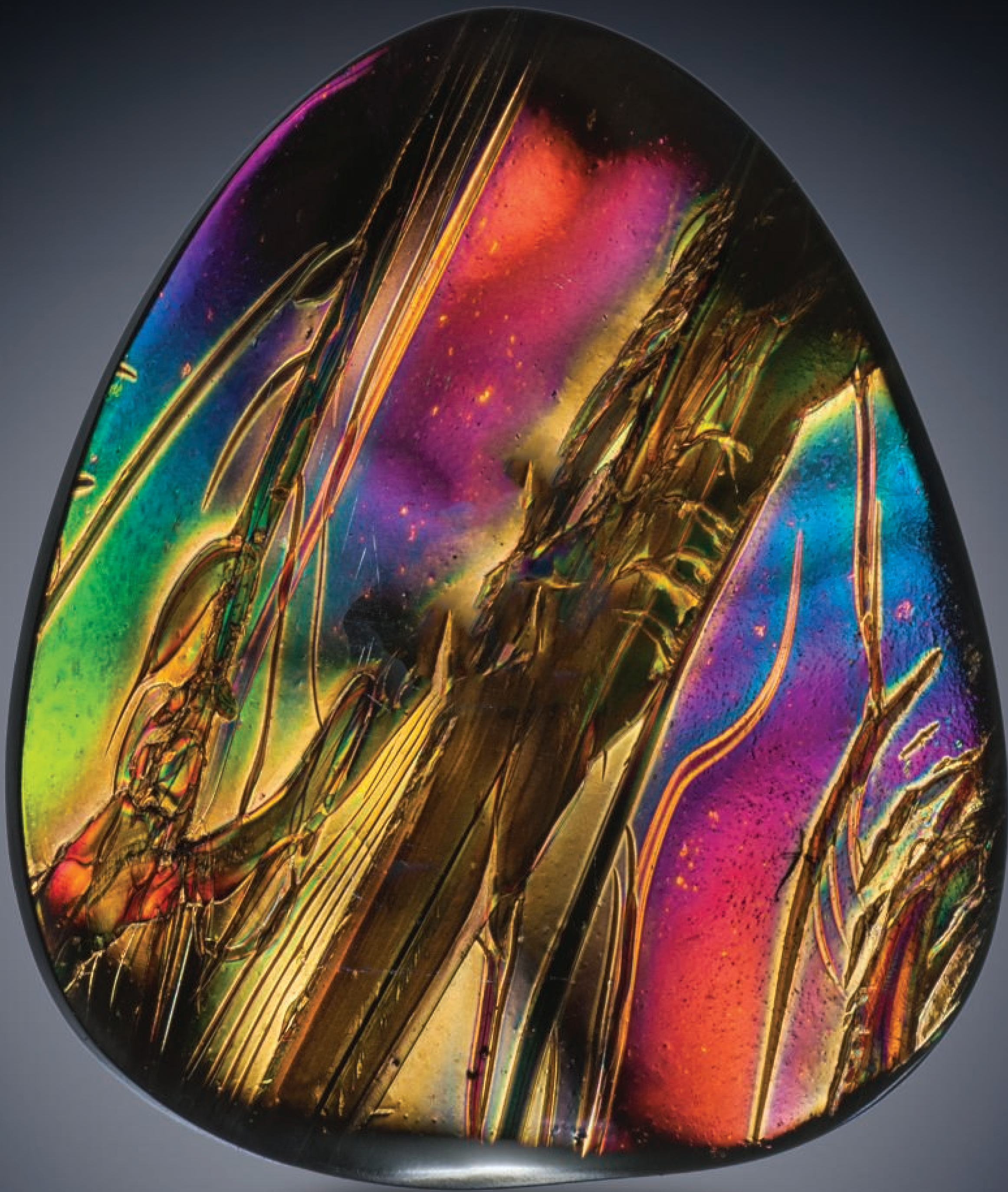
Gems & Jewellery

Jan/Feb 2016 / Volume 25 / No. 1



Gem-A Conference special

Cornish serpentine

Fire obsidian

Gem-A
THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

Gem-A

THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

Only £65.00 for Gem-A and NAJ Members and Gem-A students

It's not easy being green

Working in valuation or retail, or simply want to know more about one of the most ancient and noble gemstones? Discover Gem-A's **NEW** half-day workshop, '**Investigating jade and its imitations**', to be held on Friday 19 February 2016.

You will learn how to identify jade and to differentiate it from its imitations, including bowenite, quartzite, steatite, plastics and glass, using only a lens and hand-held gemmological equipment – an essential skill for every gemmologist.

For more information or to sign up contact **education@gem-a.com.** Previous gemmological knowledge is essential.

Creating gemmologists since 1908

Join us.

Jan/Feb 2016

Cover Picture

An example of some of the beautiful colours found in fire obsidian. See Tom Dodge's article on this enchanting material, pages 19–21.

Published by

The Gemmological Association of Great Britain (Gem-A)

21 Ely Place, London EC1N 6TD

t: +44 (0)20 7404 3334

f: +44 (0)20 7404 8843

e: editor@gem-a.com

w: www.gem-a.com

Registered charity no. 1109555

 ISSN 1746-8043

Gem-A
THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

Chief Executive Officer (CEO)

The Gemmological Association of Great Britain

The world's longest-established gemmological teaching institute is seeking a CEO of the highest calibre, to spearhead its continued growth. Gem-A traces its history back more than 100 years, and now provides gemmological education and examinations internationally, with teaching centres in 17 different countries and distance learning provision worldwide.

The successful applicant will have proven management skills, and a high level of experience in gemmology or a closely related field. They will oversee the day-to-day running of the organization, the development and provision of education, the management of the membership and media departments, and work closely with the elected Board to develop and deliver the strategic plan. They will also ensure that all of the Association's legal, financial, and other governance requirements are met. The role will include representing the Association internationally at gemmological conferences, gem industry trade shows, and relevant organizations and committees. The Association is a registered UK Charity and a Company Limited by Guarantee.

For a copy of the job description, person specification, and an application form email nick.jones@gem-a.com.

Deadline for receipt of completed application forms is 19 February 2016.

Creating gemmologists since 1908

Join us.

The Gemmological Association of Great Britain, 21 Ely Place, London, EC1N 6TD, UK. T: +44 (0) 20 7404 3334 F: +44 (0) 20 7404 8843.
Gemmological Instruments Ltd is a company limited by guarantee and registered in England No. 838324. Registered office: 3rd Floor, 1–4 Argyll Street, London W1F 7LD VAT Reg. No.: 995 8813 45. Gemmological Instruments Ltd is a wholly owned subsidiary of The Gemmological Association of Great Britain (UK Registered Charity No. 1109555).

The wonderful world of gems and jewellery

It seems incredible that 12 weeks have passed by since I first walked into the Gem-A offices as the interim CEO back in mid-October. The time has flown by and I can say that I have thoroughly enjoyed getting to know all the staff and trustees who are working together to ensure that Gem-A has a great future. It has become apparent to me that both the staff and trustees are all committed to Gem-A, and that the Association is in good hands.

The 2015 Gem-A Conference and FEEG Symposium was a great event and a credit to all those involved. I was particularly impressed by the international flavour of the conference; it is evident that the subject of gemmology is truly global. Feedback from the delegates was very positive, and all were passionate about both gemmology and Gem-A. As a newcomer to the gem world I found the presentations very interesting, although I must admit that some of the more technical elements went over my head! See pages 26-36 for a report on the conference.

The graduation ceremony for Gem-A and FEEG students was a wonderful opportunity to recognize the hard work and achievement of the graduates. Held at the Mermaid Conference and Events Centre in Blackfriars, London, the large auditorium was packed with graduates and their families. It was very encouraging to see that gemmology continues to attract capable individuals who will ensure that the industry continues to maintain the highest possible standards.

There has been a steady stream of students at Ely Place attending courses and workshops, and with more workshops planned the footfall looks sure to increase. As I write this the January exams are about to start — I would like to wish our students around the world the very best of luck in the coming weeks. New gemmologists will always be needed, and we hope they will remain part of the Gem-A family for many years to come.

Gem-A staff will once again be attending International Jewellery Tokyo from 20–23 January, the AGTA Tucson GemFair from 2–7 February and the Tucson Gem and Mineral Show from 11–14 February. Staff will be raising the profile of Gem-A, making new contacts and greeting old friends. I urge all of you who will be attending or who live local to these shows to come and speak with the staff, they would love to meet you.

Over the last few weeks I have become aware of some of the complexities of the gems and jewellery industry. There is clearly a growing need for qualified gemmologists, a need which will be met by members of Gem-A who have achieved FGA and/or DGA status.

> It was very encouraging to see that gemmology continues to attract capable individuals who will ensure that the industry continues to maintain the highest possible standards.

Since joining Gem-A there have been reports that the world's second largest diamond has been discovered in Botswana and the world's biggest blue star sapphire has recently been unearthed in Sri Lanka. These events were widely covered by the world's press, proving that the general public has an enormous amount of interest in gems — an interest that is unlikely to go away.

I would like to say thank you to the staff, the trustees and to all those I have met in the industry who have welcomed me into this wonderful world of gems and jewellery. I must say I do feel inspired to increase my (rather small) collection of rocks and minerals back home. Finally, I look forward to continuing to work with the team at Gem-A over the next few months and to meeting many more of you.

Best wishes,
Nick Jones, Interim CEO

Gem News

THE JOURNAL OF GEMMOLOGY JOINS REUTERS' DATABASE

Gem-A's flagship publication, *The Journal of Gemmology*, has been accepted for indexing in Thomson Reuters' new Emerging Sources Citation Index (ESCI), part of the prestigious Web of Science™ research platform.

The development will allow the magazine to be fully searchable and citable by academics, authors and researchers across all fields of science. Its inclusion demonstrates Gem-A's dedication to providing the most relevant and influential scholarly gemmological content to the gem and jewellery community. Journals in ESCI have passed an initial editorial evaluation and continue to be considered for inclusion in other Thomson Reuters' products, such as the prestigious Science Citation Index Expanded database.

The Journal of Gemmology's editor-in-chief Brendan Laurs FGA is thrilled with the development, stating: "*The Journal*'s inclusion in Web of Science™ is good for our authors, for our readers, and for gemmology in general. *The Journal* will now be in a better position to attract articles from researchers at top universities who are required to publish in Web of Science™ journals, and our readers will benefit from this cutting-edge research. *The Journal*'s coverage by Web of Science™ will certainly help raise awareness of gemmology to the global scientific community."

The Journal has also been accepted for inclusion in several other international abstracting and indexing services — for a full list please visit the publications section of the Gem-A website. Published in collaboration with the Swiss Gemmological Institute SSEF and with the support of the American Gemological Laboratories, *The Journal* is embarking on its third year with Laurs at the helm.

PUBLIC GETS ACCESS TO RARE GEM BOOKS

A collection of 101 rare and historically significant books on gems and jewellery is now available to the public through an extensive digitization project by GIA's Richard T. Liddicoat Gemological Library and Information Center.

The important works, which are downloadable for free, include major studies related to minerals, gems and jewellery and span more than 500 years — from 1496 to the present. The debut of the collection online includes the digitization of the oldest book in GIA's library, Pliny's *Natural History* (1496) — one of the earliest and most celebrated academic treatises of all time, the content of which dates back to 77 CE and was considered the foundation of all science until the Renaissance.

Other highlights of the collection include Marbode's *Book of Precious Stones* (1511), originally a 742-word poem; Sowerby's *British Mineralogy* (1804–1817), with the author's own hand-coloured images, and French chemist Frémy's beautifully illustrated *Synthesis of Ruby* (1891).

IDE president Schmuel Schnitzer holding the rough diamond that was later to be cut as the 'Blue Moon'.

BLUE MOON DISPLAYED BY IDE SELLS FOR US$48.5 MILLION

It was 18 months ago during Israel's Rough Diamond Week that a 29.6 ct rough blue diamond went on display in the trading hall of the Israel Diamond Exchange (IDE). Last month the cut stone, which became the 12.03 ct 'Blue Moon', was sold at auction in Geneva for more than US$48.5 million.

The rough stone, which earlier had been bought by Ehud Laniado's company Core International from diamond miners Petra Diamonds for some US$26 million, was of an exceptionally rare vivid blue colour. Recalling the stone, IDE president Shmuel Schnitzer said that the rough diamond, with its "outstanding vivid blue with extraordinary saturation, tone and clarity", was the highlight of the inaugural International Rough Diamond Week, held in Israel in 2014.

For more about the Blue Moon diamond see Jack Ogden's report on page 37.

LARGEST CANADIAN DIAMOND UNVEILED BY RIO TINTO

One of the largest diamonds ever to be discovered in Canada, a 187.7 ct rough stone found at Rio Tinto's Diavik Diamond Mine in Northwest Territories, made its public debut at Kensington Palace last month. Christened the 'Diavik Foxfire', the two-billion year old rock, which has also been given an indigenous name — 'Noi?eh Kwe' — will travel to Antwerp for assessment. It is estimated that it will yield one very large polished diamond "with its ultimate destiny in an exclusive heirloom piece of jewellery" according to Jean-Marc Lieberherr, MD of Rio Tinto's diamond division.

LARGEST BLUE STAR SAPPHIRE FOUND IN SRI LANKA

Sri Lankan gemmologists claim that the largest blue star sapphire in the world has been discovered in a mine in Sri Lanka. The gemmology institute in the capital Colombo has certified that the gem weighs 1404.49 ct and says it has not certified anything larger.

The gem is valued at "at least US$100 million" and the current owner estimates that it could sell for up to US$175 million at auction. He regards the stone as an exhibition piece rather than an item of jewellery and has named it 'The Star of Adam', after a Muslim belief that Adam arrived in Sri Lanka after being expelled from the Garden of Eden.

"The moment I saw it, I decided to buy it," the current owner, who wishes to remain anonymous, told the BBC World Service's *Newsday* programme. He insists that the purchase price must remain "absolutely confidential." The previous record holder weighed 1,395 ct.


Image: BBC

NEW MD AND PRESIDENT FOR ISRAEL DIAMOND EXCHANGE


Image by ShellyD

Eli Avidar has been announced as the new managing director of the Israel Diamond Exchange (IDE) in December 2015. The appointment follows the news last month that Yoram Dvash was elected as the new president (replacing Shmuel Schnitzer).

"Eli Avidar is a formidable diplomat who has managed IDI, the umbrella organization of the Israel diamond industry and trade, successfully for almost a decade. The board of the World Diamond Mark Foundation (WDM) congratulates him on his appointment and looks forward to cooperating closely with him in the future," WDM chairman Alex Popov said in a brief statement.

Dvash, a first generation diamantaire, launched his own diamond manufacturing and trading business, Dvash Diamonds, in 1991. He joined the board of directors of the IDE in 2013. He is the driving force behind the establishment and further development and expansion of the IDE's Centre for Manufacturing and Innovation.

UPGRADED NATURAL DIAMOND DETECTION DEVICE LAUNCHED

The Swiss Gemmological Institute (SSEF) has announced the release for international export of an upgraded version of its Automated Spectral Diamond Inspection (ASDI) device. The system is designed to support the diamond industry against the threat of small synthetic diamonds mixed into parcels of natural colourless melée diamonds.

ASDI is able to conclusively identify colourless natural diamonds by sorting both HPHT and CVD colourless synthetic diamonds, as well as any colourless HPHT-treated diamonds that may be included in a parcel. It is the only automated system that can examine large numbers of stones of colourless melee, as small as one millimetre in diameter or 0.4 points in size, at high speed and at low cost.

The ASDI device is being marketed and distributed worldwide by SATT Gems SA, which was established in 2014 by SSEF, a worldwide authority in gem testing. There are currently five ASDI instruments being used on a daily basis: two are being operated by diamond trading companies in Switzerland, two by leading Swiss watchmaking groups and one by a diamond-grading laboratory.

DIAMOND-BACKED CRYPTOCURRENCY LAUNCHES

The companies behind the world's first diamond-backed cryptocurrency started selling the digital coinage this month. The asset class used is coloured diamonds, which the founders of the PinkCoin claim have not lost value since tracking began in 1959.

Precious Investments and its subsidiary BitGem Asset Management (BAM) launched the PinkCoin crowdsale — a crowdfunding process in which investors acquire PinkCoin tokens — on 18 January 2016, according to a statement. PinkCoin is based on the Ethereum cryptocurrency platform and backed by a pool of fixed coloured diamond assets kept in trust by BAM. All escrowed diamonds have been independently appraised and certified and are insured by Lloyds of London, the statement said.

The initial crowdsale will comprise 5 million PinkCoin tokens and the initial diamond asset pool has been valued at US$5 million, meaning each token will be worth US$1 to begin with. The diamond pool will be valued on a regular basis.

PinkCoins are redeemable for Bitcoins, a digital currency introduced in 2009, or individual gems, based on the diamond pool's most current valuation. Holders of the currency will be able to trade it for other assets and for asset pool-backed tokens on the BitGem Decentralized Marketplace, anticipated to be available in the second quarter of 2016. ■

Events

TUCSON 2016

AGTA GEMFAIR TUCSON
ADD MORE COLOR TO YOUR LIFE!

AGTA Tucson GemFair
2–7 February, Tucson, Arizona, USA
Gem-A will be returning to the AGTA GemFair Tucson, to take part in one of the largest and most famous international gem shows across the globe. Gem-A will be joining the show to exhibit its range of educational and training courses, instruments, membership services and publications; come and visit us at booth 29.

Gem-A's Big Gem Bash
4 February, Scottish Rite Cathedral, Tucson, Arizona, USA
We invite members, students and friends to join us at the Scottish Rite Cathedral for live music, drinks and catering with the return of our Big Gem Bash! A highly popular event in 2015; be sure to reserve your place by emailing events@gem-a.com soon. Thank you to our sponsors JIBNA for their generous support of the Big Gem Bash.

62nd Annual Tucson Gem and Mineral Show (TGMS)
11–14 February, Tucson, Arizona, USA
Gem-A will be extending its stay in Tucson to attend the TGMS. Following on from AGTA GemFair Tucson, TGMS is the Tucson Gem & Mineral Society's yearly show, inviting both gemmologists and mineralogists to come together for a number of exhibitions, workshops and events.

BASELWORLD 2016

17–24 March, Basel, Switzerland
One of the largest watch and jewellery shows, BaselWorld is the focal point of the industry, where all players showcase their creations and innovations. The show attracts everyone from designers and purchasers, to the global press and consumers. Come and visit the team at Hall 3.0 Stand A35.

OTHER EVENTS

Scottish Gemmological Association (SGA) Conference 2016
29 April–2 May, Peebles Hydro Hotel, Peebles, Scotland
Featuring talks from a host of internationally renowned speakers, the SGA Conference is a popular event in the gemmological calendar.
Visit www.scottishgemmology.org/conference for more information and to register.

GEM CENTRAL 2016

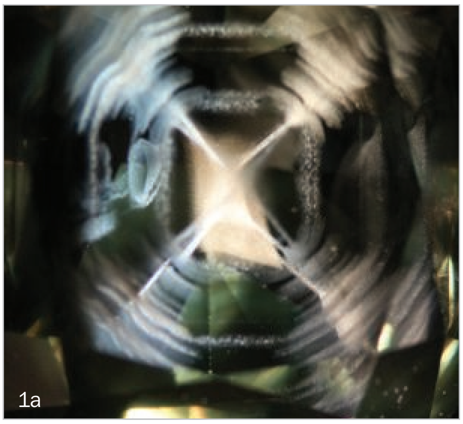
Gem Central meetings take place once a month, from 18:00 to 19:30 at Gem-A, 21 Ely Place, London EC1N 6TD.
For more information please contact events@gem-a.com

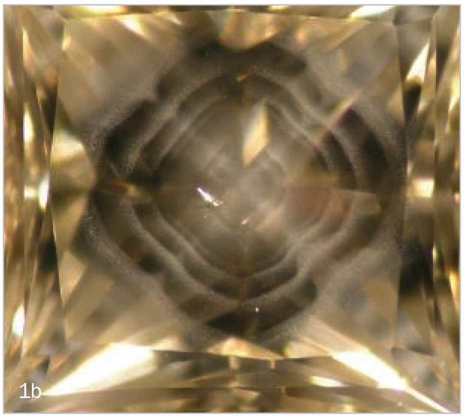
Gem Central with Chrissie Douglas
25 February

Gem Central: Andrew Fellows Practical Masterclass
31 March
A fun and informative evening for beginners just learning to use the instruments and also for experienced gemmologists looking for a refresher.

Natural diamond mistakenly identified as synthetic green diamond

Thomas Hainschwang FGA discusses a natural green diamond, reported in the October 2015 issue of *Gems&Jewellery* to be synthetic.



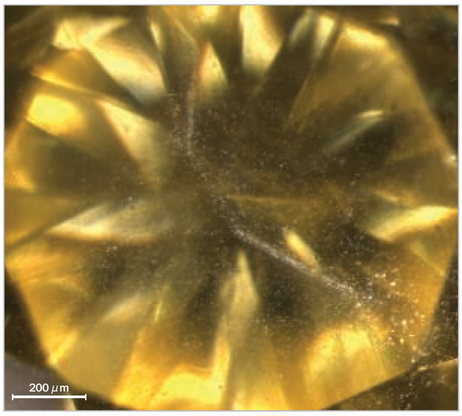


1: (a) The phantom cloud as shown in the October 2015 issue of Gems&Jewellery, *compared to a phantom cloud in a natural diamond (b). Image (a) by Anthony de Goutière, image (b) by Thomas Hainschwang.*

I have read with great interest and surprise a note concerning a 3.14 ct green diamond, described and identified as synthetic diamond based on its inclusion features, in the October 2015 issue of *Gems&Jewellery*, page 29. There are some important issues with the published note: 1) the images have been labelled in the wrong order, figure 2 is the only image under crossed polarizing filters and figures 3 to 5 are images of the inclusion features; 2) The identification of this diamond as synthetic is most certainly not correct; based on the inclusion features the diamond must be of natural origin. The cloud-like group of inclusions that forms this spectacular pattern is called a 'phantom cloud' and is a feature that can occur only in natural diamonds of cuboid or mixed cuboid octahedral growth, but which has never been observed or described for synthetic diamond. Synthetic diamond typically exhibits cubo-octahedral growth with flat cube faces, while in natural diamonds such flat cube faces are very rare, and instead hummocky rough faces called 'cuboid' are generally present. For more details on such mixed growth of natural diamonds see Rondeau *et al*. (2004) and Welbourn *et al.* (1989).

1a shows the original figure 4 as published in *Gems&Jewellery*, whilst **1b** shows a spectacular cuboid phantom in a natural diamond which can be seen as a comparison to **1a** (Hainschwang, 2004). The two growth patterns are identical and very characteristic for cuboid growth in natural diamond.

Such symmetrical clouds that are made up of tiny particles — or more likely voids — are relatively common in natural diamonds, and whilst synthetic diamonds do very commonly contain small pinpoint inclusions, these are generally arbitrarily distributed. Only in very exceptional cases may the pinpoints be aligned to a certain extent and follow growth directions, but these alignments never look anything like a phantom cloud in a natural diamond (**2**).



2: Aligned particles are very rare in synthetic diamond and never exhibit a shape similar to the one of a phantom cloud in natural diamond. Photo by Thomas Hainschwang.

These facts lead me to conclude and suggest that the described diamond is not synthetic but of natural origin, and most likely of green coloration induced by laboratory irradiation. Diamonds with such distinct phantom clouds are typically either light brown to brown or 'olive' and hence are not rarely the ones used for treatments in order to give them a more attractive colour.

Dr Thomas Hainschwang
GGTL Laboratories – Gemlab (Liechtenstein)
Gnetsch 42 LI-9496 Balzers
thomas.hainschwang@ggtl-lab.org

REFERENCES

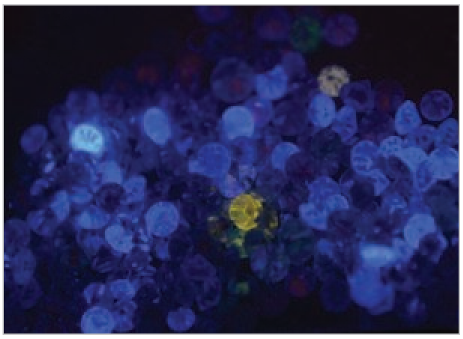
De Goutière, A., 2015. Synthetic green diamond. *Gems&Jewellery*, October 2015, **24**(6), 29.

Hainschwang, T., 2004. A diamond exhibiting a spectacular phantom. *Gems & Gemology*, **40**(1), 76–78.

Rondeau B., Fritsch E., Guiraud M., Chalain J.-P., Notari F., 2004. Three historical "asteriated" hydrogen-rich diamonds: Growth history and sector-dependent impurity incorporation. *Diamond and Related Materials*, **13**(9), 1658–1673.

Welbourn C. M., Rooney M. L. T., Evans D. J. F., 1989. A study of diamonds of cube and cube-related shape from the Jwaneng mine. *Journal of Crystal Growth*, **94**(1), 229–252.

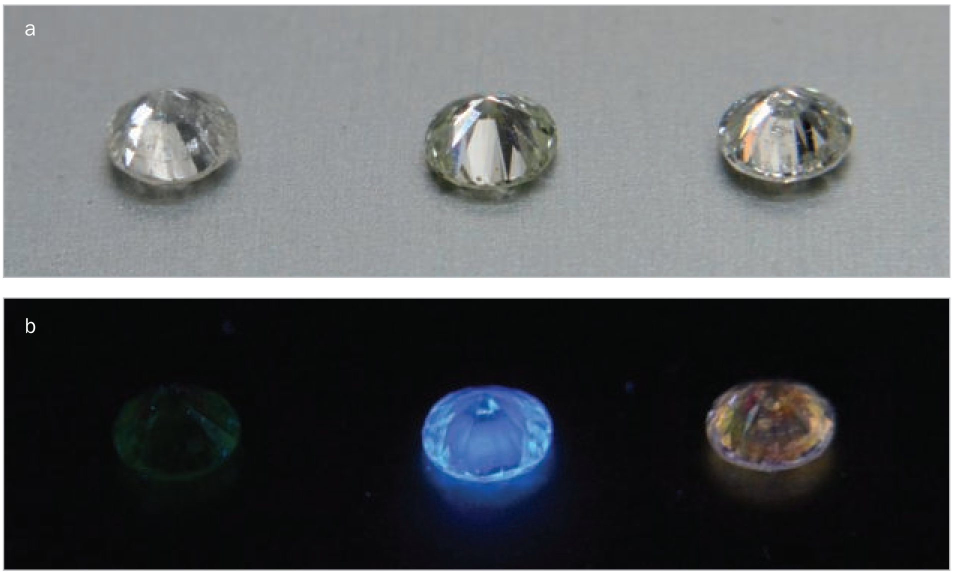
The ins and outs of polished diamonds: fluorescence



3: *A group of single-cut diamonds, approx. 0.02 ct each, generally colourless in daylight, seen under LWUV.*

Grenville Millington FGA looks at the interesting phenomena of fluorescence in diamonds.

Rather like the last phenomenon we looked at (strain patterns between crossed polars), fluorescence in diamonds is rarely seen under normal viewing conditions. In fact it would probably be true to say that most people never actually witness it. It represents another factor that makes the study of diamonds an interesting one — not because fluorescence exists in diamonds, but because of its diversity. Two diamonds may appear rather similar in ordinary light but can look totally different when viewed in ultraviolet (UV) light. The image in **1a** shows three brilliant-cut diamonds in normal light (daylight fluorescent tubes) whilst **1b** shows these diamonds under long-wave ultraviolet light (LWUV).



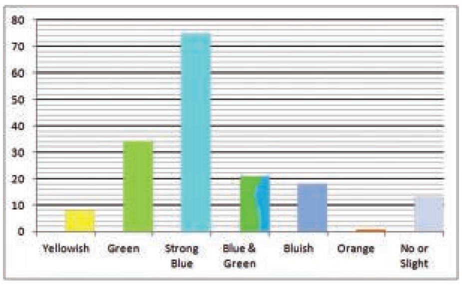
1: Three brilliant-cut diamonds; the far right stone weighs 0.09 ct and measures 2.9 mm. (a) Under a daylight fluorescent tube and (b) under LWUV.

2: Three diamonds under LWUV that graded (from left–right) E.SI, G.SI, P/Q.VS in normal light. The far left stone is 0.28 ct.

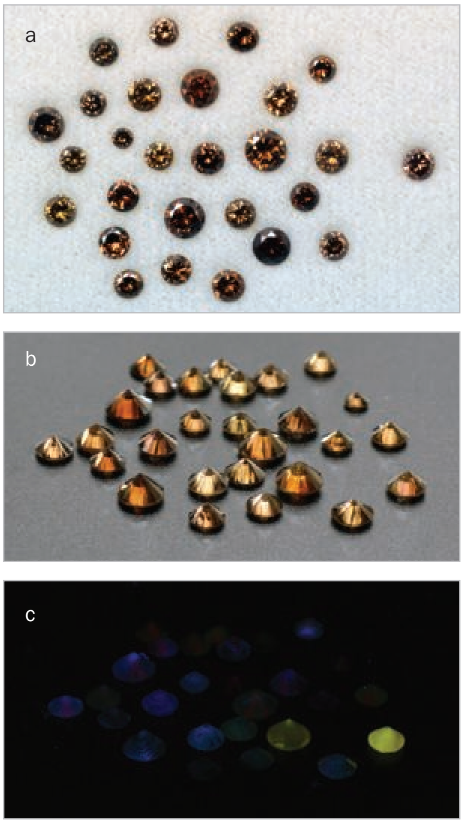
The second stone from the right in **1a** is a little more yellowish than the others, yet in **1b** it fluoresces a strong light blue, not uncommon in the light yellowish diamonds that used to be referred to as the 'Cape' series (GIA colour grades G to Z). This game can be played in reverse — look at the three diamonds in **2**: all fluoresce a very strong light blue, but their grades are E.SI, G.SI, and P/Q.VS.

In a random group of commercial diamonds (polished or otherwise), all of grades D to M, many will appear inert (no fluorescence) and many blue (very slight dull blue to mid-blue to very strong whitish blue) with maybe one or two showing an exceptionally strong reaction, such as the centre stone in **2**. On occasions, a yellow fluorescing stone may occur — or possibly dull green, or even white (**3**).

With light brown or brownish commercial diamonds (not fancy colours), a dull green is common, with blue also being widespread. I came across a note I had made in the late



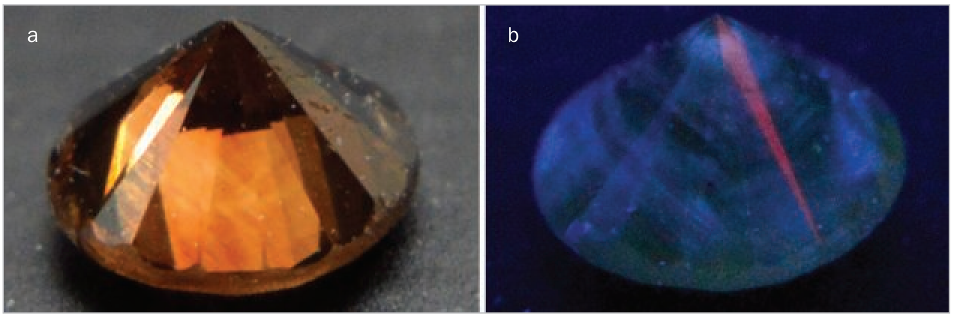
4: Graph showing the reactions of a parcel of 170 light brown polished diamonds under LWUV.



5: A group of fancy brown diamonds featuring a reddish brown stone of 0.10 ct on the far right, shown under (a) daylight equivalent fluorescent light, table facing up, (b) daylight equivalent fluorescent light, culet facing up, and (c) LWUV, showing the same reddish brown stone fluorescing a very strong yellow colour under LWUV.

Two diamonds may appear rather similar in ordinary light but can look totally different when viewed in ultraviolet light.

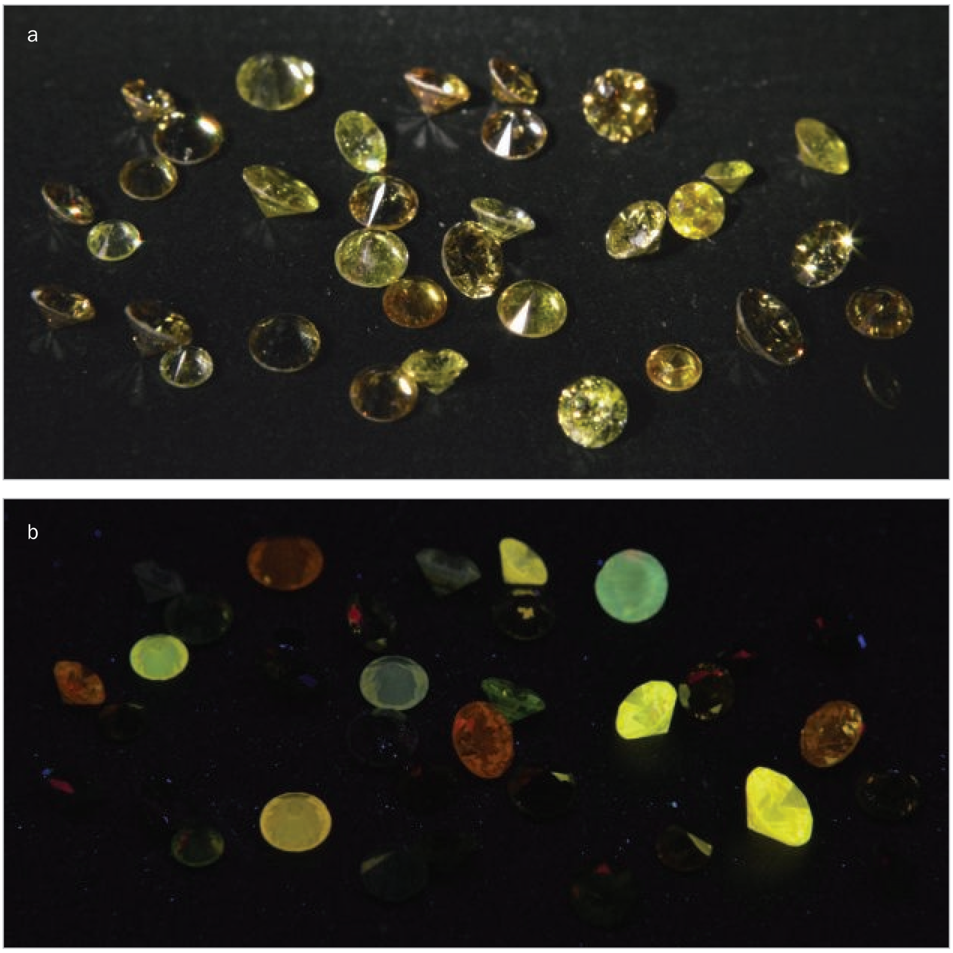
1970s about a small parcel of light brown diamonds that I had to grade. There were 170 stones from 0.20 ct (3.8 mm) up to 0.65 ct (5.65 mm) — what would have been called a 'mélange' parcel. I had placed them under a LWUV lamp and recorded the reactions, the results of which are shown in **4**. At that time there was little information about the reaction of brown diamonds to LWUV (as opposed to light yellowish, 'Cape' series diamonds), so I wanted to see for myself. I was surprised at the number of blue/bluish fluorescent stones — these were 67% of the total, including 21 stones that had a mixture of blue and green in the same stone. This, of course, was only one group and no doubt others would vary from these figures. Fancy browns are less prone to showing strong blue fluorescence, as is seen in a group of 'chocolate brown' stones (**5a**, **5b**). The image in **5c** reveals one stone in particular that fluoresces with a distinctly zoned manner and this is shown in **6a** and **6b**.



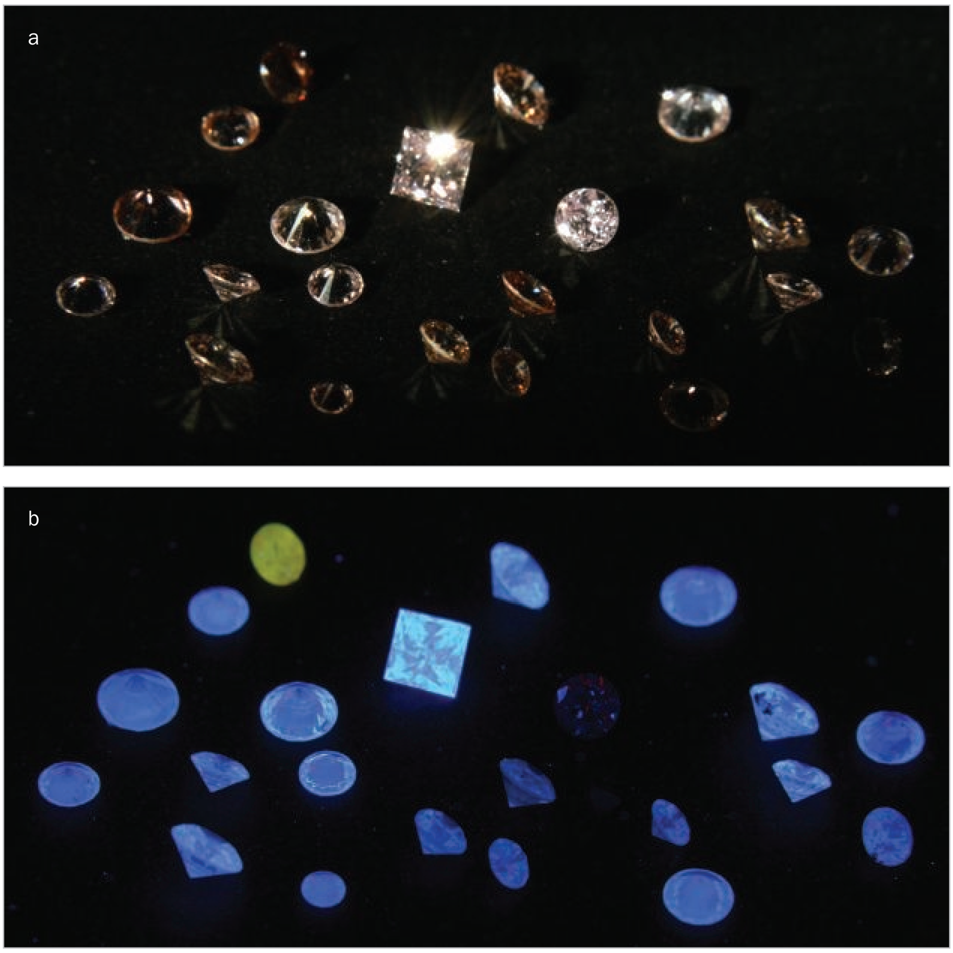
6: A fancy brown diamond (0.20 ct), showing (a) a slight patchiness in colour distribution, and showing (b) much stronger zoning under LWUV.

Other fancy coloured diamonds are shown in **7a** and **7b** for yellows, and **8a** and **8b** for light pinks (all natural and believed to be African in origin, as are the brown stones shown in **5**). There were no blue fluorescing stones in the fancy yellow group and in the pink group they all fluoresced blue, except one that was yellow and one inert.

Once you begin to look at diamonds under LWUV, at some stage you will find one that seems to react differently, depending on the angle of view — for example, when viewed through the table and then from the pavilion side. Or, if you can get close enough to the stone, you may find you can detect blue and green (for example) within the same diamond. These diamonds will certainly have some areas within them that fluoresce



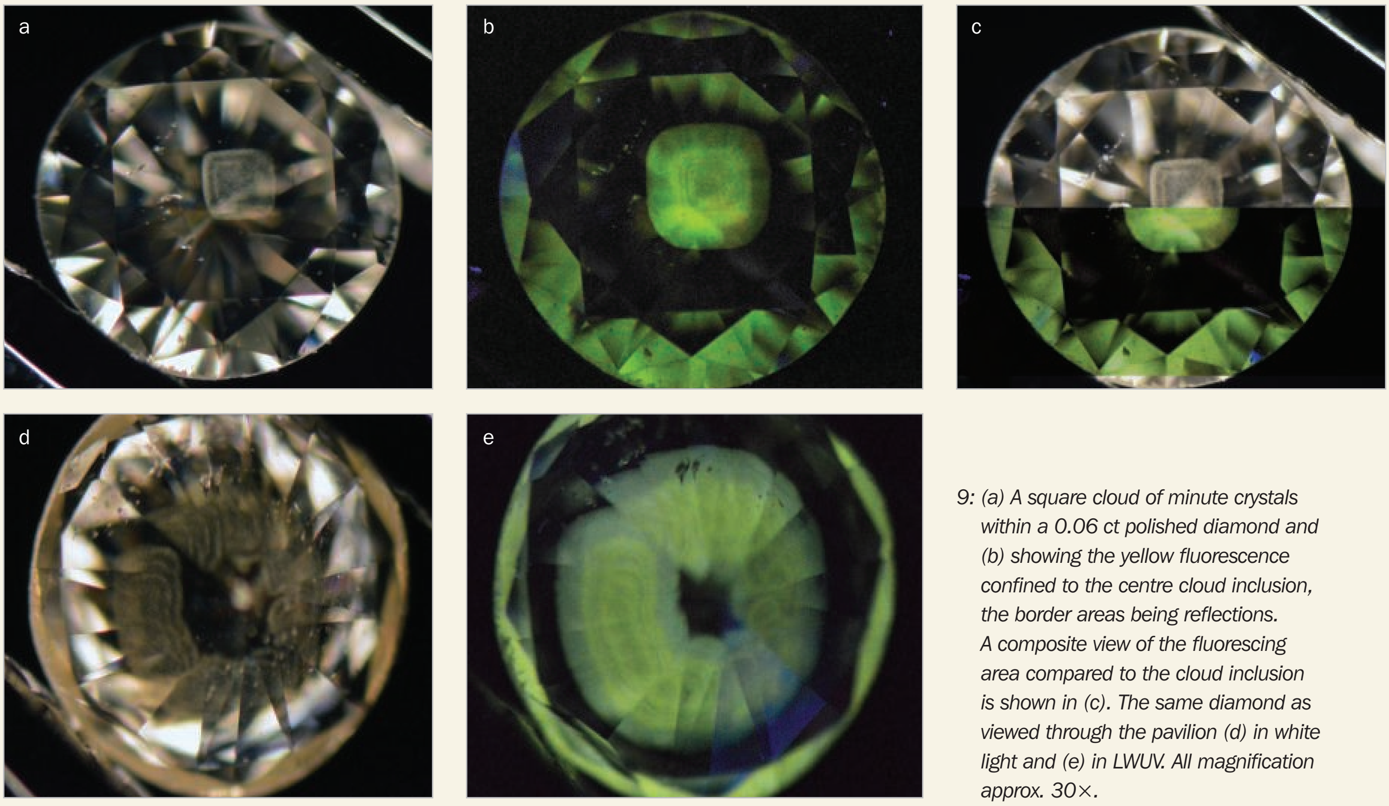
7: A group of 34 fancy yellow diamonds, total 0.91 ct, in (a) tungsten light and (b) LWUV.



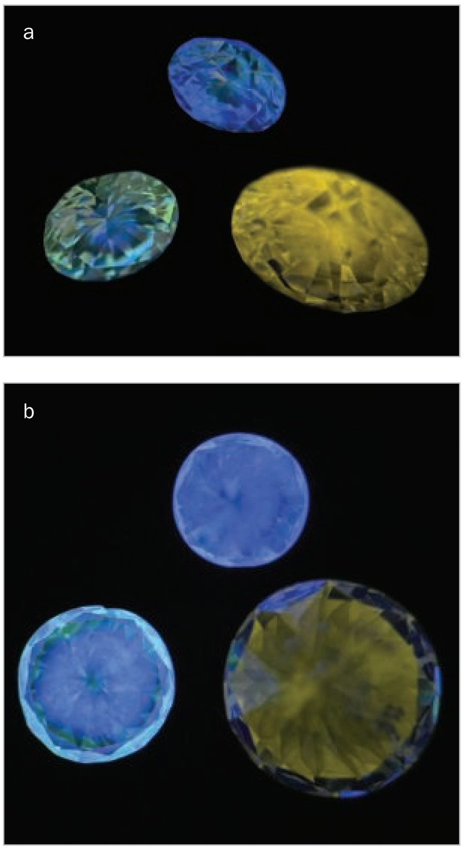
8: *A group of 22 fancy pink diamonds, total 0.61 ct, in (a) tungsten light and (b) LWUV.*

differently to the remaining body of the stone. A good example is a diamond that we looked at in the 'Inclusions' instalment of this series ('The ins and outs of polished diamonds: inclusions', *Gems&Jewellery*, March/April 2015, pages 22–25), which is shown in 9a. Under LWUV the stone fluoresced a strong lemon yellow, with closer examination showing that only part of the stone was responsible for the colour. Owing to its small size (2.6 mm), magnification was required to see the effect in detail (**9**). However, now that I compare the photographs, it is apparent that the fluorescing area extends beyond the square cloud, although retaining the shape (**9c**).

Usually when this variation of fluorescence occurs the affected area is more nebulous and the reason for its reaction is not apparent to the eye. All three stones shown in **10** show this differentiation. The smallest diamond in is 0.07 ct and fluoresces a strong blue, except for a small area at its culet that fluoresces yellow (**11a–c**). When viewed by eye the mixture of blue and yellow areas presents a green colour (similar to some green sapphires which, when examined critically, are found to be blue and yellow zoned). The other blue fluorescing stone is 0.10 ct and looks quite blue viewed from the pavilion side but changes when viewed from the front, as shown in **12a–c**.



9: *(a) A square cloud of minute crystals within a 0.06 ct polished diamond and (b) showing the yellow fluorescence confined to the centre cloud inclusion, the border areas being reflections. A composite view of the fluorescing area compared to the cloud inclusion is shown in (c). The same diamond as viewed through the pavilion (d) in white light and (e) in LWUV. All magnification approx. 30×.*

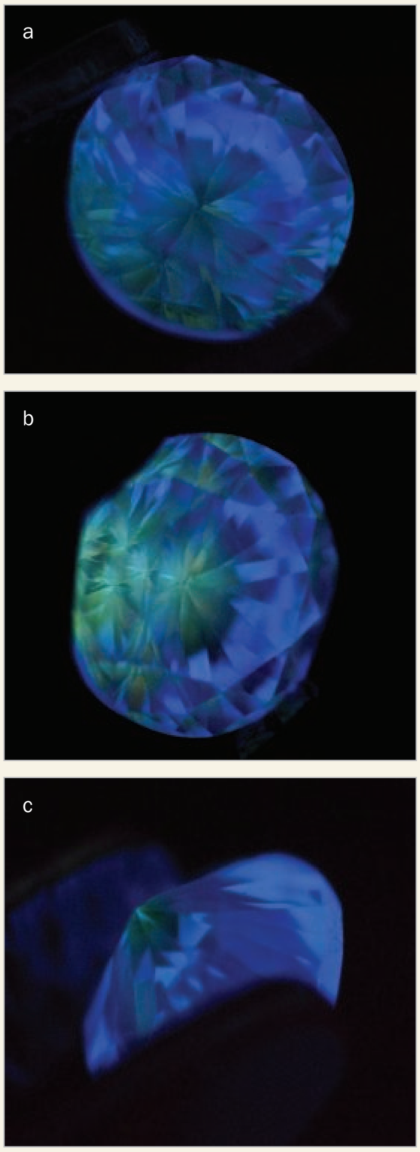


10: Each of these diamonds shows varying fluorescence within each one; the largest stone is 0.26 ct. (a) Viewed through the table and (b) through the pavilion.

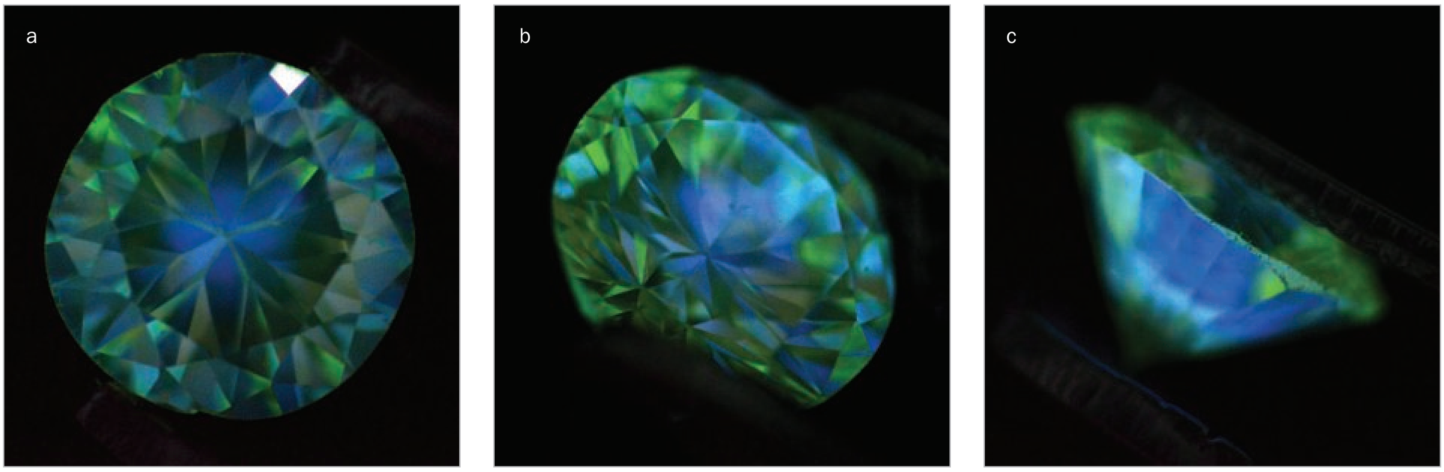
The largest stone of the group (0.26 ct) gives off only one fluorescent colour, yellow, but this is also restricted to certain areas — although you wouldn't believe it by looking at this stone through the table side (**13a**). Viewing from other angles shows the fluorescence is patchy (**13b,c**). The stone seen in **14** just exhibits a patchy yellow fluorescence when viewed from any angle.

This is what is meant by the old term 'over blue'; when ordinary daylight causes a noticeable bluish fluorescence in a diamond.

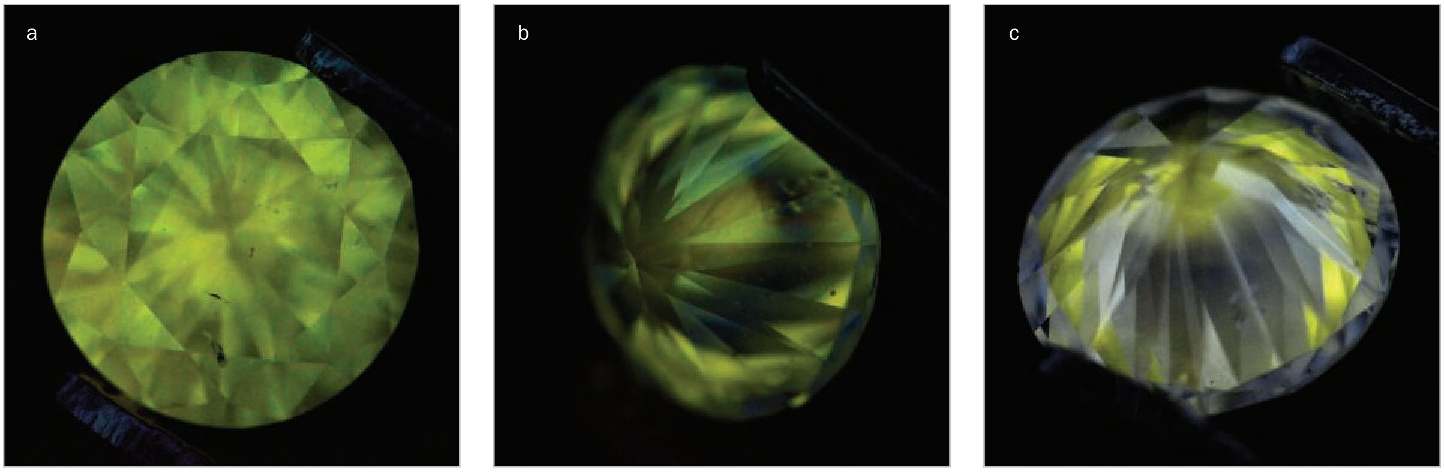
I wrote at the beginning of this article that fluorescence in diamonds is rarely seen under normal viewing conditions. This implies that there might be circumstances when it can be seen in normal lighting without using a LWUV lamp. Some diamonds are so fluorescent that the very small amount of UV in normal light is enough to make them fluoresce sufficiently to have an effect on their appearance. The mounted diamond shown in **15** is such a stone. When seen in daylight this diamond has a hazy, bluish appearance (**15b**). This is what is meant by the old term 'over blue'; when ordinary daylight causes a noticeable bluish fluorescence in a diamond. If the diamond in question has a slightly yellowish or brownish body colour then this might be masked in such light conditions and the stone presents a 'whiter' look. Such a stone might appear to be, say, a 'G' colour in daylight when in fact its grade might be 'I' or 'J' when examined under the grading lamp. This sounds like an advantage but the hazy or 'petrol' look is a greater disadvantage.



11: (a–c) A 0.07 ct diamond fluorescing blue (the smallest stone in 10), but with a small area at the culet fluorescing yellow.



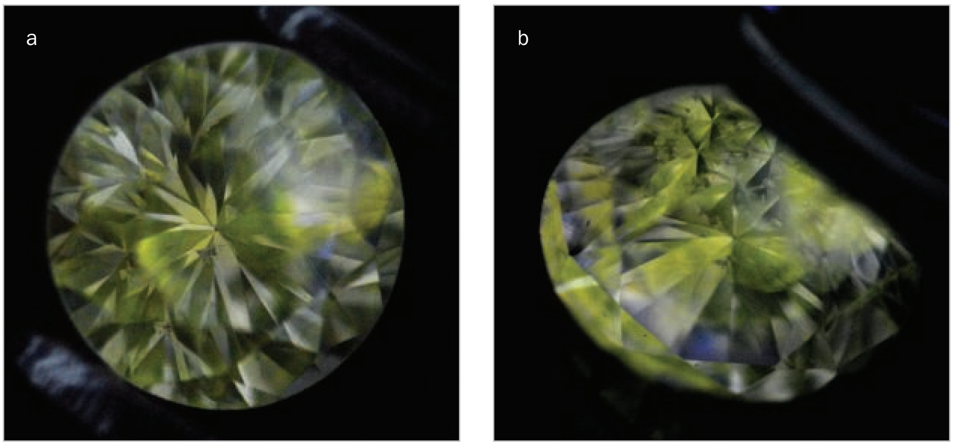
12: (a–c) A 0.10 ct diamond (the left-hand stone in 10) showing areas of blue and yellow fluorescence, producing a green colour.



13: (a–c) A 0.26 ct diamond showing full yellow fluorescence viewed through the table, but patchy fluorescence when viewed through the pavilion.

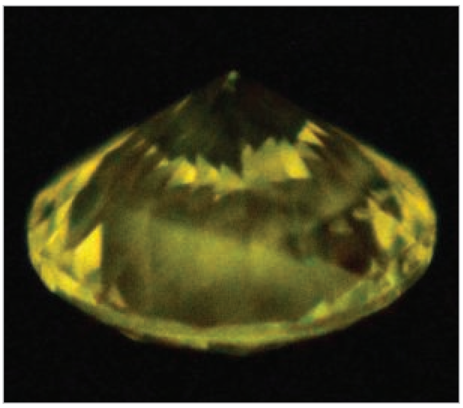
The ring shown in **15b** was featured in an article which concerned the phosphorescence of this stone. When viewed under the LWUV lamp, as shown in **15a**, and then viewed with the lamp switched off, the stone emitted a strong yellow ochre colour phosphorescence. After exposure to LWUV I placed the stone into a black 35 mm film canister and viewed it in complete darkness at varying times. I had to give up after 30 hours because the ring had to be returned to the customer. The light emission was still (just!) visible, even after all that time.

All diamonds that fluoresce usually give off a yellowish phosphorescence — the stronger the fluorescence the stronger the phosphorescence. It's considered to be a definite test for diamond. However, I did come across a 2.08 ct loose brilliant-cut diamond that gave a strong whitish blue fluorescence but emitted a light green phosphorescence which only lasted a few seconds — just long enough to register. However, when viewed under short-xwave UV light (SWUV), this stone gave a slightly weaker blue fluorescence (as expected), but the phosphorescence was very strong for six or seven seconds then stayed at a reduced glow. After 25 minutes — and still with a small amount of phosphorescence left — I brought it back into the light of day (I did not have time to wait until it had all finished). Under the hand-held spectroscope the 415 nm line was present, but extremely difficult to see. The stone had some haziness and the body colour was that strange yellowish brown that graders will know; it looks yellow when compared to a brown stone but brown when compared to a yellowish stone!

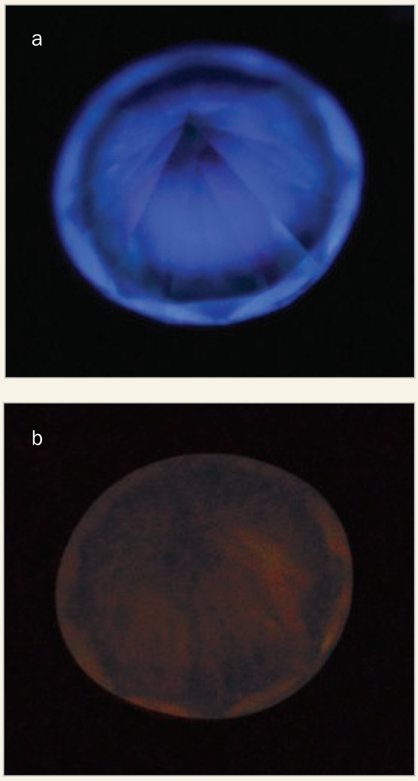


14: A 0.10 ct diamond displaying patchy yellow fluorescence.

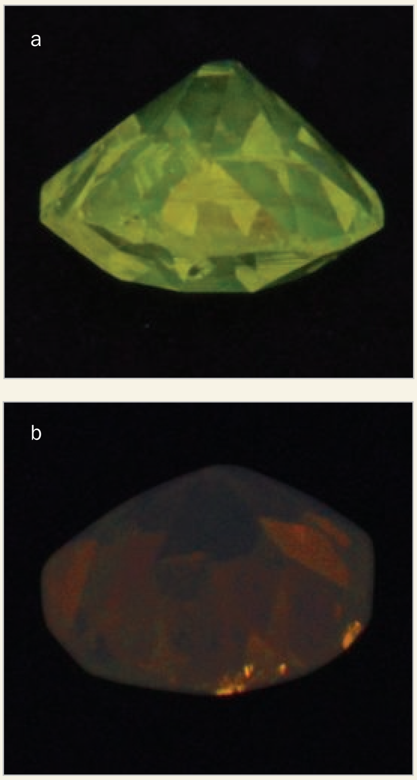
15: A 2 ct mounted diamond showing (a) exceptionally bright blue fluorescence, with a shoulder diamond fluorescing a normal blue and (b) a hazy, bluish appearance under normal light.



16: The 0.24 ct diamond seen in the centre of image 2, graded G.SI, displaying a yellowish phosphorescence.



17: A 0.09 ct diamond showing (a) medium to strong blue fluorescence and (b) dull yellowish phosphorescence.



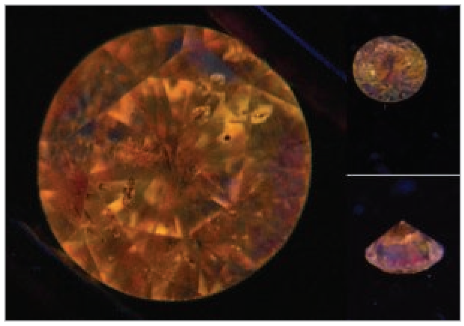
18: (a) A 0.13 ct yellow diamond fluorescing yellow. The phosphorescence was too little to be noticed by eye but a 15 second exposure can be seen in (b).

I took the stone shown in the centre of **2**, which displays exceptional light blue fluorescence, to see if I could photograph its phosphorescence. I tried a 10 second exposure, but so strong was the phosphorescence that I finished (in stages) at only a tenth of a second (**16**).

The diamond shown in **17a,b** displayed more normal, medium to strong blue fluorescence and emitted slight yellow phosphorescence long enough to notice, but which took an eight second exposure to photograph. I tried a yellow fluorescing diamond, which also had an almost fancy yellow body colour, to see if it displayed phosphorescence. I could not see any with the eye, but I did try photographing with a 15 second exposure (**18a,b**).

An unusual fluorescent colour seen in diamonds that are more or less colourless is orange. I came across one, shown in **19**, which weighs only 0.09 ct (2.8 mm). This stone was one of those "is it yellow or brown?" conundrums, like the one mentioned earlier, but equating to about I/J colour grade. The interior was unusual (for diamond inclusions), but perhaps we shall devote more time to this at a later stage. The phosphorescence was like the yellow stone in **18b**.

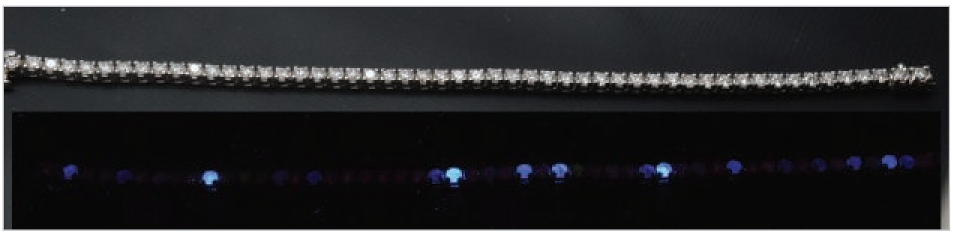
It was long ago suggested by Robert Webster, in his publication *Gems*, that such was the unpredictability of diamond fluorescence that a multi-diamond piece of jewellery might be photographed under LWUV to form a positive identification should the item be stolen and recovered. The photo-composite shown in **20** shows a 26 ct total diamond weight bracelet. You might say that this piece could be recognized without the trouble, but how about a straightforward line bracelet, such as the example given in **21**? When many diamonds look very similar in terms of colour, cut and clarity, it's refreshing to know that this 'King of Gems' can still surprise us with the range of reactions it displays under such 'secretive' viewing conditions. ■



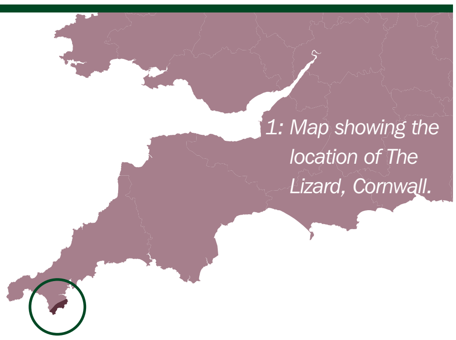
19: A 0.09 ct diamond (measuring 2.8 mm) showing overall orange fluorescence with some yellow areas.

All photos Grenville Millington FGA.

20: Platinum bracelet set with 26 ct (total weight) of diamonds under both normal and LWUV light. The violet colour is from the UV lamp.



21: Line bracelet with 4.40 ct (total weight) of diamonds, with its fluorescent identification pattern.


1: Map showing the location of The Lizard, Cornwall.

Cornish serpentine

Sarah Steele FGA DGA discusses the geology and history of Cornish serpentine, one of Britain's unique treasures.

I first fell in love with Cornish serpentine many years ago whilst on a holiday to The Lizard, Cornwall (**1**). As a British lapidary, the colours and textures appealed to me, but perhaps more important was the integrity of the product and industry, with half a dozen independent manufacturers working from small workshops — essentially sheds — in the town of Lizard. I could see comparisons with my own Whitby jet industry back home. Since then I have visited a number of times as some of the manufacturers save their 'scats' (chips from the lathe) for me to cut back home. But what is this enigmatic material — as wild and diverse in colour and texture (**2**) as the Cornish landscape from which it originates?


2: A collection of beach pebbles and polished pieces showing the variation in colour and texture of the serpentine.

GEOLOGY

A brief glance at the geological map of the southwest tip of Cornwall will tell even the most amateur geologist that there is something unusual going on in this area, and that The Lizard Peninsula has some rather exotic rocks. What we are seeing is in fact an 'ophiolite suite' — a slice of continental and oceanic crust, including material from the upper mantle that has been 'thrust up' over younger rocks. These oceanic sediments were deposited during the early Devonian age 375 million years ago, in a small rift basin similar to the Red Sea today, known as the Rheic Ocean. The rock, which would eventually became The Lizard, was about 10 km below the surface at this time, only reaching the crust's surface about 30° south of the equator as part of an ocean ridge. As the Rheic Ocean closed, continental drift carried the mass of rock north. It crossed the equator about 250 million years ago and finally reached its current position 50° north at around the start of the last Ice Age.

The Lizard now contains a suite of rocks which provide a rare opportunity to examine a geological sequence representing the transition from the mantle to the crust. As jewellers and gemmologists the concept of gem material from the mantle isn't new to us (diamond and peridot spring to mind), but in this case it's the mantle rocks themselves that are of interest.

For me the most decorative rocks from a lapidary point of view are the serpentines (**3**), which represent the metamorphosed upper layers of the mantle. It is a somewhat unusual case whereby metamorphism is induced in mantle rocks by a decrease in temperature and pressure, rather than an increase. Originally they consisted of lherzolite peridotite and depleted harzburgite. Residence in the upper crust takes the minerals which comprise these ultramafic rocks far from their stability fields, also, the mantle is depleted of water, whereas water is abundant in the upper crust and such minerals, namely olivines and pyroxenes, are unstable in the presence of water. Hydrothermal alteration from percolating seawater in the mantle, by which magnesium-rich silicate minerals are converted into or replaced by serpentine minerals, is known as 'serpentinization'. This process produces clay minerals such as lizardite, saponite and chrysotile. Other minerals formed are chlorite, tremolite and talc, which are all produced from the breaking down of olivine and pyroxene. Iron derived from the hydrothermal alteration of these minerals forms goethite and hematite. This process produces the multicoloured serpentines resembling a snake or lizard skin.

There are primarily two types of Cornish serpentine on The Lizard: bastite serpentine — coarse-grained with large shiny crystals of bastite which give a flecked appearance — and tremolite serpentine, which is fine-grained and banded. More often than not they are deformed and exhibit a foliation. Serpentines are frequently criss-crossed by veins filled with fibrous serpentine and tremolite. These are often pale green in colour (in which case the mineral is the serpentine antigorite).

A brief glance at the geological map of the southwest tip of Cornwall will tell even the most amateur geologist that there is something unusual going on in this area...

THE BIRTH OF AN INDUSTRY

Globally serpentines are not rare, but what distinguishes the serpentines of The Lizard, however, are the variety of colours and textures seen. The natural beauty of the serpentine has led to a thriving industry surrounding it. The exact date the industry commenced is uncertain, but the first documented reference to serpentine working is in 1828. This earliest mention does not refer to a primitive art but to what had clearly become an industry. It's said that Josiah Wedgewood himself had travelled to examine serpentine's potential for clay minerals in 1818.

A combination of factors in the mid-nineteenth century transformed its fortunes. Queen Victoria was keen to promote England as an international centre for art and craft and the great houses of England were requiring more elaborate materials for columns and fireplaces. The workers in The Lizard quarries began to compete for trade with foreign marble suppliers.

Initially the quarries just produced the raw building blocks that were sent to Truro for manufacture, but eventually, with the aid of improved mining and quarrying technology, a manufacturing industry evolved within The Lizard area.

In Penzance three businessmen purchased the abandoned Wherry Mine and serpentine was ordered and shipped to the site. By 1848 it was reported that 37 men were employed at the works. Two years previous to this the business had received royal patronage when a seasick Prince Albert came ashore at Kynance and an ingenious local sold him some pieces. The Queen and their children then visited the Wherrytown works to inspect the factory, sealing orders for fireplaces for Osbourne House. The company also had a presence at The Great Exhibition, winning prizes for a pair of 13-foot obelisks and a carved font, thus securing them orders from Westminster Abbey, Chatsworth House and many other public buildings. The company hadn't expected the demand and could hardly cope. A partnership was formed with a group of London businessmen and the London and Penzance Serpentine Company was formed.


a


b

3: Serpentine in situ*, located (a) on the beach and (b) on the cliffs.*

4: Abandoned Poltesco works.

The demand led to the opening of several new quarries on The Lizard, but finding large pieces of suitable stone was proving problematic. The industry had also started to attract visitors keen to see the origin of the material that was causing such a stir in London — giving The Lizard a fledgling tourist trade. Smaller tourist trinkets and ornaments were needed for these visitors and the production of hand-turned ornaments flourished.

The next step was to set up larger-scale manufacturing sites on The Lizard itself rather than export the stone to Truro or Penzance. There were, however, few suitable sites. A sizeable stream was needed for power, plus a navigable yet sheltered cove, as there was no rail access and the site needed to be near to the quarries. Carleon Cove at the mouth of Poltesco Valley was an obvious choice, and in 1853 The Lizard Serpentine Company was formed. The Poltesco works had several advantages over the Wherrytown site; primarily proximity to the raw material and coastal transport links, especially during harsh winter conditions (**4**). Competition for the raw material was also driving up prices but at Poltesco, the lower handling costs gave them the edge. The workers also favoured the local company and many men defected from Wherrytown to the Poltesco works. Wherrytown spread its net wider for skilled tradesmen and in 1854 it successfully head-hunted six skilled Blue John turners from Castleton in Derbyshire and relocated them to Penzance with considerable publicity. The Lizard Company opened showrooms on The Strand in London at a similar time and the two companies went head to head in competition. Both were prosperous — for a while at least.

5: A fine example of a turned lighthouse crafted from serpentine and other typical tourist pieces.

There was, however, early controversy surrounding the product, when in 1854 *The Illustrated London News* reported: "Objections have been hitherto raised to serpentine as unlikely to prove durable; seeing that the general introduction of this beautiful product may greatly interfere with the important interest of the marble trade, it is not to be wondered at that the forebodings of failure should be vehement and frequent."

6: An example of contemporary jewellery featuring Cornish serpentine. Piece by Sarah Steele.

The manufacturers countered the concerns by referencing the many Lizard churches built from serpentine blocks that had withstood centuries of extreme Cornish weather. However, the new demand for serpentine as a surface dressing for buildings using slabs of stone only an inch thick was a very different prospect from using solid blocks of stone. The Cornish climate is windy and wet, but it is protected from frost, extreme cold and the baking heat of a London street in summer. The hydrated nature of the crystals within the serpentinized rock caused thermal expansion and contractions, and the cracks quite literally began to show. Despite these problems the industry continued to flourish. At Poltesco the workforce increased to 65 and, with the installation of a steam engine for power, the Lizard Serpentine Company Ltd gained the commercial advantage over the Wherrytown works. However, the industry could not fulfil the endless demand for large, unflawed pieces of stone and supplies soon dried up as quarry after quarry was worked out. As cost rose so did prices, and, coupled with news of its poor durability and stability, the reputation of serpentine became tarnished. In 1865 the London and Penzance Serpentine Company was wound up but many smaller companies grew from the fragmented workforce, serving the tourist trade with mementos of their visit to the area. The workforce at Poltesco fell to around 20 and concentrated solely on interior pieces. In 1893, following a loss of cargo on an uninsured ship, the factory finally fell silent. Its meteoric rise and subsequent decline had taken only 30 years. Its legacy remains however, with beautiful pieces still adorning stately homes — not to mention the thousands of turned lighthouses produced for the tourist trade (**5**).

Nobody knows who first came up with the idea to turn lighthouses but the village was soon awash with them of all sizes, each manufacturer having their own distinct style. This trade has kept manufacturing alive in the area for the last 125 years.

THE INDUSTRY TODAY

Five years ago I was told that the industry was once again facing problems. At that time the biggest concern was access to raw materials — the headlands in the area are National Trust property, making extraction of serpentine problematic. There was also a concern that younger generations simply weren't interested in taking over the family business and, as in the case of most British lapidary centres, serpentine working is a vernacular trade passed down from father to son. What struck me at the time, however, was a reluctance to move into a more lucrative contemporary jewellery market rather than traditional ornament manufacture and lathe-turned earrings and pendants (**6**). I felt the potential as a lapidary material was perhaps not being fulfilled.

When I was asked to write this article, I truly hoped that I would be able to report a rosy future for Cornish serpentine manufacturing. Sadly, however, it seems that the industry is finally coming to an end. I was shocked to learn that The Lizard is down to one full-time manufacturer and one part-time turner, with the other shops that remain open now selling off old stock. The primary cause is not lack of raw materials as I expected; instead it is an ageing workforce in a labour-intensive and often cold, harsh working environment which is simply not appealing to a younger generation (**7**, **8**). A lack of tourist spending has also taken its toll and I'm told that there has been a decline in overseas visitors to the area over the last couple of years. The import of much cheaper lighthouses turned in the Far East using foreign serpentine has also been a contributing factor. Although we can scarcely afford to lose one of the last remaining historic lapidary centres, sadly it looks like we are near the end of serpentine production in Cornwall. Away from the Lizard there are a handful of us still cutting Cornish serpentine, but sadly much of the traditional skill will soon be gone forever. ■

7: A typical Lizard workshop.

8: Interior of Derek Pitman's workshop.

All images Sarah Steele.

Further reading

- Bates, R. and Scolding, B., 2000. *Beneath the Skin of The Lizard*, Serpentine Design, Cornwall.
- Kirby, G.A., 1979. The Lizard complex as an ophiolite. *Nature*, 282, 58–61, http://dx.doi.org/10.1038/282058a0.
- Sagar-Fenton, M., 2005. *Serpentine*, Truran Books, Cornwall.
- The Lizard, http://bit.ly/1JYfgaF

Acknowledgements

Many thanks to Derek Pitman for his up to date information regarding the Cornish Serpentine industry on The Lizard.

Fire obsidian

Tom Dodge takes a look at this enchanting and little-known material.

Fire obsidian, a particular variety of iridescent obsidian found in the northwest USA, displays various brilliant colours and patterns. When carefully worked by the lapidary, exquisite gems can be produced that, in the author's opinion, are equal to the finest examples of other iridescent gems in 'play of colour', brilliance, uniqueness and intrinsic beauty. To date this location is the only occurrence of fire obsidian known.

Iridescent gems and minerals have held a special fascination for man throughout history. Many early attempts were made to describe both the cause of the iridescence and the metaphysical properties that were believed to be associated with them. In ancient times precious opal was considered a stone of great benefit to the eyes and was worn to cure ocular ailments, as well as to render the carrier of the stone invisible to the eyes of others (Braid, 2015). Fire opal was admired as a symbol of fervent love in ancient times among the peoples of India, Persia, Central America and North America. It was believed that a gem that bubbled over with vivacity to such an extent as the fire opal could have been created only in the waters of paradise (International Coloured Gemstone Association, 2015). The Mayans and Aztecs particularly loved this gemstone and used it in mosaics and for ritualistic purposes. Today rainbow obsidian is believed by some to be particularly powerful in meditation to dissolve shock, fear or barriers.

Optical phenomena are caused by the light-dependent properties of a gem. They are not due to its basic chemical and crystalline structure, rather the interaction of light with certain inclusions or structural features within the gem. Iridescence is the phenomenon seen as a multicoloured surface effect caused by diffraction. As white light passes through very small openings such as pores or slits it is diffracted and a prism effect causes it to separate into spectral colours. This diffraction creates the rainbow display of fractures, the colours of labradorite, and the 'play of colour' of precious opal. Iridescence is the most widespread of the optical phenomena and can be observed in pearls, fire agate, 'rainbow calcite', some obsidians and iris agate. When iridescence is combined with interference, thin-film interference occurs (The Physics Classroom, 2015). When colour waves reflect through thin layers of material which differ in refractive index, a loss of some colours and a reinforcement of others can take place. This gives rise to dramatic colour blocks, which may shift with viewing angle.

> It was believed that a gem that bubbled over with vivacity to such an extent as the fire opal could have been created only in the waters of paradise...

Recent laboratory analysis has determined that the 'fire' in fire obsidian is caused by thin-film interference. Examples of this form of interference include the sheen of soap bubbles on a sunny day, the streaks of colour on a freshly wiped windshield, and a colourful film of oil on a rain puddle — these are all the results of the interference of light by a very thin film of one material that is spread over the surface of another material. Collected samples of fire obsidian were investigated with field-emission scanning electron microscopy, X-ray energy-dispersive spectroscopy, electron back-scatter diffraction and optical spectroscopy methods (Ma *et al.,* 2007). The study revealed that thin layers (flow bands) within the obsidian have a thickness of 300 to 700 nm and are enriched with nanometric-sized crystals of magnetite. The colour is caused by thin-film optical interference, in which the thin iron-enriched layers have a higher calculated index of refraction ($1.496 < n < 1.519$) than that of the host glass ($n = 1.481$).

Obsidian is an igneous rock that forms when molten rock material cools so rapidly that atoms are unable to arrange themselves into a crystalline structure. The result is a volcanic glass with a smooth uniform texture that breaks with a conchoidal fracture. It is an amorphous material known as a 'mineraloid'. Pure obsidian is usually dark in appearance, although the colour varies depending on the presence of impurities. Iron and magnesium typically give obsidian a dark green to brown to black colour. Very few samples are nearly colourless. Certain types, however, display iridescent patterns due to dense and

relatively homogenous concentrations of minute suspended inclusions of magnetite that act like diffraction gratings. Descriptive trade names like 'velvet' or 'rainbow' obsidian are used to market these varieties.

The volcanic highland hosting the fire obsidian is located in southeast Oregon and is an extinct rhyolite dome complex that encompasses approximately 90 km^2 at altitudes of 1,400 to 1,950 m (Walker and MacLeod, 1991). Most of the volcanic deposits, which include numerous varieties of obsidian, rhyolite flows and dykes and perlite have been dated at four to five million years old on the basis of potassium–argon age dating (Walker *et al.,* 1974). Post-eruption weathering and erosion have removed much of the youngest volcanic deposits, locally exposing older sections of the rhyolite dome.

Although extensive deposits of a wide variety of obsidian occur in the area, fire obsidian has been found only in small localized dykes which appear to be intimately related to, and sub-parallel to, rhyolite dykes. Zones containing the bright colour bands exist as small, isolated and discontinuous 'pods' within weak to strongly flow banded black or brown obsidian. These flow bands are generally aligned sub-parallel to the orientation of the obsidian dykes (Miller, 2006). Hard labour is necessary to excavate the fractured but compact material. Approximately 10 to 20% of the total volume extracted will have the potential to contain fire layers and only about 5% of that amount will contain fire. Fresh from the ground, the irregularly shaped and sized pieces are dirty and opaque. Small test chips can be carefully removed to inspect for the faint thin flow bands. More detailed inspection may reveal the sought-after bright fire reflecting from the band(s). Then the work begins.

Fire obsidian is excellent for cutting and polishing into unique and spectacular cabochons. First, the stone must be cleaned, and then a detailed 'reading' of the rock (to determine the exact location and orientation of fire layers) is performed. This is a challenging procedure as every piece is unique. Some layers reflect many colours in bands and patterns, with sharp boundaries between the colours, while in other stones the colours may overlap each other. Colour may exist only on part of the layer, leaving the remainder of the same layer a dull grey.

Although extensive deposits of a wide variety of obsidian occur in the area, fire obsidian has been found only in small localized dykes which appear to be intimately related to, and sub-parallel to, rhyolite dykes.

The colours and intensity of the iridescence (the 'flash') can be highly variable along the same layer. Some layers reflect colours on both sides, while others reflect colours on only one side. The colour can occur as single isolated layers in the stone or as several colour layers stacked very closely on top of one another. Reflective layers are rarely flat. They often undulate and change orientation, usually to a small degree, but these shifts can be abrupt and drastic. Some layers are so contorted as to turn and double back on themselves. The colours reflected by a single layer can have colours that range through the entire spectrum, while other layers display a single colour. Additionally, patterns (striations, blotches, ropes, wrinkles, straw-like shoots, rods and others) observed along with the reflectance can be highly variable. The cause of these patterns is not known but is possibly the result of small localized differences in the thickness or the orientation of the magnetite enrichment along the flow bands.

Successful cutting and polishing of fire obsidian is extremely challenging for the lapidary. Diamond cabochon-making lapidary equipment is ideal for working this material. Locating and isolating nanometric layers within black glass requires skill, diligence and a great deal of patience. Obtaining a high 'wet' polish on black glass is difficult and time consuming. Ideal results are achieved using expensive polishing agents such as optical grade cerium oxide.

Equipment contamination is a strong concern at all stages of grinding, sanding and polishing, and must be avoided.

Fire obsidian is relatively new to the gem and jewellery community and is known to occur at only one location worldwide. The collecting of fire obsidian is labour intensive and successfully working the material by the lapidary is challenging, expensive, time consuming and tedious. Recent initial marketing efforts have resulted in high interest from jewellers and collectors in finished cabochons and polished windowed specimens. While rough material is seldom available, proven pieces in the form of small slabs or unpolished 'windowed' stones are available to the lapidary. ■

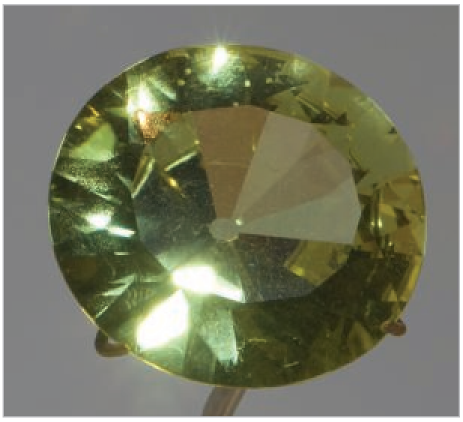
ABOUT THE AUTHOR
William Thomas (Tom) Dodge is a retired geologist living in Arizona, USA. Tom has been an avid rock collector for 57 years, a registered professional consulting exploration geologist for 35 years, a skilled flint knapper for 16 years and a budding lapidary for two years. Collecting and working fire obsidian has truly become his passion and he blames (and sincerely thanks) Emory Coons, the master of this spectacular material and a generous tutor. Tom affectionately refers to fire obsidian as "the nectar of the earth". For more information about this material contact Tom at tdodge101@gmail.com.

Samples shown were created by and belong to either the author or Emory Coons. Photography by Jeff Scovil.

References

- Braid, F., 2015. International Gem Society, www.gemsociety.org/article/history-legend-opal-gems-yore/
- International Coloured Gemstone Association (ICA), 2015, www.gemstone.org/index.php?option=com_content&view=article&id=125:sapphire&catid=1:gem-by-gem&Itemid=14
- Ma, C., Rossman, G.R., and Miller, J.A., 2007. The Origin of Colour in "Fire" Obsidian. *The Canadian Mineralogist*, 45(3), 551–557.
- Miller, J.A., 2006. Fabulous Fire Obsidian. *Rock and Gem*, 36(1), 60–64.
- The Physics Classroom, 2015. www.physicsclassroom.com/class/light/Lesson-1/Thin-Film-Interference
- Walker, G.W., Dalrymple, G.B., and Lanphere, M.A., 1974. Index to potassium–argon ages of Cenozoic volcanic rocks of Oregon. U.S. Geol. Survey, Misc. Invest. Ser., Field Studies Map MF–569 (scale 1:1,000,000).
- Walker, G.W., and MacLeod, N.S., 1991. Geologic Map of Oregon. U.S. Geol. Survey, Map 32383 (scale 1:500,000).

The Hope Chrysoberyl



Alan Hart BSc FGA DGA, head of Earth Sciences collections and Principle Curator of Gems and Minerals at the Natural History Museum, takes a look at the Hope Chrysoberyl, part of the famous Hope collection.

Recently a rare historic spinel, once the property of Henry Philip Hope, sold for a world record £962,500 (see Jack Ogden's article on the Hope Spinel, *Gems&Jewellery*, October 2015, pages 20–21). The Hope Spinel, named for its former owner, was part of a great collection of stones which included amongst them the Hope Diamond, now the pride of the collection at the National Museum of Natural History in the Smithsonian Institution. When historic specimens come to auction, it is often the case that curators of collections around the world review and critically appraise the collections under their care for similar items of interest or historic provenance, to both put them in context and to understand market values. In the collections of the Natural History Museum (NHM), we have the Hope Chrysoberyl (pictured), a name given to a gemstone which Hope owned, and which was described as 'matchless', which gave a pedigree alongside the Hope Diamond and Hope Spinel.

A catalogue of the Hope collection makes interesting reading. It is noted that it "took Hope a great number of years, a result of the most refined taste, an ardent love for nature and an abundant means of securing them, the collection is unrivalled, and trusted with the descriptive catalogue and thorough and minute examination of every gem... the collection is kept in a mahogany case, containing 16 drawers, each glazed and numbered, most mounted as rings with an ivory ticket attached with the more precious the weight of the stone engraved".

Indeed, the sixteenth drawer must have been a spectacle to behold, containing the prize items of the collection, including the Hope Diamond, Spinel, Chrysoberyl and large pearls and emeralds. The descriptions of the individual items are concise, but also impart the importance of the specimens as given by the author. The Hope Chrysoberyl was described as "A most superb chrysolite, nearly of a circular form, and of a deep yellowish-green tint, approaching the peridot colour, and most admirably cut like a brilliant. This extraordinarily fine gem is of the greatest transparency and brilliancy, and free from any speck or flaw; its uncommonly large size and great perfection entitle it to be called a matchless specimen. It is certainly to be considered one of the rarest specimens of the cymophane, there being very seldom a stone of this size and weight found in this class of gems, which exhibit such perfection: set as a ring with small brilliants…"

However, as with many historic gems, there is often much information that has been lost or disassociated from the specimens themselves. Looking through the archives and records of the catalogues of the NHM, some surprising information comes to light for the Hope Chrysoberyl. The specimen came into the Museum in 1866 having been purchased from J.R. Gregory who bought it at the auction of the collection at Christie's, possibly acting for the Museum. There is also a Trustees Minute with a report that it had been previously offered to Professor Nevil Story-Maskelyne (then Keeper of Mineralogy) for £110 in 1857, but no indication of why it had not been purchased. From the archives of the former Museum of Practical Geology (now part of the NHM archives) there is an interesting letter from famous mineral collector and dealer Henry Heuland to his Excellency William Thornton (1766–1852), then Minister of Portugal. Within it is stated that a fine Brazilian chrysoberyl from the collections of the Marquis of Anaga had been sold to Hope: "I lately sold for him his water worn chrysoberyl to Mr Henry Philip Hope (the well-known collector of pictures and precious stones) for £250. It was less valuable in the rough, and I advised him to have it cut; he did so, and besides a small stone it gave a perfect one of 44 carats." It was undoubtedly this stone that was described by Herbert Smith in his outstanding work *Gemstones* as "Absolutely flawless…probably by far the finest cut example of this type of chryoberyl known".

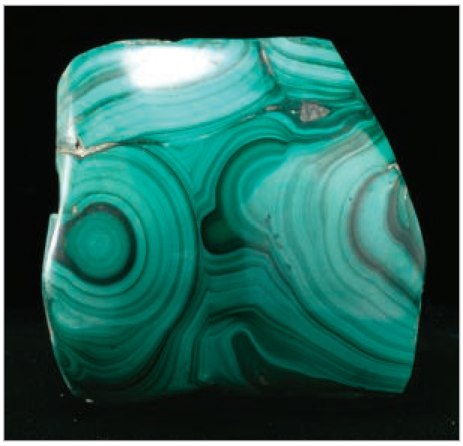
> ...its uncommonly large size and great perfection entitle it to be called a 'matchless' specimen.

The Hope Chrysoberyl, with its rather more formal description of "BM 39906 Chrysoberyl, $BeAl_2O_4$ [Brazil], clear, pale green; facetted; deep back. 8.989 grams, 45 carats"; now sits proudly on display in the 'Vault' exhibition at the NHM in London. As a relatively new mineral in 1821, having only been described for the first time by Werner in 1789, it would have been a unique cut stone of the 'species' for its time. It is free from flaws and is of a remarkable, even lime-green colour, with bright lustre adding to its presence. With its long history and proven provenance it is one of the highlights of the gem collections at the Museum. Although I am sure there are many Hope specimens from the original collection that may be revealed through research (ignited by the auction of the recent Hope Spinel), it seems fitting that much of Hope's original collections, although not kept together post-auction, can still be seen and enjoyed in various museums, institutions and private collections around the world. It seems that Hope truly did have "refined taste". ■

The Hart of The Matter

To anyone with a love of gems, rocks and minerals, Alan Hart's job is akin to being a child in a sweet shop. The head of the Earth Sciences Department at the Natural History Museum admits to us that he's in his element and explains just what his enviable position entails.

Alan Hart, vault curator with various specimens



An example of the NHM's collection of 80 million specimens, which scientists at the museum are researching every day.

When did you first become interested in minerals and how did that come about?
From an early age I have always been interested in collecting things; stamps, cards, etc, but it was visiting the Natural History Museum (NHM) during primary school that I first went into the Mineral Gallery and was amazed by the colours, shapes and varieties of minerals. When I found out that you could actually buy, and sometimes rarely go to places to collect them, that was it! I had a small collection and it went from there.

How long have you worked at the NHM and what was your progression through the Museum?
I started at the Museum when I was 16 years old. I was not 'allowed' to combine the subjects of languages and science together at school, so my mother told me to find a good career instead. I said to her that I wanted to work at a museum as an assistant scientific officer and three weeks later I was in front of an interview panel for the job of an X-ray crystallographer at the NHM. I didn't get the position (way out of my depth at 16), but I was offered a temporary position in 'Mineral Collections' for six months.

It was an opportunity I had to grasp so I worked hard, and on the last day of employment was offered a full time position by the keeper of the department as an assistant curator. From then on I worked on curating the mineral collection, learning the subject matter and 'museology', from the established curators — as part of overall succession planning they passed on years of experience. I was promoted after tackling some big initiatives and, from becoming more autonomous in my role and developing some 'direction', moved up the ranks.

Ultimately there was a merger of the departments of Palaeontology and Mineralogy to form the Earth Sciences Department for which I was appointed head of collections four years ago. I am now also chair of the Museums Collections Committee, an overarching group responsible for cross departmental initiatives for the entire Museum's holdings — it's been quite a journey!

Your job description is pretty broad. Can you describe a typical day in your working life?
Museums are amazing places to work and there is never a typical day. However, as manager of a team of 27 people in the Earth Sciences collection and working on some big initiatives for the Museum (i.e. digitization, collections development), I have various meetings during the day. I also keep abreast of current issues across the Museum and ensure I report back on those to relevant staff to keep them informed… communication plays a big role in my everyday work.

What aspect of your work excites you the most? What is your overall aim in your work?
I am passionate about how collections are developed and obtaining new items for them to further the Museum in terms of research, but also as a visitor attraction, to show some of the most beautiful and thought-provoking 'products' of nature. I also really do enjoy working with people; everyone I meet I can and have learnt from. It's the collective expertise of people and what they can give together to drive forward major projects, or even brainstorming thoughts for development, that I really enjoy.

The overall aim of my work is very wide-ranging, but I think that it is simply to make our collections as accessible as possible and to develop the collections and its staff to maximize this. We then both benefit and inspire as wide an audience as possible in our work.

> It is essential to have direction in what you are trying to accomplish and set goals for where you want to be and how you are going to get there.

Can you explain exactly what 'earth sciences' means, particularly in the context of the Museum?
Earth Sciences is such a wide-ranging field, but in the Museum it is the amalgamation of the Department of Palaeontology and Mineralogy. We have collections from dinosaurs, minerals, gems and meteorites, to ores, rocks and soils; all of which we research and study at various levels.

Can you explain what developing collections strategy and developing strategic missions means in context of the NHM and the Earth Sciences department?
It is essential to have direction in what you are trying to accomplish and set goals for where you want to be and how you are going to get there. For example, with developing collections, what do we want to acquire? Do we play to our strengths or try to build upon our weaknesses? In times of limited resources we need to clearly articulate how we prioritize our resources to get to our stated aims. So our collections strategies are formulated to expand our research impact through making it relevant to society, which in turn is reflected in how we deliver our message of who we are and what we are trying to do.

Medusa emerald — on display in The Vault

Describe your own contribution to developing the gemstone collections for the NHM. How far and wide did you have to travel to get it off the ground? Who loans collections/objects and why?
I have always loved the gemstone collection at the NHM and have been so fortunate to learn and be inspired by the people that previously looked after them. Funnily enough I can also see 'gems' as being basically the purest of minerals in a sense, so I see the development of them being similar to any collection for research and display.

However, as we know, gems are exceptional for being an enormous part of our culture and I want to develop the collections to embrace the huge opportunities that I can see. I am very fortunate to be able to go to the AGTA Tucson GemFair and various other trade shows regularly to meet many people in the trade, whilst also being able to travel the world to see other major collections. I meet lots of people responsible for these collections, all of whom I have learnt from (and become great friends with) and put the collections at the Museum in 'context'.

I have been able to 'loan-in' significant items, which would have simply not been available to purchase, but through securing these loans are able to be seen by the 5.5 million people that come through our doors every year. I know and hope that when people do loan to us, they get to know that the object(s) they display do inspire our public, rather than being locked away in private collections where not many people may see them.

Does your job involve a lot of contact with the press?
I have often been 'wheeled out' to give interviews about various aspects of the departments and the Museum's work, which I do enjoy! Many people know I can talk (I hope) passionately about the subject.

As curator of two major exhibitions 'Diamonds' and 'The Vault', media activity is essential for us to both promote the exhibitions and the work of the Museum itself. I also give general interviews and opinion pieces as and when required, sometimes on wildly different subject matters in natural history science or the thought processes behind the strategy and direction we are taking.

How is the collections' digitization progressing? What exactly does it involve? Is it largely an aid for scientists, as opposed to the enthusiastic amateur?
We have 80 million specimens at the Museum — a huge number, and in some sense a treasure vault of information waiting to be tapped. We aim to have the collection digitized to make it available to as wide an audience as possible. This helps drive future research initiatives by unlocking the 'big data' on collections that will enlighten us on those big questions affecting our natural world today — climate change, our origins and evolution, biodiversity loss and sustainability — all part of the Museum's strategic aims. This is for the benefit of all of our audiences as, through this, we aim to also have a big citizen science contribution. I wrote the initial scoping document as a way forward on how to approach digitization at this scale, which has subsequently become the Museum's Digital Collections Programme — as you can imagine, a complex initiative! As senior responsible officer, I am charged with keeping on track of some of the projects within the overall programme of work.

Please tell me us little about the research you are undertaking now —particularly the cutting of famous Mogul diamonds. Has this been completed? Will visitors be able to see the results in the Museum or is it to be published somewhere?
Since the 'Diamonds' exhibition, I have been fascinated by large diamonds (aren't we all!). However, in particular, in the Museum we have a collection of famous diamond models created from moulds which were taken directly from the original diamonds themselves. I have studied them and made some surprising discoveries, assisted by the huge amount of open information from digital libraries that can be referred to directly. As with any research, it is ongoing as there are so many different avenues to explore, but I hope my research on the Koh-i-Noor diamond will be published soon — it has been an amazing project for me. The original moulds and replicas in CZ of its original form can be seen in the Museum's Vault exhibition.

Tissint meteorite on display in The Vault gallery — it is the most important meteorite to have fallen in 100 years.

It's finding the opportunities to deliver our aims and inspiring others with our collections, research and continued standing of our work that I find very fulfilling.

You mentioned in your Gem-A Conference talk that the NHM is not afraid to be controversial. What did you mean by that?
What I meant was that the Museum will clearly state the outcomes of its research or give examples of its impact in an authoritative way. We are living in an unprecedented era of global change, and the research we are doing is shedding light on the impact or humanity of this change.

What's next for the Museum?
As always, museums need to evolve. For us we will need to prioritize resources as we often do more with less funds. We have amazing collections and, most importantly, amazing staff to look after, to develop and make them available. We are all very proud of the Museum and its work and so we continually strive to do the best for it and be the best where we can.

Is there a commercial part of your brain, a creative one — or are you a scientist and educator through and through?
Great question. I have evolved throughout my career. I am always a scientist and educator through and through, but as I have gone up through the management 'ranks', I have gained a commercial brain in some sense, to ensure that we can continue to science, and educate through that science, to the best of our means. If that means getting sponsorship or engaging with commercial activities which are now often essential for most museums, then that's fine and it's something I enjoy immensely. It's finding the opportunities to deliver our aims and inspiring others with our collections, research and continued standing of our work that I find very fulfilling.

What concerns — if any — do have regarding the world of gemstones?
Not a concern as such, but I am amazed by the rise in scientific and aesthetic value of objects over the years since I started work at the Museum. We are always looking for new opportunities to display and conserve these new specimens. For gems, there is a need to ensure the correct scientific 'taxonomy' is adhered to. It is understandable to use various new 'trade names' to market items, which is interesting for us scientists — but we like to be able to pigeonhole things based on proper scientific nomenclature. ■

Gem-A Conference 2015

Held at the Royal Institute of British Architects (RIBA) from 21–22 November, the Gem-A Conference and 18th FEEG Symposium welcomed a host of top-rated international speakers and delegates from all over the world. Andrew Fellows and Georgina Brown report.

A pearl of incredible size and colour. Photo © Gellner.

JÖRG GELLNER – 'A 'RAP LIST' FOR PEARLS'

Jörg Gellner, head of the famous pearl jewellery design house Gellner, kicked off Saturday morning with his presentation on pearls and a proposition for a Rapaport-style price list for pearls, used in-house at Gellner. Whilst the quality of a diamond can be assessed using the 4 Cs, Jörg suggested that the quality of a pearl can be assessed using the 5 Ss: size, shape, shade, surface (or spot level) and shine (lustre). Jörg said that, as a rough guide, increasing the size of a pearl by 1 mm adds approximately 35% to its value (provided all other factors are equal). Round pearls are worth the most, with other shapes incurring reductions. Ovals can trade at about 70% of the price of an identically-weighted round pearl, but this can fall as low as 20% for some of the less desirable baroque shapes. Exceptions to the rule do exist, however, and Jörg showed how a drop-shaped pearl could trade in the region of 70% the price of a round, but increase up to 150% (1.5 times the price) of the same round if the drop were part of a matched pair.

Jörg then moved on to consider the shade of a pearl — this can almost be thought of as being the equivalent of the colour grade for a diamond. As with the Rapaport report for diamonds (where 'white' or colourless diamonds trade for high prices), true white pearls are near the top of the scale. As colour/shade increases, the price falls, with cream or off-whites being given a guide of 80% of the value of a white pearl. In diamonds fancy colours are highly sought after and command a premium price — this is also true of pearls. Those showing a 'peacock' coloration can reach twice the price of a pure white pearl, whilst golden pearls can be even higher, at three times the price. Specific shades take this to extremes — Jörg highlighted how a pearl displaying a copper coloration can, due to its rarity, hit 10 times the price of a white pearl. Source also plays a part in factor, as certain colours are more common from some localities and in given sizes, with a Fijian grey pearl trading at a higher value than its Tahitian equivalent.

The surface condition (or spot level) of a pearl also affects the value. Under his proposed 'Rap List' for pearls, the different spot levels (equating to different surface conditions and blemishes) would attract different price bands, in much the same way as clarity affects a diamond. Dropping from one spot level to the next could have as much as a 1.5 times price differential.

The final factor affecting price is the shine or lustre of the pearl, which can be equated roughly to the lustre of a gemstone. Starting with the highest lustre, such pearls are given a triple A (AAA) grade, and then fall through AA to A before descending into B and below. The price differences can be significant here, as a pearl exhibiting a B grade shine would lose close to 70% of the value that a AAA pearl would have.

As with all grading of gemstones, experience is needed to be able to differentiate between the different levels of the 5 Ss, but with the relevant training any pearl dealer could be educated and shown how to separate pearls into the various levels of each of the factors, giving a starting point for negotiations.

Application to real world markets could lead to consistent pricing throughout the market. Jörg summed up how each of the 5 Ss had an individual effect on price and how, by using price calculation charts, a final price could be determined from a known starting point.

JEAN-PIERRE CHALAIN — 'RETROSPECTIVE VIEWS ON THE IDENTIFICATION OF THE HPHT TREATMENT AT THE SSEF'

Next up was Jean-Pierre Chalain, deputy director of SSEF and director of its diamond department. Jean-Pierre gave delegates a retrospective look at the history and identification of high pressure, high temperature (HPHT) treatment of diamonds, with the emphasis on the lab's work in the field. Although sounding technical from its title, Jean Pierre's unique style ensured that this presentation was understood by all. Jean-Pierre started by explaining to delegates that if diamonds were to have a gender, they would be irrefutably female, stating that diamonds are a symbol of beauty and "the queen of gemstones".

From its first mention in 1997, HPHT had been a major worry to the diamond trade, as initially it was thought to be an irreversible and undetectable treatment. Although applicable only to a small percentage of diamonds that show a brown coloration due to internal strain, this new treatment nonetheless presented laboratories with a problem — how do you detect something that may or may not be present in the stone under test? Jean-Pierre went back to basics, explaining the processes involved in HPHT treatment (created through a combination of increased heat — up to 1200°C — at pressures in the region of 60 KBar) that effectively puts the diamond back into a state mimicking its original growth conditions. This allows the brown colour to vanish and thus the colour to lighten. This was believed to closely mirror a potential natural process that could feasibly happen to any stone during its formation. The brown colour that this treatment sets out to remove or reduce is due at least partially to a heat-sensitive colouring effect and so can be affected by higher temperatures. As diamond is made up of carbon, however, it would revert to its preferred state of graphite or carbon dioxide if this were carried out at

…if diamonds were to have a gender, they would be irrefutably female… a symbol of beauty and "the queen of gemstones".

Sorting pearls by colour. Photo © Gellner.

normal pressures, so the addition on high pressure is needed to ensure the diamond remains diamond. When performed on diamonds of a high clarity grade, the evidence that a lot of gemmologists look for (heat damage to inclusions) isn't present, making this hard to detect with standard equipment. With advanced testing identification may be possible, but what to look for and what it meant were the challenges set.

Detection thus presented a challenge that SSEF set about tackling. Reviewing the timeline of developments, discoveries and literature, Jean-Pierre took the audience on a tour from unknown effect and result through to the SSEF's 'state of enlightenment' on the process — where nowadays HPHT treatment is, where present, regularly detected and reported. From simple observations through to FTIR and photoluminescence spectroscopy, eager gemmologists and students were led through the process that eventually resulted in the identification of HPHT treatment. Nowadays the treatment has been advanced and is applied to a wider range of stones as part of multi-step treatments to enhance colours, not merely to lighten a small proportion of brown diamonds.

By the end of Jean-Pierre's talk all delegates were conversant with the basics and history of this form of diamond treatment, as well as SSEF's part in bringing it to the attention of the diamond world. In 2000, De Beers officially congratulated SSEF on the work they had put in to research in this area, and since then numerous articles have been reproduced throughout the gemmological world, in all major publications, building on these initial findings. Jean-Pierre also reported that after the study of a greenish yellow diamond at the Natural History Museum Vienna and a later work by the combined efforts of De Beers and SSEF, the identification criteria of the HPHT treatment of type Ia diamonds were drastically strengthened.

DR ADOLF PERETTI — 'COMMERCIALLY IMPORTANT ORIGINS OF RUBY AND SAPPHIRE AND COLOUR GRADING (PIGEON'S BLOOD AND ROYAL BLUE)'

After the break Adolf Peretti, director and owner of GemResearch SwissLab (GRS), took to the podium to discuss commercially important locations of ruby and sapphire. With corundum being found on almost every continent, this was no mean feat, with mines in Cameroon, Mozambique, Kenya, Tanzania and Madagascar, to name but a few. Starting with the famous Mogok rubies, now available only in stones under 5 ct, Adolf showed the range of inclusions that are found in these stones, and which formed the basis for laboratory origin reports. Rubies from this locality include the famous 'Sunrise Ruby', weighing approximately 25 ct, and claimed to be the largest of its type in the world. Large sapphires are also reported from this region, including the 'Majestic', a 60 ct natural blue sapphire.

Adolf then moved on to the more recent finds in Mong Hsu, Myanmar, an area which has been producing high quality stones since 1992. Although these stones can display a distinct blue core, once heat-treated this becomes far less evident, and stones from this location now account for up to 95% of stones on the market. Adolf then showed delegates how the supply and demand of heat-treated stones had consistently outweighed the supply of unheated stones year upon year, finally peaking in 2007, but since 2007 unheated stones have been staging a comeback and seeing increased demand. Adolf highlighted that in the current market, almost all 'Burmese' rubies are from the Mong Hsu region, with the vast majority undergoing enhancement by heat treatment.

Madagascar was the next stop, with the mines at Andilamena (ruby), Didy (ruby and sapphire) and Ilakaka (sapphire) being highlighted. Each of these locations were covered, with the inclusions typical of each mine/region illustrated. The Ilakaka mine in particular was highlighted as having stones with the full range of inclusions and also as being one of the few localities to produce the sought-after 'Royal Blue' coloration without the aid of any heat treatment.

Sri Lankan stones also came under the spotlight, with an entertaining video showing the gentle heating of a stone exsolving and dissolving bubbles in a fluid inclusion. The find, from Kataragama, was found not as a result of prospecting, but on the site for a new road, showing that gems can sometimes be found in the most unexpected locations.

West African mines were also covered — some being a source of rough stones that can be up to 75 ct and trade at prices close to £3000. This locality is a basaltic source, which contrasted neatly with the next source: the pegmatic to ultramafic sapphires of Kashmir. This historic locality, which even now commands a premium price, allegedly dates back 25 million years based on zircon dating, and has produced stones containing colour zoning, zircon needles and a 'barcode' effect.

Colour zoning is also found in corundums in the Winza mines of Tanzania — these show unusual inclusions comprising of 360˚ spirals, possibly caused by the ruby material spiralling up through the mantle as it grew. Other inclusions that present here are orange garnet crystal inclusions.

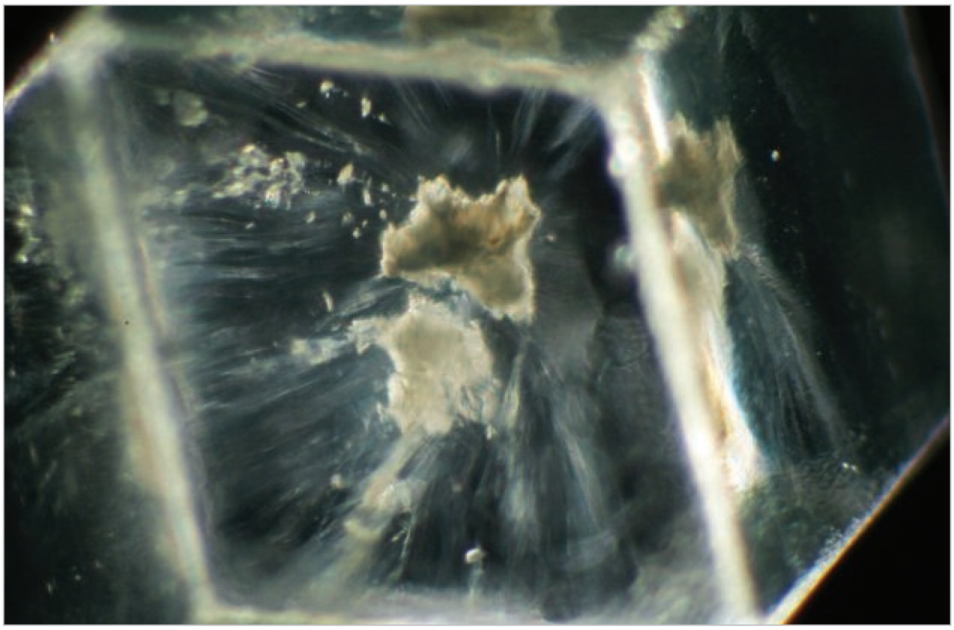
Rubies from this locality include the famous 'Sunrise Ruby', weighing approximately 25 ct, and claimed to be the largest of its type in the world.

Other mines and areas covered in this enlightening and entertaining talk included the Luc Yen mine in Vietnam, the Kuh-i-Lal mine in Tajikistan (actually a source of spinel) and the Gemfields mines in Mozambique. The latter, active since 2008, has produced rubies in excess of 10 ct, which have realized prices from $150,000 to $1,000,000.

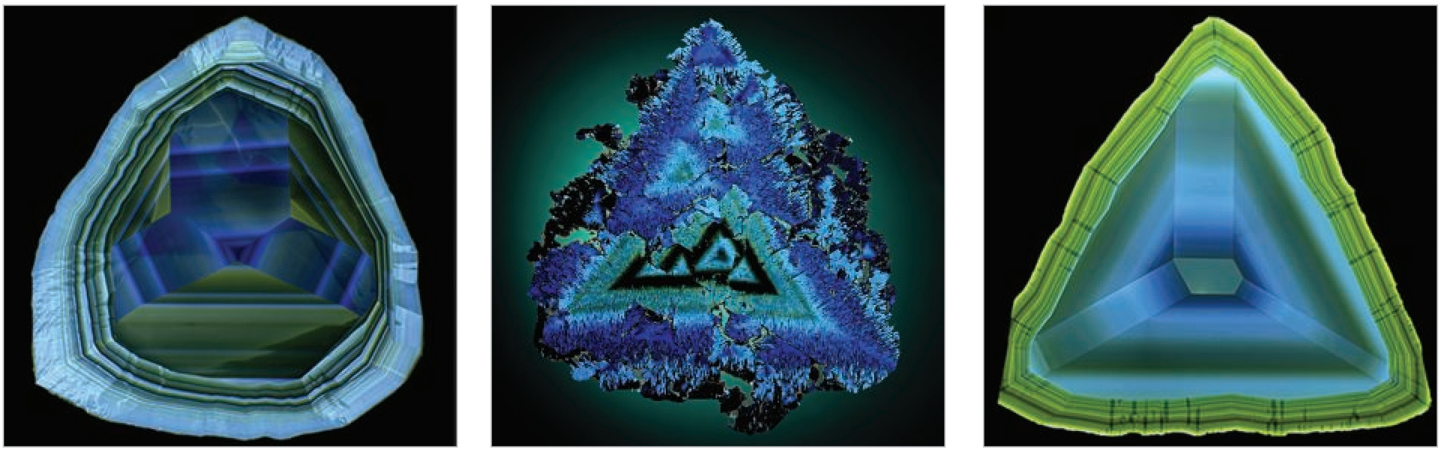
DR ILARIA ADAMO — 'DEMANTOID GARNET: IDENTIFICATION, OCCURRENCES AND ORIGIN DETERMINATION'

Dr Ilaria Adamo, a mineralogist and gemmologist at the Italian Gemmological Institute (IGI), moved away from general gemstone families to focus on one specific variety of garnet: demantoid. Ilaria, a specialist in this field, presented a study on this unique stone, covering identification, occurrence and origin determination, showing that it is an interesting gemstone with an illustrious history.

The first known (and probably most recognized) source for demantoid garnets is in the Ural Mountains, Russia, and it was here that the famous stones that were to adorn the jewellery of the Tsars were mined. The mines were active between 1875 and 1971, with most of the recovered rough being high quality and suitable for jewellery use. One of the most famous users of this stone was the Russian jeweller Fabergé, who enhanced the reputation of the stone



Typical inclusions found in demantoid associated with serpentinite rocks include fibrous ('horsetails') and massive serpentine crystals. Magnification 45×. Photo by Andrea Zullino.



Tourmaline slices from Brazil measuring 20–30 mm. Collection and photo Paul Rustemeyer.

when he incorporated it into his 'Winter Egg', using demantoid as the leaves in the floral basket, presented by Tsar Nicholas II in 1913. Because of the popularity of this stone, Fabergé went on to include demantoids in a range of his smaller works, including charms and pendants, influencing other designers to feature demantoids.

Although the Urals are synonymous with demantoids, they are not the sole source. Since the end of the 1800s, demantoids have been mined in Val Malenco, in the Lombardy region of Italy, from serpentinite sources (as they are in Russia). The most famous mine in this area was the Sferlùn mine, where well-formed rhombic dodecahedral crystals of approximately 1 cm diameter were found, typically smaller than those of the Urals. These crystals were always found in association with asbestos — key to the fibrous inclusions seen. It is the presence of this asbestos that ultimately led to the closure of the mine in the 1970s.

New deposits have been found as far afield as the Erongo region of Namibia. In 1996 the Green Dragon Mine opened, which recovered demantoids from a calco-silicate skarn — very different in origin to the Russian and Italian garnets. This mine produced a consistent supply however, albeit mainly in melee size. Annual production figures quoted showed an output between 5,000 and 10,000 ct per annum, with occasional larger crystals coming to light. One such crystal weighed 46 ct rough, yielding a faceted stone of 11.63 ct. Since early 2009, the village of Antetezambato in northern Madagascar has become known for producing fine andradite gems, including the demantoid variety. The crystals, found in skarn rocks (as with the Namibian stones), are faceted into fine gemstones, generally about 1 or 2 ct and rarely exceeding 3 or 4 ct. Other minor deposits were recently discovered in Iran and Pakistan.

Ilaria then discussed the gemmological properties of demantoids. Coloration due to trivalent iron and traces of chromium (ostensibly from serpentinite localities), could, from from Russian sources, be improved by heating in reducing atmospheres, which reduced any brown coloration, leaving the more desired green body colour. This treatment has only been found to be effective on stones from Russian sources, however, having little or no effect on stones from other localities, such as Madagascar and Namibia. Ilaria showed that there are several additional inclusion materials that can be found beyond the usual horsetail inclusions, including chrysotile, chromite, magnetite and antigorite. Stones recovered from skarn-based localities had a different and wider range of inclusions, including two-phase and fluid inclusions, diopsides, pyrites and calcites. Horsetails were notably lacking in these localities, however.

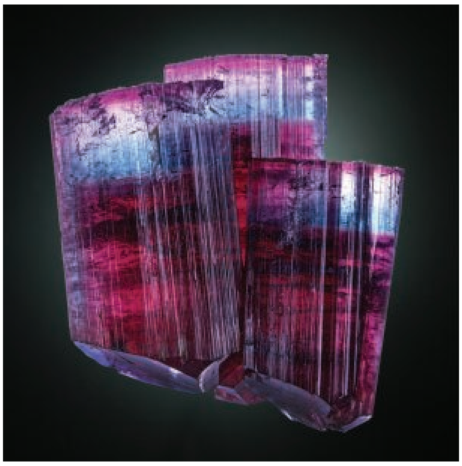
Demantoid crystal (9.01 × 9.42 mm) from Val Malenco, Italy. Photo by Matteo Chinellato. Copyright © Gems & Gemology*, 2009.*

Lastly, Ilaria showed how the chemistry of demantoids could be used to assist in origin determination. Trace element analysis could show the presence of various elements that can narrow the field and differentiate between serpentinite and skarn-based sources. For example, chromium content is non-existent in skarn-related demantoids, but present in concentrations of up to 9,000 ppm in Iranian and Pakistani demantoids, with lower levels of 3,000 to 4,000 ppm in Russian and Italian sources. One effect of this concentration appears to be a darker coloration.

DR PAUL RUSTEMEYER — 'COLOUR ZONES AND GROWTH PHENOMENA IN TOURMALINE CRYSTALS'

Next Paul Rustemeyer delighted delegates with his take on colour zones and growth phenomena in tourmaline crystals. As every gemmologist knows, tourmaline can be found in probably the greatest range of colours of any gemstone, as well as in different zoned combinations, including parti-coloured and concentric (the most recognized being watermelon tourmaline). Simply, tourmaline attracts extra elements beyond those intrinsic in its makeup, creating colour centres. Using a breathtaking and phenomenally large selection of photos, Paul treated delegates to an in-depth analysis of these colouring mechanisms and their chemistry.

Paul began by showing how the colour zones could be caused by the sequential incorporation of colouring elements (mainly metals) into the structure, with iron being the first to be taken in. By creating thin slices, Rustemeyer was able to demonstrate how these growth zones and colour concentrations were related, and by a



A 35 mm large multicoloured tourmaline crystal from the Pederneira Mine, Brazil. J.Margraf collection, photo by Paul Rustemeyer.

sequential analysis through the crystal showed the journey of growth through a whole crystal. An alternative method for coloration shown was a face-selective incorporation of colouring elements and, in this case, instead of the crystal being zoned in layers perpendicular to the growth direction, the coloration formed in concentric bands, with colours varying as the crystal grows outwards. Tourmalines can also break and 'reheal' as they grow, allowing incorporation of alternative elements into the crystal, again creating colour zones and giving varying growth phenomenon. Delta growth formations were also shown, highlighting how a second colour phase with mainly triangular shape may grow in a pyramidal crystal face.

In order to study the growth zoning, tourmaline crystals were sliced, first with standard lapidary tools. Each slice was then polished to a thickness to give optimum colour depth. At this thickness of only micrometres the darkest looking tourmaline crystal becomes colourful and often fantastic structures appear out of the dark. It was these tourmaline worlds that Paul captured and shared through a slideshow of beautiful photos, to the delight of delegates. The presentation proceeded through a range of slices displaying unique and unexpected patterns and colours; some reminiscent of an Egyptian desert scene with triangular zoning, creating the illusion of pyramids amidst dunes, others suggesting a flock of birds, but each portraying a surprising and unexpected scene. Delegates were treated to ever more extraordinary patterns and colorations, proving that even the most 'plain' crystals could yield amazing results. It became clear that only by slicing the crystal can you get an insight into the amazing inner architecture of a tourmaline crystal, which allows us to get a picture of its growth history. Paul published the results of his research work on thousands of tourmaline crystals in his book *Tourmaline — Fascinating Crystals with Fantastic Inner Worlds*.

Tourmalines can also break and 'reheal' as they grow, allowing incorporation of alternative elements into the crystal, again creating colour zones and giving varying growth phenomenon.

DR RAQUEL ALONSO-PEREZ — 'THE HISTORY AND SCIENCE BEHIND THE HARVARD COLLECTION'

The final talk on Saturday was delivered by Dr Raquel Alonso-Perez, Curator of the Mineralogical and Geological Museum at Harvard University, who presented an overview of the mineral collection at Harvard. This impressive mineral collection was initiated in 1784, when it was brought together under the Mineralogy Department as part of the Geology Museum. Today, this collection houses over 200,000 rock and ore samples/specimens, 1,600 meteorite samples, 100,000 minerals and 1,600 gemstones — many of which are unique, with many of the sources having been mined out. In the 1970s the collection saw

The Hamlin Necklace. Photo © Benjamin DeCamp.

…a rare opalized plesiosaur and, even rarer, samples of an opalized upper and lower jawbone of a very early mammal (possibly from a predecessor to the platypus) which were found 30 km apart, but which fit together perfectly.

an unprecedented increase in the number of gemstones in its collection, from various donations and sources, and the collection now encompasses some truly notable stones. As might be expected, American minerals feature heavily in the collection. The zinc mines in New Jersey have yielded in the region of 4,000 specimens for the museum, whilst a further 7,000 specimens have been collected from the New England region. However, overseas minerals do still play a major part collection, for example, and the Tsumeb region in Namibia has provided approximately 900 quality samples for the collection.

Harvard also houses the Burrage Collection, which includes possibly the finest sample of native gold known, formed as a spiral growth (pictured, right). The history of this specimen dates back to May 1893 when it was featured in *The Great Divide* magazine. The collector and owner, A.C. Burrage, first gained mineralogical fame when he purchased an entire gold collection at a 1911 Paris auction, a collection that he increased and retained for the rest of his life. Upon his death, he bequeathed the entire collection to the Harvard Museum. This donation was in addition to an annually-running award of $100, payable to the student producing the best thesis on the crystallinity of gold.

Other notable collections include the Hamlin, which features a unique piece of jewellery, known as the 'Hamlin Necklace' (pictured, left). This necklace, donated to Harvard in 1934, is formed of 18 pendant tourmalines, in varying colours, all of which were mined and sourced from the Mount Mica Mine, owned by Hamlin himself. This donation is one of the most prized pieces of the collection.

Raquel then discussed the specifics of tourmalines — her own field of speciality — which neatly linked in to the Hamlin necklace and to the previous talk. Tourmalines have a complex chemical formula, and this, with its impurities and growth sectors, can give evidence as to the sequential development of the host rock, giving a better idea of the geological timeline and the varying conditions of the Earth. Using the Hamlin collection of tourmalines, Raquel showed how analysis using Raman spectroscopy and LA-ICPMS had provided evidence of the chemical constituents to trace element levels, and to shed more light on the different constituents in tourmaline. Moreover, a straight correlation of subtle changes in their chemistry was correlated to the different tourmaline colours of blue, green and pink — the main body colours present on the Hamlin set. In green tourmalines, Raman results indicated that manganese (and to a lesser extent iron) plays a key role in the blue and green tourmaline, while the increase of lithium concentration and decrease in iron and manganese promotes the pink colours. By further analysis, and the plotting of various elements against each other in combination with ratios of Raman spectral peaks (such as lithium and OH-ratios), Raquel highlighted that simply from the appearance or absence of some of the OH-vibration peaks located at around 3300 cm^{-1}, it would be possible to predict the colour of a tourmaline. Raquel concluded with the notion that little is known about tourmalines, that far more research can still be done with this highly underestimated gemstone, and that the collections are the basis for research and the future of education.

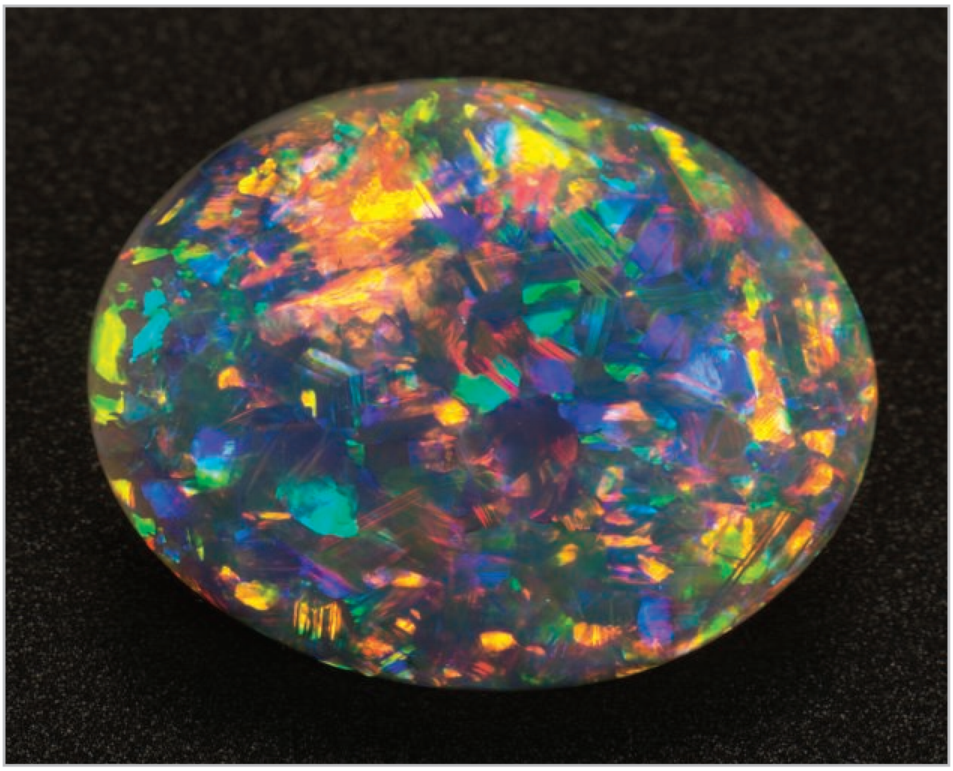
Gold Horn, Ground Hog Mine, Gilman, Colorado. Gift of A.C. Burrage. Photo by Joaquim Callen. © 2012, President and Fellows of Harvard College. All rights reserved.

ANDREW CODY – 'THE ASTONISHING WORLD OF OPALS'

Andrew Cody, director of Cody Opal, kicked off Sunday morning with his talk on opals and their various sources and characteristics.

Andrew confessed to delegates that his future was set (quite literally) in stone as a 12 year old boy, after he made £27 cutting and selling opals. Fifty years on and he is still finding something new and interesting about opals. Richard T. Liddicoat once said: "If there was a scale of difficulty in the understanding of gemstones then diamonds

The 110-million-year-old opalized toe bone and claw from Lightning Ridge. Photo Cody Opal/Robert Weldon GIA.



A 32 ct Black opal from Lightning Ridge, New South Wales, Australia. Photo Cody Opal/Robert Weldon GIA.

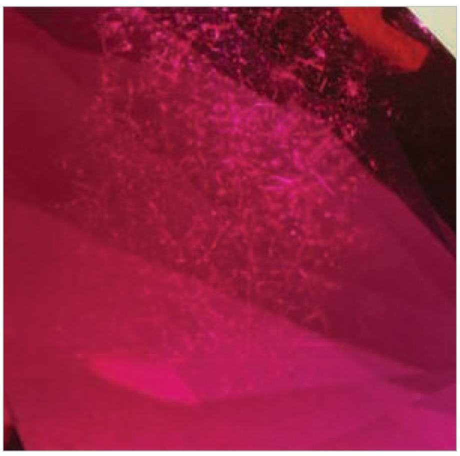
would rank 1 as the easiest, and opal would rank 10 as the most complex." Andrew then gave delegates an overview of the various locations of opal deposits, including the USA, Mexico, Ethiopia and, of course, Australia.

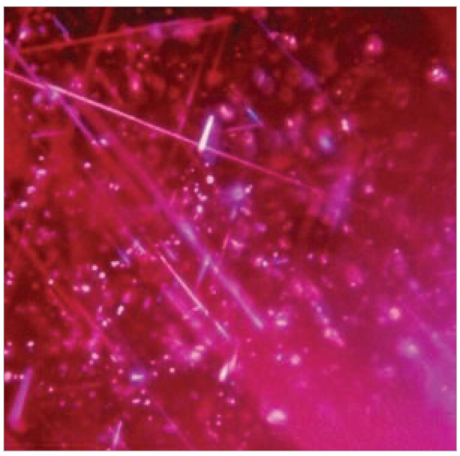
Andrew then discussed the differing rates of hydrophanity; he stated that not all Ethiopian material is hydrophane and that a high degree of hydrophanity is not good for use in jewellery. Because of this, Andrew states that we need a standardized, universal test for hydrophanity — a simple test that anyone can do. This would be conducted by weighing a stone (the 'dry' weight) before immersion (the 'dry' weight), immersing it in water for 10 minutes, then weighing the stone after immersion (the 'wet' weight). The change should be expressed as a percentage of the original weight, and this would be the degree of hydrophanity of the stone. Andrew urged that this should be included on all invoices pertaining to opal, as should full disclosure of all lowly or highly hydrophanic material.

Andrew shared with delegates wonderful examples of opalized remains which capture history: a rare opalized plesiosaur and, even rarer, samples of an opalized upper and lower jawbone of a very early mammal (possibly from a predecessor to the platypus) which were found 30 km apart, but which fit together perfectly. Andrew said it was unlikely that these were from the same individual, but that they are from two creatures who were alive during the early development of mammals — so early on that there was very little change between individuals at that time.

Andrew then went on to discuss opal's curious relationship with water, microbes, Mars, uranium, insects, plants, chickens and dinosaurs. Andrew informed delegates that 6–10% of precious opal is water, but sometimes this percentage increases for other varieties. Within opal the water can be held either colloidally or loosely held within spheres. Andrew questioned what an opal would tell us if we drilled into it an tested the water. What kind of microbes would be present? These microbes — present in a lot of Australian material, usually in non-precious zones, — are the same age as the opal itself, and it is these microbes that may have started the seeding process and been responsible for the formation of opal in the first place. Opal forms where there has been or is artesian activity. A Martian meteorite struck earth in 1911, landing in Nakhla, Egypt which contained opal (a sample is now with the Natural History Museum in London). If opal formed on Mars, water must have also existed there. Where there is water there might be life. If Martian microbes existed, is it possible that they too could be preserved in the opal deposits in Mars? Andrew questioned whether it was feasible that meteorites could have transported microbial life into our solar system in a shower of meteorites striking Earth and Mars, and whether the origin of life itself related to these microbes.

Richard T. Liddicoat once said: "If there was a scale of difficulty in the understanding of gemstones then diamonds would rank 1 as the easiest, and opal would rank 10 as the most complex."





(Left) Unheated Madagascan ruby (note: acicular needles of silk and scattered crystals) and (right) heated Mozambique ruby (note: dot-like disrupted silk needles). Photos GAA – Kwok-Ching Cheng.

After this mesmerizing thought, Andrew went on to discuss opal's relationship with uranium. The degree of fluorescence in opal is dependent on the level of uranium and iron present in the material. With this in mind, it is now thought that opal might be the secret to cleaning up contaminated radioactive sites. If synthetic opal material in its gel hydrosol form and is exposed to uranium, the opal will absorb the uranium and make it inert. The opal is able to hold the uranium inert for hundreds of thousands to maybe even millions of years.

Lastly, Andrew connected opal to phytoliths (from the Greek meaning 'plant stone'). Phytoliths, which are microscopic rigid structures made of silica and found in some plant tissues and which persist even after the plant has decayed, have the same chemical formula as opal, and could also provide a basis for the formation of opal.

GRANT HAMID – 'CORUNDUM CONUNDRUM: WEAVING A PATH THROUGH THE CORUNDUM MAZE'

Grant Hamid, a third generation gem merchant, then took the floor providing delegates with a timeline for major discoveries and developments in corundum, including localities, synthetics and treatments. He suggested methods of identification for separation of these stones, and provided a glimpse into the world of origin determination where features, such as the type of inclusions, can be used as a starting point for laboratories.

First on Grant's tour was Mogok, where he showed images of the typical inclusions found in stones from the area, such as silk and rounded crystal features. These rounded crystals are also found in stones from Thai localities, but these also featured fluid-filled fingerprints. Furthermore, the latter stones had strong lamellar twinning effect seen throughout them. At this point in time these were the only two viable sources of ruby; the only competition came from the one form of synthetic to truly stand the test of time — the Verneuil flame fusion synthetic.

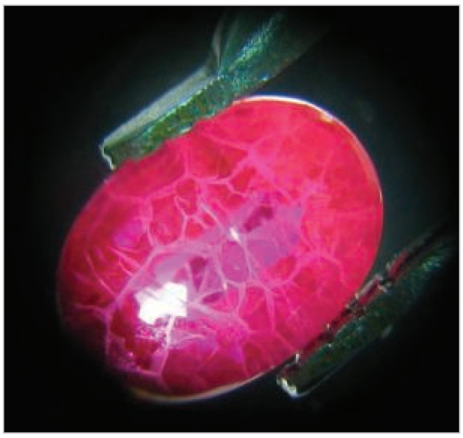
Grant then discussed the Mong Hsu stones, showing how inclusions here could differ (even if only slightly) from those seen in the previous two localities. Here, undissolved silk could be found, accompanied by fluid inclusions and hexagonal zoning — more evident than in other localities. At this point the synthetic varieties became more prevalent with the introduction of flux-grown varieties, including the well-known Ramaura and Kashan names. These contained their own unique inclusions, with internal feathers having a more 'frosted' appearance. Flux could easily be caught up in the growing crystal and be seen as an inclusion itself. In the Ramaura versions this took on a yellowish colour, but the Kashan created stones used a flux that gave a whiter appearance.

Next onto the market came the Tairus hydrothermal synthetics, with their accompanying heat-haze inclusion pattern — easy enough for a gemmologist to recognize nowadays, but which presented a challenge when it first appeared on the market.

The early 1990s saw the introduction of the first real combination of synthesis and treatment, with both heat and flux being used to create a more convincing synthetic. These, Grant noted, were heated synthetic Verneuil stones that were crackled and then immersed in a flux bath to heal the fractures, which created a more natural looking feather inclusion. As with hydrothermal synthetics, when these were first introduced they were a challenge to the markets, but with subsequent testing and disclosure these stones can now be identified under laboratory conditions and by experienced gemmologists. Other treatments examined were glass surface filling of pits in rubies, surface diffusion in blue and star sapphire, and glass fracture filling, all of which continue to be misidentified by jewellers and gemmologists today.

The early 1990s saw the introduction of the first real combination of synthesis and treatment, with both heat and flux being used to create a more convincing synthetic.

Grant then discussed rubies from Tanzania, particularly those from the Songea mines. With the different locality and potential for differences in the chemical and mineral makeup of the rocks, these rubies could be shown to include black crystalline inclusions, which differed from those seen in any of the synthetics or previous sources.



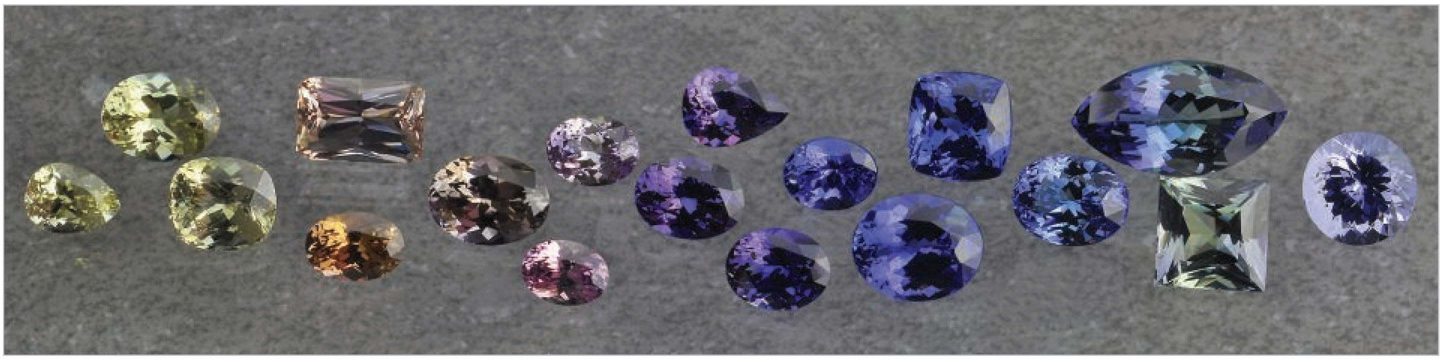
Heat quenched synthetic flame fusion ruby with induced flux healed fingerprints. Note: Induced fingerprints with hexagonal 'chicken wire' pattern. Photo GAA – Kwok-Ching Cheng.

Finally Grant looked at Madagascar — still a producer of quality corundum. Here we find the inclusions subtly change again, this time including cloudy patches and scattered crystals. These contrasted with the final stop on the timeline of Mozambique, which (almost in line with the starting point of Mogok) contained silk which, when heated to enhance the colour of the stone, would break down to produce a 'morse-code' effect. He finished with a discussion of the attempted colour grading of coloured gems and the hope that clients would purchase gems for their beauty and colour preference rather than what is printed on a certificate.

RICHARD DRUCKER — 'ISSUES & ANSWERS'

Richard Drucker, president of GemWorld International, then addressed delegates on five industry issues that Richard feels are important for gemmologists to discuss. Richard stated that one of the greatest things about conferences and networking is the opportunity to generate discussion about the industry — and this was the aim of his talk.

Richard began with the issue of coloured gem treatments. Treatments have now altered the perception of quality — they make unsaleable material saleable. The issue, however, is the nomenclature of these treatments. Nomenclature is often not reflective of treatments and, as more



This suite of fancy coloured zoisites is challenged by industry nomenclature. Some prefer to call these varieties the same as tanzanite, such as 'pink tanzanite' or 'green tanzanite', etc. The GemWorld opinion is that 'tanzanite' is reserved for only the blue and purplish-blue colours. Courtesy of Mayer & Watt. Photo by Geoffrey Watt.

of these treatments crop up, the trade becomes 'stuck' with a flood of material on the market and so pushes for nomenclature that is consumer-friendly. Richard stated that one of the major issues is that labs are not using clear nomenclature; the information is all there on the lab report, but it's either in code or listed on the back where it's not easily seen, so the consumer (and therefore the end user) doesn't understand or see it. To combat this, Richard suggested that lab reports should be transparent and post all of the information on the front and back of a report.

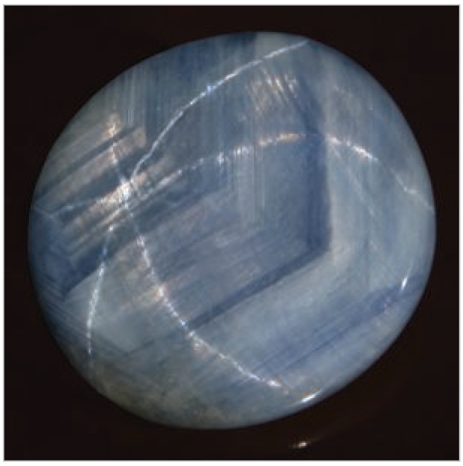
GemWorld conducted a search on a gem trading platform and found 550 rubies for sale, all between 1–2.5 ct. They found that 90% were labelled 'pigeon's blood' rubies, and were being sold for between $450 –$50,000 per carat.

Next Richard discussed the nomenclature of colour, for example, do we use the terms 'pigeon's blood red', 'crimson red' or 'scarlet red'? Is it 'royal blue', 'vivid blue' or 'cornflower blue'? There are different standards for different labs, and therefore a lack of uniformity. Some labs base nomenclature on origin, others on treatments and some on colour exhibited different lighting conditions. Richard then gave an eye-opening example whereby GemWorld conducted a search on a gem trading platform and found 550 rubies for sale, all between 1–2.5 ct. They found that 90% were labelled 'pigeon's blood' rubies, and were being sold for between $450 –$50,000 per carat. Richard questioned how there could be such a difference between the two prices if the stones were of similar colour and size. Richard also noted that he had heard that a gem dealer with a fine 'cornflower blue' stone had lost a valuable sale to a client because when the report came back from the lab it said 'royal blue', and not the 'cornflower' that the client wanted.

Issue three concerned nomenclature of origin, with Richard quoting a geologist: "Geology knows no borders." There is a trend of gems that can be more than one origin getting the better origin. It is also often the case that gems can go to more than one lab for appraisal — if the reports differ it is very easy to bin the less favourable report. Richard reminded delegates that it is important to remember that lab reports are a statement of expert opinion, but not always scientific fact. To combat this Richard suggested that there should be a degree of confidence on reports.

Richard also discussed the hot topic of the nomenclature of gem names, using zoisite as an example. 'Zoisite' comes in many colours, including teal, yellow, brown, pink and bi-colours. However, pink and green zoisite are marketed as 'pink tanzanite' and 'green tanzanite', while Tiffany & Co. named the blue variety of zoisite simply 'tanzanite'. Richard stated that dealers are so desperate to make sales that we are now making up names, stating that if the trade is going to allow 'pink tanzanite', that names such as 'red emerald', 'yellow emerald', 'green amethyst' and 'green rubies' should also be allowed. Where does the trade draw the line? Richard suggested that labs have now become the marketers of gems, but that they need to first and foremost on the gemmology of gems.

Lastly, Richard discussed the issue of lab-grown diamonds. Advances in technology mean that companies can now grow bigger diamonds, at a faster pace and more cost effective. The market is growing rapidly, but that this has had no short-term impact on natural diamond prices. Richard questioned whether the market is ready to accept synthetic diamonds as the 'real thing', and questioned whether the eco-friendly and conflict-free aspect of synthetic diamonds will drive the market. Richard noted that the only problem with synthetic diamonds is the salting of melee parcels — Richard urged that dealers to pay the higher price and to pay for batch testing, to ensure that the diamonds purchased are not synthetic. However, there is currently little to no demand for synthetic material.



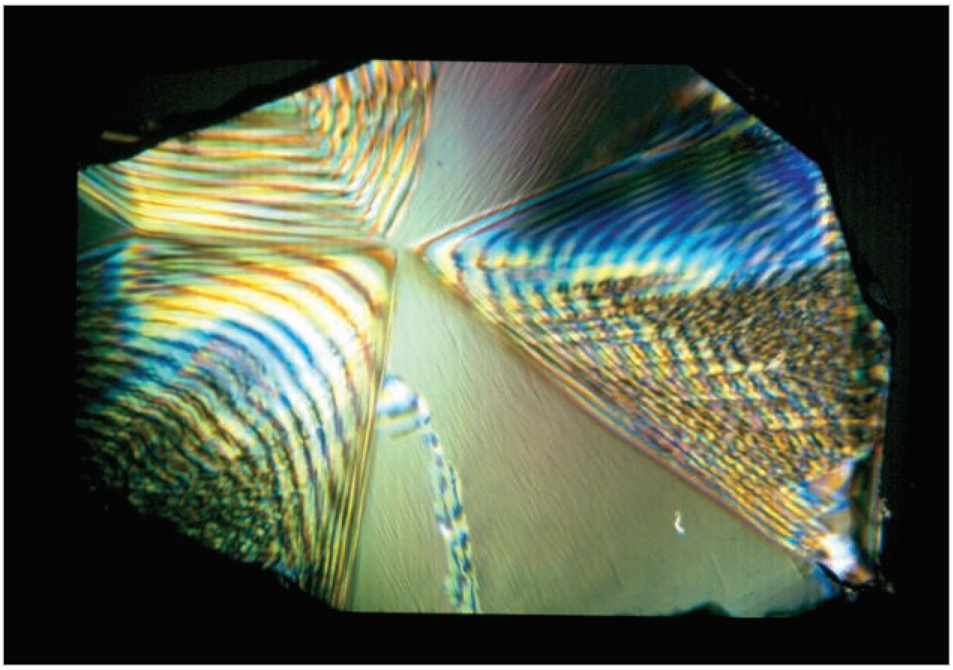
A beautiful six-rayed star sapphire, 301.58 ct. Photo Martin Steinbach.

MARTIN STEINBACH — 'ASTERISM: GEMS WITH A STAR. FROM HEAVEN TO YOU — FASCINATING AND BRAND NEW'

Martin Steinbach, asterism expert and gem dealer, took to the floor to discuss asterism. He started off sharing background information on asteriated gems, stating that there are 50 gems that display asterism, with 10 trapiche gems showing a 'fixed' star. There are several different types of star — the most common being 4- and 6-rayed stars, but 8, 12, 18 and even 24-rayed stars are also possible. Sri Lanka is the main source of asteriated gems, but Brazil, India, Madagascar, Myanmar, Thailand and Vietnam are also important sources of these stones.

Martin listed examples accompanied by images of famous star rubies, including the DeLong (100.32 ct), Rosser Reeves (138.72 ct), Eminent (6,465 ct) and the Neelanjali (1,370 ct) — which also displays the largest 12-rayed star. Martin also listed examples of star sapphires, including the Star of Jolie (888.88 ct), Black Star of Queensland (733 ct), the Star of Asia (330 ct) and the Star of Bombay (182 ct).

Martin then shared with delegates beautiful images of natural star sapphires, accompanied by a psychedelic soundtrack, followed by images of synthetic asteriated gems. Martin pointed out that the stars of synthetic stones are "too good"; they are too sharp and their colour is too good to be natural, and shared photos of synthetic asteriated gems.



Typical Brazil Law twinning in natural amethyst under crossed polarizing filters. Immersion. Magnification 20×. Photo Fabian Schmitz.

...to guide the audience through the minefield of determining if a quartz were natural or synthetic, and then on into the underlying science behind these differences.

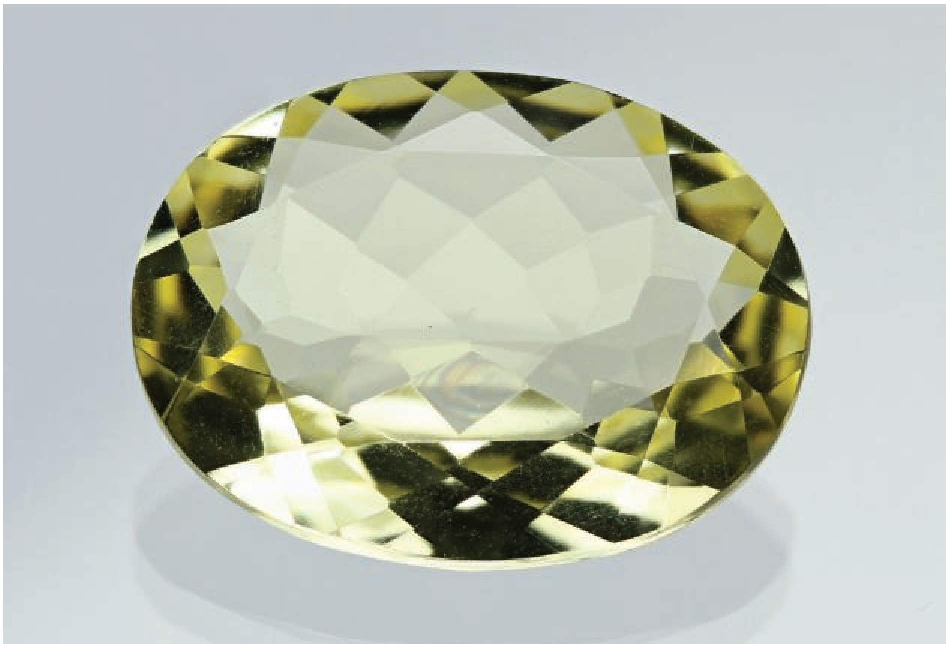
FABIAN SCHMITZ — 'NATURAL VS. SYNTHETIC QUARTZ: AN OVERVIEW OF DIFFERENCES, COLOUR REASONS AND IDENTIFICATION'

Fabian Schmitz, of the German Gemmological Association, was up next with his presentation, in which he set out to guide the audience through the minefield of determining if a quartz were natural or synthetic, and then on into the underlying science behind these differences. By applying science to the elements present and their relative concentrations and ratios, Fabian led the audience into the realms of laboratory analysis, accompanied by the relatively common gem material that is quartz.

As an example of how quartz (either natural or synthetic) could be transformed between its varieties, Fabian showed a slide with amethyst at its centre where, radiating outwards and then interconnecting, was a web of treatments, some reversible, some permanent, that led to almost all colours and varieties. Fabian showed that amethyst could, by way of gamma radiation, be rendered colourless if the right elements were present — a treatment that could be reversed by heating. If, however, the amethyst itself were heated, then the colour of citrine could be produced. Similarly, the green variety of prasiolite could be artificially induced and this, if irradiated with gamma rays and then stabilized by heating, could further change into the colour of 'blueberry' quartz. All of these treatments are dependent on the presence of iron in the structure and the ability of this iron to alter its valency state, moving from Fe^{2+} to Fe^{4+}, by way of its trivalent form. The transformation of this simple element, by the addition or removal of electrons, is the underlying feature of all iron-bearing quartz. There is, however, another grouping of quartz, this time containing aluminium. These account for the brown to smoky varieties, including morion quartz. With the presence of increasing amounts of lithium in the structure, the variety of lemon quartz can be achieved.

These different groupings all have one feature in common: absorption bands that can be seen in the laboratory, and which can help in the determination of natural or synthetic origin. One such example, demonstrated by Fabian, involved green quartz, known as 'prasiolite'. As shown near the start of his presentation, this can be created by gamma irradiation and heating, to generate a yellow to greenish coloration. This creates an absorption centred at 610 nm, which is significantly offset from the band seen in natural prasiolite, which is centred at 720 nm. Similarly rose quartz and pink quartz can also be separated by the same spectrographic technique. True rose quartz, according to Fabian, is coloured by inclusions of dumortierite, which add to the haziness of the stone and gives a broad absorption peak at 500 nm. Pink quartz, on the other hand, has peaks at different locations, and does not show the same 500 nm band.

Fabian also highlighted other causes of colour within the quartz family. 'Strawberry'



Synthetic 'lemon-coloured' quartz. Photo Fabian Schmitz.

quartz, for example, is coloured by a mechanism involving hematite, whilst the variety referred to as 'guava' quartz is a manganese bearing form. 'Lemurian' quartz differs again, this time being an ilmenite included form.

Fabian then provided a timeline for quartz synthesis, starting in 1905, when G. Spezia first created a synthetic quartz in Italy. This was a hydrothermal process, in line with techniques still used today, but which was cutting edge at the time. It wasn't until 1980 that this synthetic quartz really made inroads into the jewellery market. About this time, concerns were also being raised about the ability to differentiate between the natural and synthetic quartz, and it was to combat this that the gemmologist Lund published his work, showing that differentiation was possible by way or IR-spectroscopy. Fabian also suggested that there may be other features that could help with this, which he simplified into the following: natural quartz — could show tiger-stripe inclusions, have lepidocrocite inclusions (derived from iron oxide) and Brazil Law twinning. Synthetic quartz, on the other hand, is commonly not twinned, and can contain microscopic metallic residues from the autoclave in which it has been grown. Thus Fabian showed that it is possible to separate out these two materials, natural from synthetic, without resorting to laboratory equipment. Care, however, must always be taken due to advances in technology.

Finally Fabian provided a guide list for the different absorption peaks that may be seen, and an indication of their cause, ranging from OH bonds, through Si-O and the different valency states of iron. A truly in-depth analysis of a stone all too often taken for granted.

SHANE MCCLURE — 'TALES FROM A GEM LAB: THE SUBLIME TO THE RIDICULOUS'

Shane McClure, Global Director of Identification Services at the GIA lab, was last but by no means the least on the agenda, with his entertaining talk which looked at objects that he has seen in the lab over the last 37 years that don't usually get reported; from the ridiculous, to interesting treatments, to scams, to those that are meant to deceive.

Shane began by discussing and sharing images of some of the more ridiculous things that he has had the pleasure of receiving into the lab, including 'Brunswick opal' — which had a smooth rounded surface and slight play of colour (a piece of bowling ball); a piece of 'natural material' found in a remote location in Mexico which contained a piece of a Coca-Cola bottle — as Shane said, "That's a pretty young rock." Shane also discussed 'night glowing pearls' that arrive in the lab — often the owner claims that they were owned by a Chinese emperor — which fluoresce in visible light. These are usually a coated material with some kind of phosphor on it. Shane also shared a story of a client who had paid hundreds of thousands of dollars for what was, in essence, a large fluorite ball that had been stuck together.

Shane has also received countless fake mineral specimens, of which he shared images with delegates, including an emerald specimen in matrix where the glue fluoresces. Shane also reported instances of fake gem crystals being sent in for appraisal, including synthetic corundum and CZ made to look like diamond crystals — an attempt which Shane said wasn't too bad, if you didn't happen to understand diamonds.

Shane then discussed scams — and whilst there is no proof that these were scams, they seemed that way to him. He shared one of his favourites — the 'idents that wouldn't go away' — rubies that appeared at the lab over seven times in a decade with a claim that they were valued at US$95 million, and which kept appearing despite being turned away. Shane stated that usually these requests are not actually trying to sell the rubies, but are trying to use them as collateral from a bank. Another scam involved 'Arabian sand diamonds' — engineers working out in Saudi Arabia were told that there was a place in the desert that they could go and pick up diamonds from the surface and that they would be guided to the location for a small fee. (Shane pointed out that if this were true, why would these people not keep this fantastical location a secret and collect the diamonds themselves?) The engineers arrived and collected what they thought were diamonds, but which turned out to be pebbles of quartz. When they returned to the city they were then offered cutting services, for another small fee, and the quartz was then replaced with cut cubic zirconia. Shane noted that people were always adamant that, because they had found something, that it had to be natural. ■

See the March/April 2016 issue of *Gems&Jewellery* for a full report of Conference seminars and trips and of the Gem-A and FEEG Graduation Ceremony and Presentation of Awards. Gem-A would like to thank our Platinum Sponsors, JTV, our Silver Sponsors AGL, AnchorCert GemLab, CGA, Gemworld and Marcus McCallum, and our Bronze Sponsors Fellows and T.H.March, for their generous support of the conference.

Out of the Blue: From Agra to Totnes

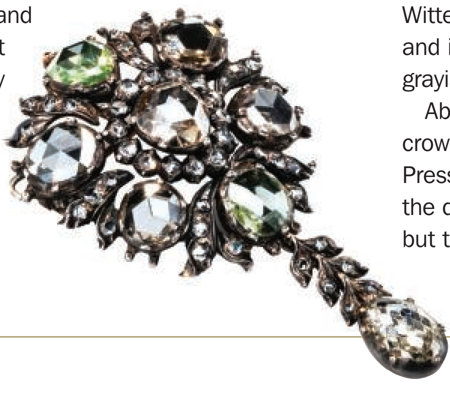
Jack Ogden FGA looks at the story of blue diamonds.

The Blue Moon of Josephine, a sensational Fancy Vivid Blue diamond weighing 12.03 ct, Internally Flawless. Image courtesy of Sotheby's Geneva.

The recent sale of the 12.03 ct Blue Moon diamond for just over US$4 million per carat at Sotheby's Geneva last November created yet another record price for a coloured diamond. The modern appeal and rarity of these gems is clearly not in doubt, but they have not always been so highly esteemed in the past; a history that encompasses European royalty, Mughal Emperors, optimistic lapidaries and eccentric collectors.

One of the earliest surviving texts to mention the different colours of diamonds is the Arthashastra ('The Lesson of Profit'), traditionally said to have been written by Kautilya, a minister to the emperor Chandragupta under the Mauryan dynasty in northern India 300 BC, although recent research suggests it is a compilation written over several centuries. The brief section on gems described diamonds and their colours, including colours akin to 'cow's urine' (more memorable than calling it 'light yellow'), but no mention of blue. Fast forward to the 1600s and we find the Mughal emperor Jahangir describing a blue diamond from a Northern Indian mine that, he says, looked like a sapphire. He added that he had never seen anything like it. This emphasizes its rarity since he had no lack of colour comparisons: William Hawkins of the East India Company estimated that his treasury at Agra contained more than 137,000 carats of uncut diamonds, none under two and a half carats. Even so, Jahangir's jewellers valued this blue gem less than a sixth of the price had it been colourless. Naturally, it is tempting to equate this gem with one of the historic blue diamonds, perhaps the Hope.

In Europe the earliest mention of a blue diamond seems to be a pointed stone set in a clasp described in an inventory of Charles the Bold in the fifteenth century. Two hundred years later the French traveller and gem dealer Jean Baptiste Tavernier brought back from India a large blue diamond which he sold to King Louis XIV of France in 1668. His invoice to the king described the stone as a large blue diamond in the form of a heart (i.e. pear-shaped) and cut in the Indian fashion. This diamond was recut as the 'French Blue' and later reborn as the Hope Diamond. This royal attention to a blue diamond may have helped spark wider interest. A generation later, in 1698, John Fryer, a surgeon with the East India Company, still noted that a diamond "of a Blue, Brown or yellow water, is not worth half the price of a perfect Stone of a White Water", but from about that time we do begin to find more evidence for coloured diamonds in jewellery. The extraordinary pendant shown below dates to the late 1600s or early 1700s and is set with rose-cut diamonds in several colours. The consistency in size and cut of the diamonds suggest that they must have been deliberately assembled and cut, making the pendant a very early example of a piece of jewellery with a deliberate range of coloured diamonds. From about the same period as this pendant we find a note in the London press (May 1724) concerning the loss of a gold ring set with a 2.75 ct blue rose diamond. A reward of ten guineas (£10.50) was offered to the finder, the owner adding "no questions asked". In 1768 the stock of jeweller Philip Jonas which was sold off for the benefit of creditors included "a curious green and blue diamond cluster ring". A few years later the Anglo-French surgeon and author John Obadiah Justamond noted that diamonds came in all colours including "the blue of the sapphire" but that green was rarest and most valuable. A watch made in Geneva around 1760 which once belonged to Catherine the Great of Russia is described as set with rose diamonds which have coloured foils to give the appearance of coloured diamonds, presumably an indication of the growing interest in the real thing.



Pendant set with rose diamonds of various colours. Late seventeenth–early eighteenth century. Private collection, New York.

The 1800s were significant for blue diamonds. In prime position is the Hope, the "most magnificent and rare brilliant, of a deep sapphire blue" catalogued in the Hope collection in 1839. At the other extreme is the so-called 'Totnes diamond'. In 1856 the English press worked itself into a frenzy about a huge gem owned by John Bastow Taylor of Totnes, Devon. A lapidary had announced it to be "a blue diamond of the second water, and of more than £50,000 in value". Unfortunately *The Mining Journal* later reported that the stone was a blue chalcedony. Perhaps the weight of the stone (at just over 3,400 ct) should have given the lapidary and owner a clue that it was unlikely to be a diamond.

A decade after this, in 1865, we find the first certain mention of the so-called 'Idol's Eye' diamond, then the property of the eccentric collector Edward Strutt Hallum. In recent times this 70.21 ct diamond has been graded by the GIA as 'Light Blue', and the late Lord Balfour described it as the largest blue diamond in the world. It is noteworthy that there is no mention of it being blue until quite recently. It may indeed appear blue under a modern diamond grading light, but under more day-to-day lighting or sunlight there is little obvious blue coloration. This is a reminder that perceived colour is very much a matter of lighting and cut. A perfect example of this is the historic Wittelsbach blue diamond which, until 1918, was set in the Bavarian crown. In late 2009 this was recut as the Wittelsbach-Graff, accompanied with a fair amount of controversy, and in the process its GIA colour grade changed from "fancy deep grayish-blue" to "fancy deep blue".

About the time the Wittelsbach was removed from the Bavarian crown another large blue diamond had some celebrity in the British Press with a story involving a Mademoiselle Suzanne Thuillier (aka the dancer Mademoiselle Primrose) and the last Russian Czar — but that is a story for another time. ■

Bejewelled: Treasures of the Al Thani Collection

This book is designed to accompany the exhibition of the same name, which is currently exhibiting at the Victoria and Albert Museum (V&A) until 28 March 2016. The aim of both the exhibition and this book is to illustrate, by the use of selected pieces, the arts and jewellery of the Indian subcontinent, and to show the extent of interaction and influence between this area and European jewellers.

The first section, covering some 35 pages, provides an insight into the development of the Mughal court and its expansion throughout India and beyond. It also covers aspects of the gemstones used and the importance of certain stones, such as spinels. Spinels were valued for beauty and size, and were often engraved with emperor's names. The section also shows the range of skills, techniques and styles employed at the time, and how craftsmen utilized the high quality stones available. The images shown in this section attest to the levels of opulence and majesty attributed to the ruling classes, and it is from this background that the Al Thani Collection is drawn.

The remainder of the book is made up of several sections, each focusing on a specific area of the pieces and the techniques involved in their creation. The first section discusses the collection of stones and jewelled pieces of emperors. Stones detailed in this area include the Timur ruby — actually a famous spinel — which is engraved with the names of five of its previous owners and which is now in the Royal Collection. Other pieces covered include an engraved spinel seal ring (showing the intricacy of the engravers' skills) and several large and famous diamonds, such as the Idol's Eye, the Arcott II and the Mirror of Paradise, followed by an equally impressive selection of carved emeralds.

The next section focuses on the jewelled pieces used in court, from finials and jewel-encrusted birds that adorned thrones through to the famous Mughal jades, carved as huqqa bases and mouthpieces (vessels used to smoke tobacco through water). Similar decanters and flasks are also detailed, with gold, rubies and emeralds used to great effect.

Section three focuses on kundan and enamel techniques, with the former here referring to the technique of using very high quality gold to surround and hold gemstones in place — both unique and delicate arts, and the subject of a video at the end of the exhibition. The photographs displayed in this section cover more items of nephrite jade, such as daggers and thumb rings, with additional images of enamelled bracelets, bangles and pendants.

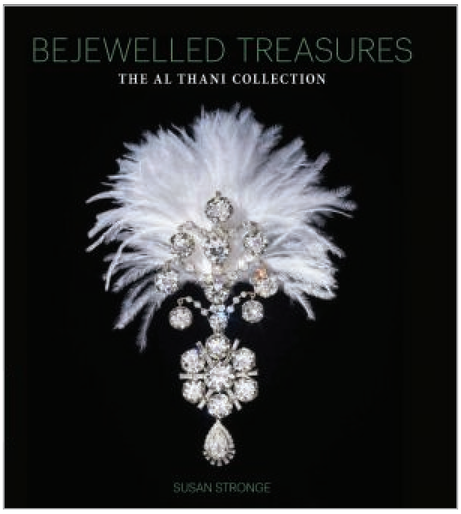
The fourth section, entitled 'The Age Of Transition', looks at the turning point when jewellery manufacture ceased to be confined to royal workshops and instead became a commercial enterprise. The pieces shown include pearls and carved emeralds, as well as a ceremonial sword set with rubies, emeralds, and diamonds, again demonstrating that it was more than just jewellery that was used for decorative purposes.

The next section looks at the way in which European influences changed the way Indian jewellery was designed and produced, and vice versa. The pieces depicted here include brooches, pendants and turban ornaments, including one set with a 109.5 ct blue sapphire and another containing over 160 ct of diamond. One of the more impressive images shows clip brooches from a Cartier ensemble, set with diamonds and carved emerald panels.

The section titled 'Contemporary Masters' looks at modern jewellers and craftsmen, in particular Joel Arthur Rosenthal (JAR) and Viren Bhagat. Both of these artists draw their inspiration from traditional Indian designs of a bygone era. The choice of pieces used to illustrate this section ties in neatly with the older styles and historic pieces of the earlier sections and provides a fitting end to the book.

This book is a stunning companion text to the must-see exhibition at the V&A and provides a visual reference to this unique collection of timeless jewels. In addition to this it is able to stand alone as an informative and useful text for anyone interested in this superb era of jewellery history, technique and design.

Andrew Fellows FGA DGA



Bejewelled: Treasures of the Al Thani Collection
By Susan Stronge
Published by V&A Publishing (2015),
176 pages
ISBN: 978-1-85177-857-7
Price: £25.00

For more information on the Al Thani Collection see Susan Stronge and Joanna Whalley's article in *Gems&Jewellery*, October 2015, pages 12–14.

Shine Bright

Celebrating 20 Years of Opening the World of Jewelry and Gemstones to Everyone!

As the largest retailer of loose gemstones in the world, Jewelry Television is committed to offering more of the naturally beautiful treasures that our customers adore.

Education, Expertise & Entertainment

We take pride in our longstanding commitment to education. With programs like our web-based GEM-A course and our on-air Jewel School® series, our partnerships bring industry luminaries straight into the homes of jewelry and gemstone aficionados everywhere.

Educational videos, professional tools of the trade, plus live programming with knowledgeable hosts place Jewelry Television and jtv.com at the forefront of a dynamic learning and shopping environment.

Into the Future

At the heart of our vision is a continuing quest to deliver the rarest of gemstones, plus educational resources and world-class gemstone authorities to our customers. We believe this is the ultimate way to enlighten, inform and entertain, as we take flight into our next decade.

JTV Your Way

To order call 800-619-3000 or visit jtv.com

20 yrs jewelrytelevision.