needles, dumortierite, pyrite and others.

From an identification standpoint, cabochons can be tricky. This is not only because of the domed surface (which makes taking an R.I. challenging) but also due to the wide variety of materials used including natural gemstones, artificial materials (such as glass, plastic, and ceramics), assembled stones (doublets and triplets) and dyed stones (such as low-quality quartz colored with green dye to imitate emerald or jade or dyed magnesite or howlite sold as turquoise).

Rutile inclusions in Quartz cabochon (Photo by Nina Gold)

Cabochon necklace by Bvlgary (Courtesy of Bvlgary)

Cabochon cut Emerald in Cartier ring (Courtesy of Cartier)

So what testing instruments can we use to examine cabochons?

1. Loupe with 10x magnification
2. Polariscope
3. Refractometer
4. Immersion
5. Microscope
6. Scales
7. Ceramic Streak Plate
8. Hardness Pencils
9. Diamond Tester
10. Color Filters
11. UV light
12. Magnetism

13. Spectrometry methods (VIS VS NIR, Raman and other spectrometry methods)

Where do we start?

I always start with 10x magnification, paying particular attention to:

1. The presence of surface scratches (indicative of softer materials).
2. Uniformity of color (indicating perhaps that the material is man-made).
3. Colour swirls and rounded or torpedo-like gas bubbles and veils (indicative of man-made glass).
4. Surface reaching fissures containing concentrations of color (indicating the material has been dyed).
5. Uneven or zoned coloration (typically found in natural gemstones).
6. Coatings applied to either the surface of the cabochon or the base to accentuate color or an optical phenomenon.
7. Evidence that the cabochon has been hollowed out and filled with artificial material to improve the overall appearance.

Dark colored varnish on the back side of Baltic Amber (Photo by Nina Gold)

Dyed Quartz imitating Jadeite (Photo by Nina Gold)

Polariscope

Depending on the transparency of the material, the polariscope can be very useful in helping us differentiate between singly and doubly refractive gemstones, whether they are uniaxial or biaxial, amorphous (glass), exhibit ADR (anomalous double refraction due to internal strain), microcrystalline (chalcedony), polycrystalline (jade) or quartz (with its characteristic bulls-eye optical figure). Since cabochons act like condensing lens, finding the interference figures is often easier in transparent to semi-transparent gems compared to faceted stones.

Refractometer

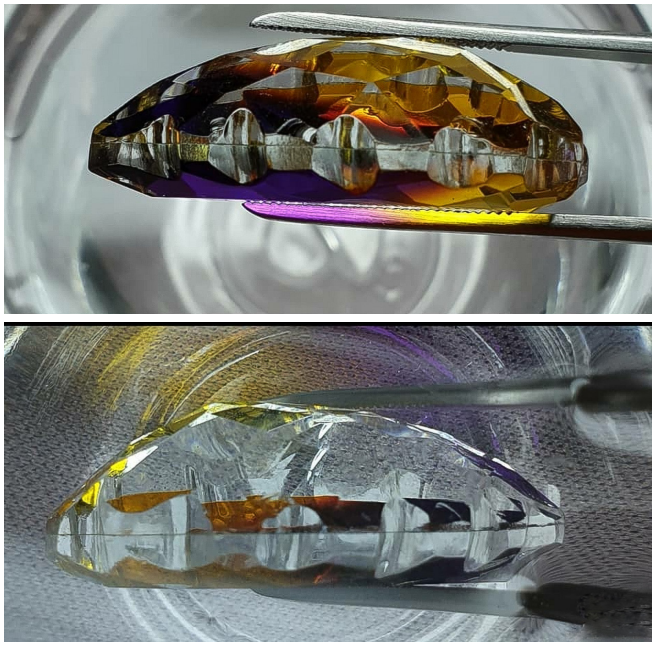
Unlike faceted gemstones, a different technique must be used when testing cabochons. Here we will use the 'Spot' method to determine the refractive index of a gemstone.

Firstly, we must make sure the refractometer glass prism is clean before applying the smallest possible drop of R.I. liquid. If the drop is too large, most of it will spread beyond the view of the refractometer. Rest the cabochon with the curved or domed side on the R.I. liquid spot. View from 30 to 45 cm away without using the polarizing filter. Locate the spot in the eyepiece. Move your head up and down until half of the spot is dark and half is light. The R.I. at the meeting line of the dark and light drop image indicates the R.I. of the stone.

When the spot is all light, the R.I. of the stone is lower. When the spot is completely dark, the R.I. of the stone is higher. While the distant or spot method will require patience and practice, once you have mastered it, you will understand all the advantages it has to offer.

The spot method is especially useful while trying to separate jadeite jade from the lesser expensive nephrite jade and chrysoprase (a microcrystalline variety of quartz). If the stone is extremely dark I can recommend you to use a more powerful LED light, pointing it directly perpendicular to the stone.

Doublet made of Fluorite and Glass with visible glue traces at the junction of the two materials (Photo by Nina Gold)



Doublet immersed in water (Photo by Nina Gold)

A variety of assembled stones (Courtesy of Lubomir Nakev) (Photo by Nina Gold)

Immersion

Immersion is a very good way to determine if the stone is assembled (doublets or triplets). Due to the difference between the refractive index and the immersion liquid, the components of assembled stones will often give a different appearance. Immersion can also help us detect concentrations of dye, surface coatings and colored glues used to enhance the color.

The immersion technique involves submerging the gemstone in an immersion liquid. As the refractive index of the liquid approaches that of the gemstone, the stone will become less visible due to a reduction in the effects of refraction and surface reflection. This is due to the surrounding medium, typically air, being replaced by a denser medium, the immersion liquid.

Microscope

One of the benefits of using a microscope is that we can now examine a gemstone under higher magnification. This is particularly useful when dealing with assembled stones since it will often reveal small round air bubbles located strictly in the same plane due to the layer of glue, differences in the condition of the various components of the stone (due to variances in the hardness of the different materials used) and even differences in lustre.

A microscope will also allow us to view the stone under both incidental and transmitted light so we can study the external and internal features of the stone.

Scales

A good quality scale, even a pocket scale, can be used to determine the specific gravity of a stone. All you need is a scale, a plastic cup, and a piece of thread or wire.

Firstly, weigh the stone on the scale (in air) and write down its weight. Now put a cup of water on the scale (preferrably it should be distilled water) and tare it (set a zero weight).

Tie the cabochon to the piece of thread or secure it to the wire and gently lower it into the water making sure it does not touch the sides or the bottom of the cup and write down the weight. It is important to note that this is not the weight of the cabochon but the weight of the water the cabochon is displacing. Finally, divide the weight in air by the weight of the displaced water and you will calculate its approximate specific gravity.

While the accuracy of this technique will depend on the precision of the scale and the size of the gem being tested, it can be very helpful in giving us a clue as to the identity of the stone especially is the size is 10 carats +.

Ceramic Streak Plates

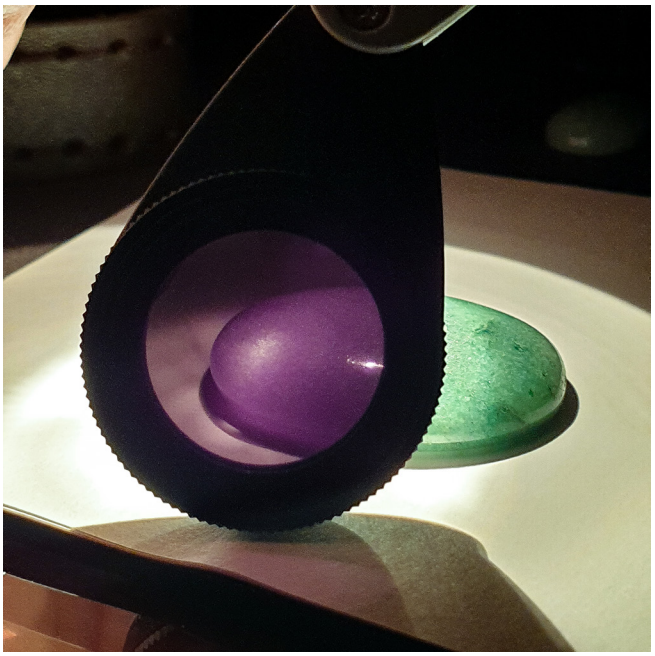
Although ceramic plates are often used for testing rough minerals, they can also be used to test cabochons (although testing should be confined to an inconspicuous spot). They can also give a clue as to the origin of its color, since many colored minerals leave colored streaks on the white ceramic plate.

Hardness Pencils

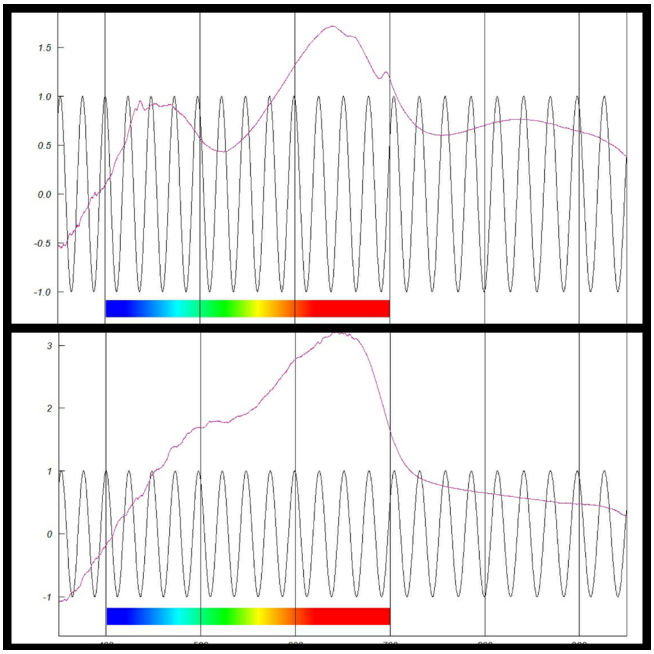
With the consent of the gem's owner, hardness pencils can help as well. Knowing the approximate hardness of a gemstone will allow us to eliminate certain possibilities and narrow down our options.

Diamond Tester

In case you can't use hardness pencils, keep in mind that a diamond tester can not only be used for diamond



Dyed Quartz using a Chelsea filter
(Photo by Nina Gold)



The difference in spectrums between Jadeite with the natural coloration (top) and dyed Jadeite (bottom)

determination. It is also useful in determining hardness. Working on the principal of thermal conductivity it can show the appreciable hardness of the stone you are working with.

Color Filters

Jadeite, Chelsea and Hanneman filters can be very helpful in detecting if a gemstone has been color enhanced. For example, jadeite, when it is dyed, appears red under the filters while naturally colored stones will be inert.

UV Light

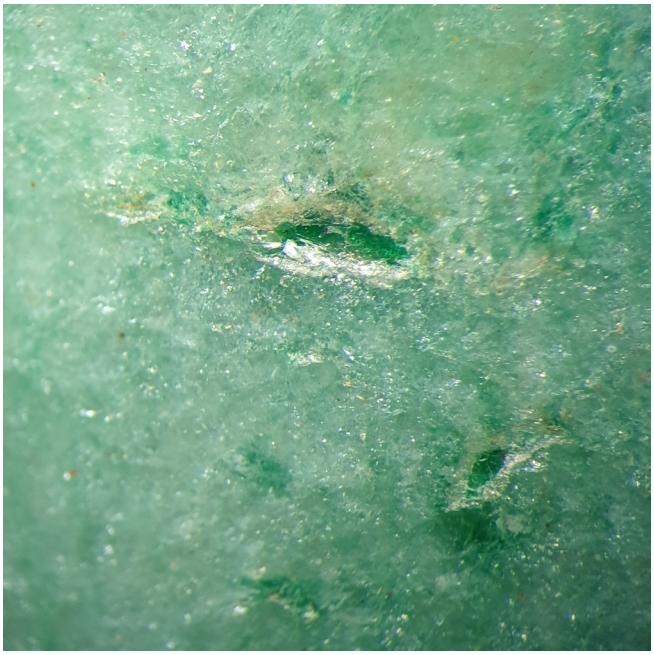
One of the advantages of using UV light is that it can be used on loose or set stones. Look for subtle or marked differences in the fluorescence of certain parts of a gemstone (indicative of assembled stones) or reactions that are characteristic of certain gemstones (natural and man-made) such as the chalky blue or chalky yellow fluorescence of glass or plastic.

Magnetism

An N52 magnet can be very useful in detecting stones that contain iron, manganese, or rare earth metals. For example, an N52 magnet will quickly help you separate almandine garnet cabochons from a parcel of red spinel cabochons.

Spectrometers

A VIS-VS-NIR spectrometer can determine the coloring agents of a gemstone and whether it is natural, lab-created, or artificial. It can be used on transparent and opaque gemstones. In the latter, you can use a xenon light source for a more intense and strong light, passing through the stone.



Dye visible in fissures that reach the surface of the stone
(Photo by Nina Gold)

A Raman spectrometer can also be used as the advanced method for the stone composition analysis, its fillers, if they are present, and the nature of its coloration.

An FTIR spectrometer will also show us if any fillers have been used for the cabochon material clarity and color enhancement.

Conclusions

While cabochons can be challenging, you can see that there is still a wide range of testing techniques you can use for data collecting. Don't panic, just pay attention to the details.

Ask yourself the following questions:

1. What is the expected mineral or material of the cabochon?
2. Is it dyed, treated or not?
3. Is it an assembled stone (doublet, triplet) or not?
4. Is it a real stone or its imitation?
5. Is this imitation natural or synthetic?
6. Is it covered with a coating?
7. Has it been restored or not?

The rules of the game may be slightly different, but the 'end' result can still be the same! I hope these tips will help you the next time a cabochon crosses your desk!

To help you to deal with cabochons in your daily routine, I have prepared a table with the general characteristics mentioned above and the ways and techniques you can use to find them out.

Abkhazian bracelet with translucent Agate and colorful underlay from color enhancement (Photo by Nina Gold)

Characteristic	Research method	What should we expect
Type and origin of cabochon material:		
• Natural stones • Lab-created stones • Natural imitations • Lab-created imitations	Balances Hardness Pencils or Diamond Tester Refractometer Spectrometer N52 Magnet	Specific Gravity Hardness Refraction Index Unique Spectrogram Magnetism
Treatments:		
• Dye • Colored or dark substrate • Fine film coverage • Waxing • Dyed glue in the junction point of the assembled stone • Folio in the junction point of the assembled stone • Restored stone • Smoked or sugar treatment (Opals) • Glass filled (Rubies, Sapphires)	Loupe & Microscope Spectrometer Immersion	Look for color zoning, dye in cracks, especially those that reach the surface of the stone or appear darker than the main body of the stone. Look for the specific spectrograms, characteristic absorption lines. Look for a difference in the coloring of the stone with the more colored zones in the center or in the sides, or in the cracks
Assembled stones:		
• Doublets • Triplets • Multi Assembled Stones	Loupe & Microscope Immersion UV light	Look for join lines and traces of glue (air bubbles located in one plane). Look for any differences in the luster or condition of the stone that may indicate it is assembled. Look for a different reaction from parts of the stone under UV light.

Pyritezed Dynobone cabochons
(Photo by Nina Gold)

Rings with various cabochons
(Photo by Nina Gold)

Various cabochons (Courtesy of Drew Durbin@stone.bender)

Synthetic and imitation cabochons (Photo by Nina Gold)

Article Submissions

- We do not accept highly scientific articles.
- 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

Deadline: May 15th, 2022
E-mail all submissions to information@worldgemfoundation.com

SPICE of Life

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.

Blues Rock - Lapis Lazuli

Rough and Polished Lapis Lazuli
(Photo Tino Hammid)

Lapis lazuli is an impure variety of lazurite and has been known and adored since antiquity. Prized for its distinct rich blue colour, it is certainly a 'unisex' gemstone, equally comfortable in men's and women's jewellery as well as objects d'art.

Etymology

The name lapis lazuli is derived from the Latin word 'lapis' for stone and the genitive form of the Medieval Latin 'lazulum', which is taken from the Arabic word 'Lazhward' meaning blue stone.

History

The mining of lapis lazuli dates to the 7th millennium BC at the Sar-i-Sang mine in the Badakshan district of northern Afghanistan.

Since sapphire was not known before the Roman Empire, most scholars agree that any reference to sapphire before this time, most likely refers to lapis lazuli. This would mean that the fifth stone on the original breastplate of the high priest in the Old Testament is lapis instead of sapphire.

Ancient Egyptians used it extensively for the burial ornaments of Egyptian kings and queens, including Tutankhamun and for jewellery, dyes, eye shadow and even medicinal purposes.

Lapis lazuli is believed to have healing powers and is said to bring inner peace and freedom of negative thoughts; lapis lazuli symbolizes friendship, brings harmony in relationships, and stimulates the desire for knowledge, truth and understanding.

During the Renaissance Period, lapis lazuli was ground and processed to make the pigment ultramarine for use in frescoes and oil painting. At that time, it was more expensive than gold. However, with the discovery of a chemically identical synthetic product, its usage as a pigment in oil paint largely ended during the early 19th century.

The artist Cenninno Cennini, from the 15th Century, described ultramarine as 'illustrious, beautiful and most perfect'. Examples of famous artists using ultramarine are Vermeer (Girl with Pearl Earrings 1665), Titian (with the Bacchus) and Van Gogh (The Starry Night in 1889).
In May 2020 researchers of the Amsterdam University, The Rijksmuseum of Amsterdam, VU Amsterdam, and the European Synchrotron Radiation Facility (ESRF) published an article in the leading journal Science Advances (How did

The Starry Night by Van Gogh (Wikipedia Commons)

Lapis Lazuli (Photo Tino Hammid)

the old masters make their ultramarine from lapis lazuli?). Their research, sponsored by Akzo Nobel, of X-rayed paint samples, revealed how the costly pigment ultramarine was prepared from lapis lazuli. This involved the removal of the mineral impurities using the laborious and time-consuming 'pastello extraction'. The procedure required the heating and then grinding of the lapis lazuli into a powder and then kneading it with a paste of resin, beeswax, and oil to create a fist-sized ball. After a week or two, the ball was 'rinsed out' under water with kneading motions. In this way, the ultramarine was released, while the impurities remained behind in the paste. After filtering and drying, the radiant, bright blue ultramarine pigment was obtained. Heating the lapis, made the paintings less prone to the feared 'ultramarine disease', in which blue sections of a painting become dull and turn grey, due in part to the chemical activity of the lazurite.

Geology

Lapis lazuli is an opaque blue rock that is formed by metamorphic action on impure limestone through contact with plutonic rocks (intrusive rocks that crystallize from slow cooling magma beneath the earth surface) causing a recrystallisation to marble. Variable grade lapis often occurs in lensoid bodies 'several hundred feet long' with the grey-white marble host up to 400 m thick.

Localities

It is primarily found in the Badakshan district of Afghanistan, but also in other localities including Russia, Canada (Baffin Island), Chile, USA, Angola, Mongolia, Myanmar (Burma) and Pakistan.

Physical and Optical Properties

Lapis lazuli is a complex sodium calcium aluminosilicate with variable amounts of sulphate, sulphur, and chlorine. The chemical composition is $(NA,Ca)_8(Al,SI)_{12}O_{24}(SO_4,S,Cl)$. At least 25 % of the composition should consist of lazurite to be called lapis lazuli.

It is often characterized by inclusions of iron pyrite and calcite. The crystal structure is isometric but nice crystals are quite rare and if found they are usually dodecahedral.

Since Lapis lazuli is opaque, most stones are cut en cabochon or in tablet form. This makes the measurement of the refractive index challenging, requiring the 'spot method'. The R.I. can range from 1.50 to 1.67. The hardness is 5-6 on Mohs scale and the specific gravity ranges between 2.50 and 3.00. It has a resinous to vitreous lustre, indistinct cleavage, and a no specific absorption spectrum.

It fluoresces pink, green, or white under S.W. UV light and has a streaked orange fluorescence under L.W. UV radiations due to the presence of calcite (particularly in Chilean material).

Lower quality lapis lazuli (with calcite inclusions) can be separated from sodalite by marked differences in their specific gravities (sodalite 2.14 to 2.40 / lapis lazuli 2.50 to 3.00). While sodalite will react in a similar fashion to lapis lazuli under L.W. UV light, it is inert under S.W. UV light.

Colour

Colours can vary from deep violet blue to royal blue to a greenish blue. The cause of the vivid blue colour is due to an anion-anion charge transfer between the three sulphur anions with increased amounts of sulphur and calcium producing a blue colour while insufficient amounts of sulphur produce a greenish colour. The blue colour can range from lighter blue to pure ultramarine.

Inclusions

As mentioned earlier lapis lazuli often has visible pyrite and calcite inclusions. A pyrite goldish sheen matrix running through the stone will increase the price per carat of this gem to a certain level, however, if the pyrite is too pronounced, it can appear dull and greenish, which decreases the price.

Since calcite is the host rock that often surrounds lapis lazuli, it is hardly surprising that it is one of the most common inclusions, however, in terms of value, its presence has a detrimental effect. Blue sodalite and traces of augite, diopside, enstatite, mica, hauynite and hornblende are also found in lapis lazuli.

Cutting

Historically, lapis has been used for carvings, as well as for bowls, vases and as inlays or for mosaic projects. For jewellery, lapis lazuli can be cut into cabochons, beads, inlays, or tablets.

Treatments and Enhancements

Due to its porosity, lapis lazuli is routinely dyed (often aniline) to improve its colour and to minimize the appearance of the calcite inclusions. It is also routinely treated with colourless paraffin wax, bee's wax, aqueous silica, oil, and colourless polymers to improve its lustre, and seal the dyed calcite. Dyed material can be detected by using acetone or nail polish remover in an inconspicuous spot.

Synthesis and Simulants

Lab-created lapis lazuli was produced by Gilson and often contained pyrite. However, since it was made from ultramarine, consisting primarily of a double silicate of aluminium and sodium, next to hydrous zinc phosphates, Gilson lab-created lapis lazuli is considered more a simulant than a 'synthetic. Compared to natural lapis lazuli, lab-created lapis is softer and decidedly more porous. If immersed in water for 15 minutes, the weight will be substantially higher. While the S.G. is much lower (1.46) compared to natural lapis lazuli (2.70 - 2.90), the refractive index is similar (1.50).

While not recommended due their destructive nature, two tests can be used to identify lapis lazuli. The first test involves applying a small drop of hydrochloric acid to an inconspicuous spot. This will result in a rotten egg smell being emitted. The second test involves using a metal pointer and applying a relative amount of pressure to the pyrite inclusions. This will cause them to crumble.

Under the Chelsea filter, natural lapis lazuli will appear a weak brownish-red, whereas lab-created lapis will not. Lab-created lapis lazuli is transparent to X-rays, while natural lapis is not.

Other common imitations include dyed magnesite, dyed jasper, dyed Howlite, and sodalite.

Cleaning and Care

As lapis lazuli is often dyed, the use of ultrasonic cleaners, steam and heat (with chemicals) are strongly discouraged.

Conclusion

Lapis lazuli is unique in the gem world since it is one of the few gemstones that is classified as a rock. Its cultural importance and its use as an important paint pigment, makes it a gemstone of historic significance. Combined with its collective appeal in both men's and women's jewellery and in decorative art, it is certain that this significance will continue for generations to come.

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For more information: https://www.uva.nl/en/content/news/press-releases/2020/05/how-did-the-old-masters-make-their-ultramarine.html

Amazing Lapis Lazuli Skateboard by Dalan Hargrave (Gemmology Today September 2018 - Copyright Dalan Hargrave)

Meet the Team

Geoffrey Dominy (World Gem Foundation) 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 fifty-three countries, is used by fourteen schools, colleges, universities and gemmological organizations as their recommended textbook and now features photographic contributions by other award winning photographers including Jeff Scovil.

In 2018, Geoff released a 5th Anniversary Printed Edition (Two Volumes) and on December 14th, 2019, released his first book in Spanish 'Gemología Para Todos' (the first 14 chapters of the Handbook of Gemmology).

He currently lives in Palma, Mallorca, Spain and in addition to lecturing and promoting his books, is the founder of the World Gem Foundation and creator of ColourWise.

Leone Langeslag (Dutch Gem Academy) 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) is half Italian and half British, and started her journey through the world of gemstones in Germany in 1984, where she studied at the Deutsche Gemmologische Gesellschaft attaining her gemmology and diamond diploma; she subsequently gained her FGA in 1986.

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

Jan Asplund (Scandinavian Gem Academy) 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 (Säterglántan 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.

Gérard Raphaël Quintin (South American Gem Academy) was born in Paris France where he studied Art and Design and graduated from Ecole Boulle. 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 gemological 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.

Marie-Hélène Corbin (Gem Academy of Canada & Gem Academy of Belgium) is an FGA gemmologist and accredited Senior Gemmologist through the AGA.

Following a busy career in real estate, she wanted to change her professional path and became interested in gemmology. This discovery of gemstones turned into a passion. Marie-Hélène studied at the EGM and successfully passed her Gemmology Diploma.

Guided by the desire to pass on her love for gems, she became the new Director of EGM in 2016, with a strong desire to modernize the school. As a teacher, she instills in her students the desire to learn more about the world of gemstones.

This passion for gems does not stop there, and Marie-Hélène created Quebec's first independent gem identification laboratory, Lelièvre Laboratoire de Gemmologie (LLG) in 2018. In order to offer the most complete service to her clients, she created the Gems and Jewelry Appraisal Center in 2019, also in Montreal.

Kyalo Kiilu (East African Gem Academy) 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 East African Gem Academy with a strong desire and ambition to share his knowledge of gemstones with his fellow East Africans, 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 (South Central African Gem Academy) 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) 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.

Barickeh Charles Kholifa Koroma (West African Gem Academy) is a freelance gemmologist, diamond grader/valuer, a member of the Gemmological Association of Great Britain and a member of the Scottish Gemmological Association. He was born in Liberia to Sierra Leonean parents and raised in the mineral rich country of Sierra Leone where he survived a devastating brutal civil war which lasted for almost 12 years.

He relocated to the United Kingdom in 2004 and received help on how to cope with Post Traumatic Stress Disorder (PTSD), which now proves pivotal in his approach to life.

He attended the coveted School of Jewellery, Birmingham City University (BCU) where he studied a diploma in diamonds (Gem-A) and a BSc (Hons) in Gemmology and Jewellery Studies. He graduated with a first-class degree in 2018 and was awarded the prestigious Scottish Gemmological Association Prize for Gemmology. He then moved back to Sierra Leone to pursue his dreams. His greatest achievement so far is working as a student mentor during his time at the university, he was able to give advice and guidance to some students that were struggling to cope with the demands of higher education and being away from home.

Like Kyalo, he comes to the World Gem Foundation and specifically the West African Gem Academy with a strong desire and ambition to share his knowledge of gemstones with his fellow West Africans, 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 Sierra Leone.

Dr. Laurent Massi (French-Swiss Gem Academy) completed his PhD studies on 'Atomic-scale Defects in Brown and Hydrogen-rich Diamonds' at the Department of Physics at Nantes University in France under the direction of Professor Emmanuel Fritsch. During his studies he also taught gemology in Paris at the French National Gemological Institute. Dr. Massi subsequently taught gemology and gave presentations at conferences in numerous countries all around the world. During his career he has also had the opportunity to publish a variety of scientific and educational articles on color-change corundum, hydrogen- and CO2-related optical centers in diamond, chameleon diamonds, clinohumite, color-change bastnäsite and on a new gem mineral: hibonite, one of the rarest gems on Earth.

Dr. Massi was the Director of the Asian Institute of Gemological Sciences (AIGS) Gem Laboratory and Gem School based in Bangkok - Thailand. He subsequently completed his Graduate Gemologist (GG) studies at the Gemological Institute of America (GIA) headquarters in Carlsbad, USA and then became the Director of the new GIA Thailand Campus located in Bangkok - Thailand.

With more than 20 years of experience in the Gems & Jewelry industry, Dr. Massi is now the head of both the new international gem academy AGAT (for 'Academy of Applied & Technical Gemology') as well as the co-founder of the French-Swiss Gem Academy (from the World Gem Foundation), both housed in the Majestic building - a former palace from the Belle Epoque - located on the French Riviera, in Nice - France.

Ludovic Durand Oro (French-Swiss Gem Academy) graduated from the Federation for European Education in Gemmology (FEEG) in 2012, has taught at the French Gemological Institute in Paris (France), was the Director of Education of a gem school based in Monaco and in 2019 co-founded the Academy of Applied & Technical Gemology (AGAT gem school) as well as the French-Swiss Gem Academy (FSGA), both based on the French Riviera in Nice, in the south of France.

A true gem enthusiast, he loves to organize gem field trips for his students to gem producing areas around the world while also acquiring top quality gemstones for his private clients.

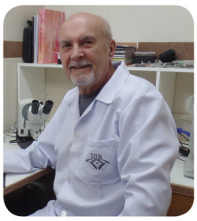
Nina Zolotukhina (Eastern Europe & Russia) studied gemmology at Moscow State University, is an independent gemmologist, now based in Bulgaria, founder of Gemlab Europe Project, researcher, gem expert and author of reviews and articles about gemstones, research methods and gemmological equipment. She is an avid mineral and gemstone collector and photographer of minerals and inclusions (photomicrography).

MEET OUR TEAM OF PROFESSIONALS

Geoffrey M. Dominy
World Gem Foundation
Spanish Gem Academy

Leone Langeslag
Dutch
Gem Academy

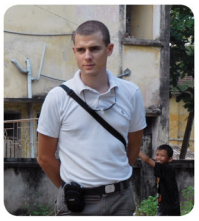
Deborah Mazza
British
Gem Academy



Gérard Raphaël Quintin
South American
Gem Academy

Marie-Hélène Corbin
Gem Academy of Canada
Gem Academy of Belgium

Jack Ghazalian
American
Gem Academy



Dr. Laurent Massi
French Swiss
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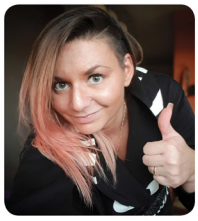
East African
Gem Academy

Salomon Lutumba
South Central African
Gem Academy

Barickeh Charles Kholifa Koroma
West African
Gem Academy



Nina Zolotukhina
Eastern Europe
& Russia

Lucille Daver
Gem Academy of Canada
Gem Academy of Belgium

Guillaume Benard
Gem Academy of Canada
Gem Academy of Belgium

Dorian Fitchko
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Alisson Lemaire
Gem Academy of Canada
Gem Academy of Belgium

Amélie Lebrun
Gem Academy of Canada
Gem Academy of Belgium

Caroline Gagnaire
Gem Academy of Canada
Gem Academy of Belgium

Wilma van der Giessen
Gem Academy of Belgium

Gamini Zoysa
Sri Lanka

IF YOU ARE INTERESTED IN JOINING OUR TEAM

WE WOULD LOVE TO CONNECT WITH YOU

Wilma van der Giessen (Belgium) received her first diamond education from Mr. S. Asscher in 1980 and in 1983 graduated at the German DGemG in Idar Oberstein as a diamond professional. At the age of 18, she was introduced to the diamond world in Antwerp where she learned all about rough and polished diamonds. Two years later, in 1985, she received her FGA diploma and in 1991 graduated as a GG at GIA's headquarters in Santa Monica, USA. Traveling is one of her great passions and her teaching space is a true paradise for gemmology students because they have access to a great collection of both natural and synthetic gemstones. Wilma is an avid photographer of gemstone inclusions and nature.

Gamini Zoysa is the Managing Director of Mincraft Company, a member of the Congress Committee and Communications Committee of the International Colored Gemstone Association (ICA), as well as serving as the organization's Ambassador to Sri Lanka, Executive Committee Member of the Sri Lanka Gem & Jewellery Association, Former President and current Executive Committee Member of the Gemmologists Association of Sri Lanka (GASL), Board member for the International Gemmological Conference (IGC), he holds a Master's Degree in Geology from the University of Moscow and Doctorate in Mineral Exploration from Delft University, Netherlands and is an FGA (Gem-A) and G.G. (GIA) gemological graduate.

Scholarships

Tino Hammid Memorial Gemmological Scholarship

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

Tino started his career as a staff gem photographer at the Gemological Institute of America (GIA) in Santa Monica, California (1980 to 1982). In 1983 he started his freelance career in gem and jewellery photography and began a 25-year association with David Federman providing photographs for Modern Jeweler's monthly Gem Profile column. During this period they jointly won two Jesse H. Neal awards from the Association of Business Publishers. In 1987 he acquired Christie's Auction house as a client and photographed more than a hundred of their jewellery sales catalogues. In 2012, Tino joined forces with gemmologist Geoffrey M. Dominy and provided the exquisite photographs for The Handbook of Gemmology, the first digitized gemmological textbook released in 2013.

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

In 2023, the World Gem Foundation will award five scholarships allowing deserving students to take the World Gem Foundation theoretical 'Career Gemmology' course.

The deadline for submitting your application is December 31st, 2022. All applications will be judged by Tino's wife Petra and his oldest daughter Evelyn with the mandate to select those five candidates who, in their opinion, best epitomize the spirit of Tino.

W.E. Hunn Memorial Gemmological Scholarship

Each recipient will also automatically receive a second scholarship (W.E. Hunn Memorial Gemmological Scholarship) that will provide funding of up to 50% of the cost of the practical workshops and final examinations.

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

Scholarship Application PDF

2022 Scholarship Recipients

Anna Kurguzova
Russia

Abuu Peter
Tanzania

Gisselle Jiménez
Colombia

Hassan Ibrahim
Uganda

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Putting the WORLD in the World Gem Foundation

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Central American	www.worldgemfoundation.com/caga	caga@worldgemfoundation.comm
Dutch	www.worldgemfoundation.com/dga	dga@worldgemfoundation.com
Eastern Europe / Russia	www.worldgemfoundation.com/eega	ninagold@worldgemfoundation.com
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East African	www.worldgemfoundation.com/eaga	eaga@worldgemfoundation.com
Indian	www.worldgemfoundation.com/iga	iga@worldgemfoundation.com
Scandinavian	www.worldgemfoundation.com/scga	scga@worldgemfoundation.com
South American	www.worldgemfoundation.com/saga	saga@worldgemfoundation.com
South Central African	www.worldgemfoundation.com/scaga	scaga@worldgemfoundation.com
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Sri Lanka	www.worldgemfoundation.com/slga	gaminiz@worldgemfoundation.com
West African	www.worldgemfoundation.com/waga	waga@worldgemfoundation.com

Australian Opal Centre

The Australian Opal Centre (AOC) is a not-for-profit facility dedicated to opal-related scientific research, education, training, heritage, arts, travel, cultural and economic development. Based in the classic opal mining locality of Lightning Ridge, Australia, the AOC has developed its public collection and programs since 2004, while working towards construction of an innovative building that will be an international hub for opal-related knowledge and activity.

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