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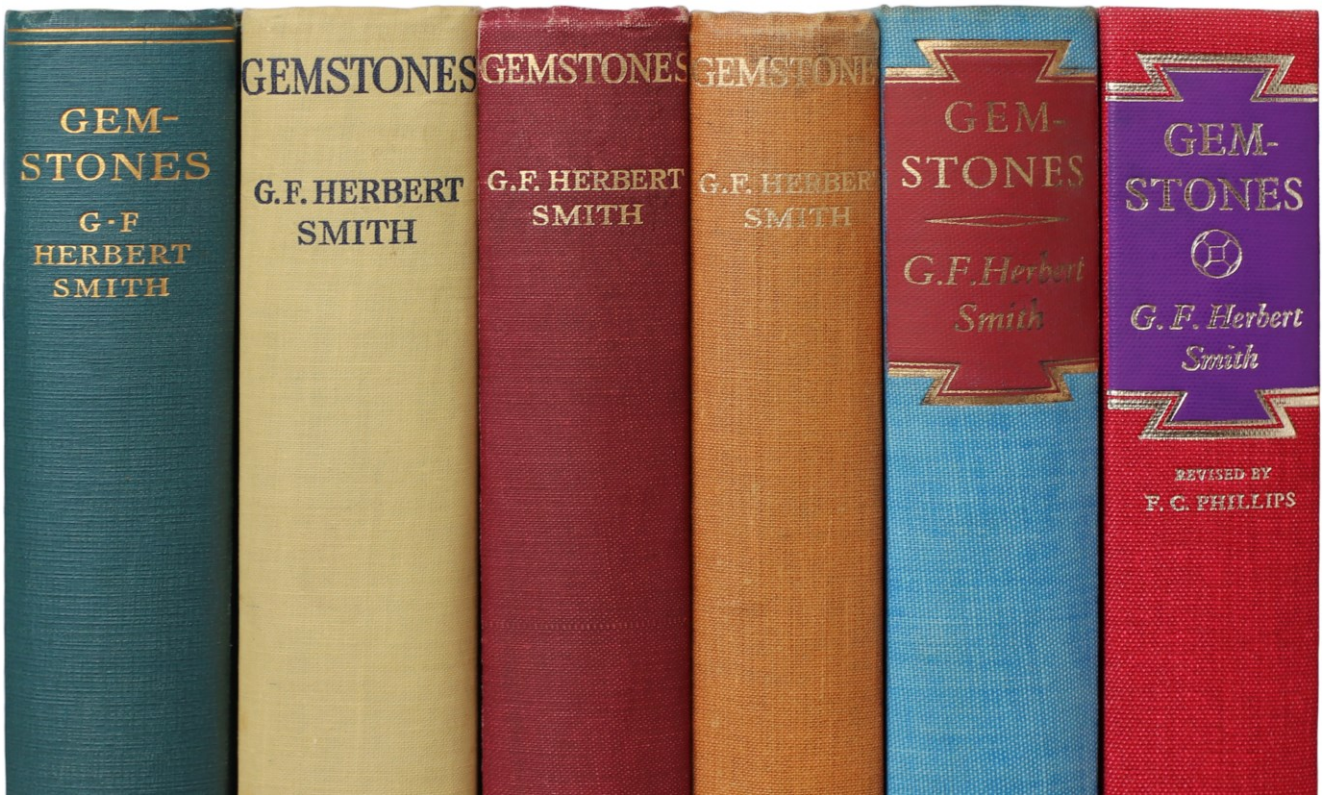
Gemmology Bulletin

A History of Gemmology: 1912-1972

By James Evans, EG

In reviewing the fourteen editions of *Gemstones*, the gradual development of gemmology can be traced across the 20th century.



Edition 1, 1912

The early 20th century was a formative period for the study of gemmology. And George Herbert Smith was at the centre of it. In 1908, the *National Association of Goldsmiths of Great Britain* had begun work on a new course in gemmology for the jewellery trade. Herbert Smith's work on crystallography at the Natural History Museum (London) and his development of the Herbert Smith refractometer (first released 1905 then updated 1907) made him a natural choice for the role of principal examiner. With the first diploma exam held in 1913, it's no surprise that students regarded the examiner's new book as their gemmological "bible" (Anderson, 1973, p.236).

The first edition of *Gemstones* covered the majority of a modern gemmologist's toolkit, including the refractometer, polariscope, dichroscope, hydrostatic scales, and spectroscope (albeit with diagrams for just five partial spectra). Notable for their absence were:

Electrical items. The goniometer was recommended for measuring the RI of highly refractive stones (in the absence of reflectivity meters); heavy liquids were recommended for measuring SG (in the absence of electronic scales); the thermal properties of gemstones were mentioned only for the outlying case of amber (in the absence of thermal probes); electrical properties were mentioned only in relation to static electricity, and fluorescence under UV light wasn't mentioned at all.

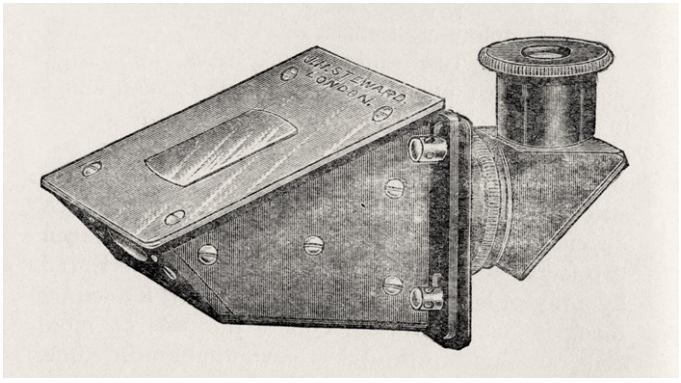
Items based on plastic. This includes the polarizing dichroscope and colour filters (though this is as much a result of the limited application of spectroscopy). The only plastic gemstones to be mentioned were amber and kauri-gum.

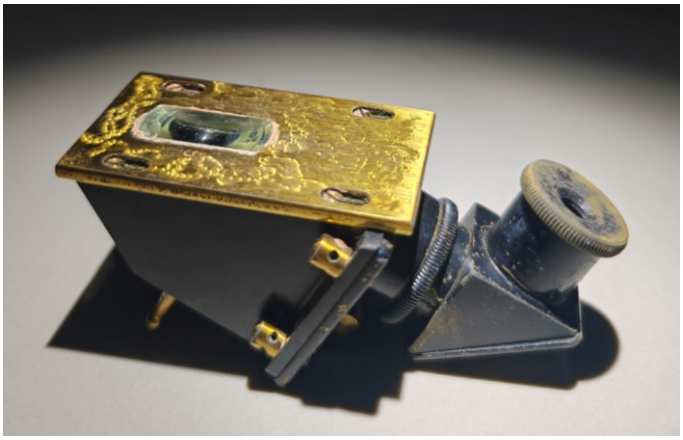
A short chapter on manufactured stones focussed on flame-fusion corundum and spinel. Curiously, Henri Moissan was mentioned within this chapter as having manufactured diamond, despite the earlier claim of James Hannay (some of whose crystals were held by the Natural History Museum).[1] An even shorter chapter on imitation stones then covered composite and artificial glass gemstones – including the imitation pearls consisting of glass spheres lined with *Essence d'Orient* (a preparation of fish scales).

Basil Anderson (Herbert Smith's successor as principal examiner) would later state that, since its first publication, *Gemstones* has been the standard work on the subject in the English language (Anderson, 1955, p.166). The caveat here likely relates to the second edition of Max Bauer's work *Edelsteinkunde* (*Gemmology*). The first edition of this work was published in parts between 1895 and 1896, with an English translation published in 1904. Having translated the work, Leonard Spencer[2] noted that:

> *'In the original scarcely enough importance is attached to the optical characters of minerals, to their examination in convergent polarised light and to the measurement of refractive indices, which are of the greatest practical value in the determination of faceted stones. It was felt, however, that the such matter would considerably alter the scope and plan of the work, which it has been the aim of the translator to preserve unaltered throughout.'* (Bauer, 1904, v).

This criticism of Bauer's first edition was seemingly unfair, given the limited use made of refractivity at the time of its publication. The second (untranslated) edition, published in 1909, did make use of refractivity as a determinative test for gemstones.





One of the highlights of Bauer's work was his method of grouping gemstones by colour, before outlining how the stones within each group could be distinguished. But from this method it was apparent that, even in the second edition of *Edelsteinkunde*, Bauer was still treating refractivity as a supplementary test. Herbert Smith's work – on his book, his refractometer, and the diploma exams he set – would bring refractivity to the forefront of practical gemmology.

The Herbert Smith refractometer, as illustrated (top), and from the collection of Nicolas Francfort.

Edition 4, 1923

Few changes were made to *Gemmology* until the fourth edition, when:

- Three minerals were admitted to the ranks of 'semi-precious stones': fibrolite (aka sillimanite); willemite; and scapolite (the only one that was newly discovered).
- The pearl section was expanded to cover the newly developed 'culture' pearl. These had previously consisted of a blister pearl backed with mother-of-pearl but were now completely coated in nacre. Herbert Smith and Edward Hopkins were credited with the discovery of the culture pearl's greenish-yellow fluorescence under UV light (the first mention of UV light as a diagnostic test).
- The decimal carat had finally been adopted in London, bringing to an end *'one of the eccentricities of the jewellery trade'* that the unit of weight should vary not only across centres of trade, but often within each centre (Herbert Smith, 1923, p.85). Basil Anderon would later attribute Herbert Smith's *'tactful, authoritative, and persistent advocacy'* as having brought this change about (Anderson, 1953, p.148).

Edition 9, 1940

The ninth edition marked the first time *Gemstones* was substantially rewritten – quite possibly spurred by Spencer having published his own work on the topic in 1936.

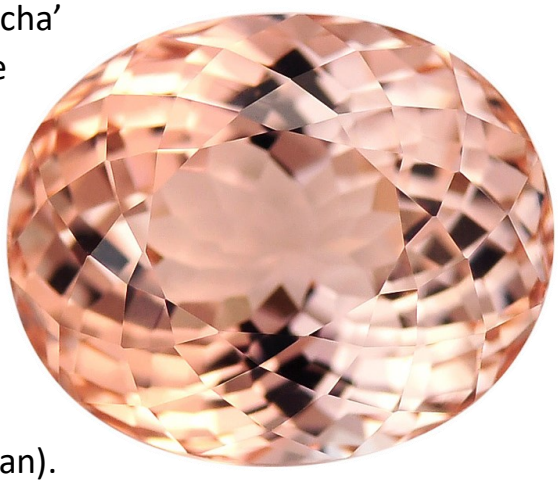
The range of tools available to the gemmologist had now grown to include:

- The Chelsea filter (developed in 1934 by Anderson alongside Cecil Payne, his colleague at the *Gem Testing Laboratory of the London Chamber of Commerce*, and diploma students at the *Chelsea College of Science and Technology*).
- Improved refractometers (developed by Tully and by Rayner).
- UV light boxes.
- Three additional heavy liquids: clerici solution; bromoform; and acetylene tetrabromide (all of which are toxic).

Furthermore, Herbert Smith noted that a polaroid plate, when rotated, could be used as a dichroscope – surely the predecessor to the polarizing dichroscope.[3]

Around 20 gem materials were added to the book – some obscure (e.g. hambergite), some previously overlooked (e.g. casein), and just one newly discovered (Libyan desert glass).

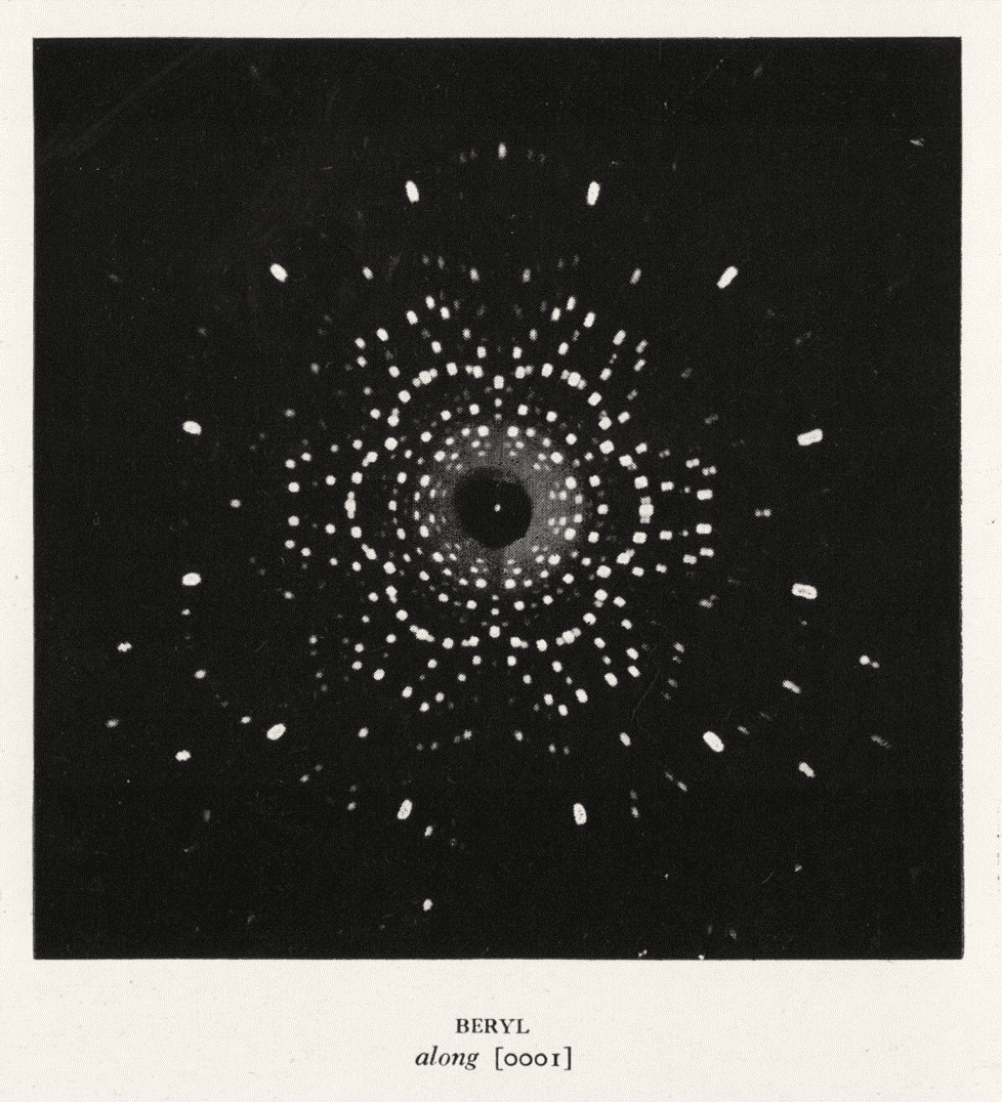
Some of the most notable changes would relate to terminology. A number of previously 'semi-precious' stones were relegated to a new 'miscellaneous' category, whilst the chapter on 'manufactured' stones was now relabelled as 'synthetic' (despite Spencer's scientific objection that *'the artificial production of ruby'*, for example, *'is not one of synthesis by the combination of aluminium and oxygen'*) (Spencer, 1936, p.101). A marketing term that was resisted was 'padparadscha' (for 'reddish-yellow' corundum; named from the Sinhalese word for lotus-colour). Herbert Smith considered this a fantastic term of no real use. Presumably it was the Indo-Aryan root of the word which he objected to, for he raised no such qualms in relation to 'kunzite' (for lilac-coloured spodumene; named after George Kunz) nor 'morganite' (for rose-coloured beryl; named by Kunz in honour of the American banker John Morgan).



A faceted morganite.[4]

The chapter on imitation stones was expanded to include garnet-topped doublets (which had become prominent by around 1923); whilst the chapter on 'synthetic' stones referenced the flux-grown emeralds released by the German company I.G. Farbenindustry in 1935.

Some of the most practical additions were provided by Anderson and Payne, including: a new set of gemmological constants; a description of various diagnostic spectra; and several photographs of corundum inclusions. In contrast, the addition of fourteen x-ray diffraction patterns was of questionable value to practical gemmology, whilst a new appendix on the Greek alphabet avoided the question of practical relevance entirely. Herbert Smith had pushed forward the methods of practical gemmology in the early 20th century. But this role would soon be taken over by Anderson, with the publication of his own book – *Gem testing for jewellers* – in 1942.



An x-ray diffraction pattern for beryl (one of 14 patterns in the ninth edition).

Edition 10, 1949

By the time of the tenth edition, Herbert Smith had become President of the newly incorporated *Gemmological Association of Great Britain* (the organisation having initially emerged from the *National Association of Goldsmiths* in 1931, shortly after the founding of the *Gemological Institute of America, GIA*).

Two major changes were made to the text. Firstly, the chapter on 'crystal form and structure' was so greatly expanded that Herbert Smith himself admitted it largely constituted a separate treatise on crystal morphology. Secondly, the scope of the work was widened to include ivory (and tortoiseshell).[5] This second change was the highlight of the edition. Alongside ivory, Herbert Smith had included celluloid as an ivory imitation, together with a twenty-page discourse on both natural and manufactured plastics. More amusingly, two new plates were provided to help identify the ivory-bearing animals (in fairness, few gemmologists would be aware of the babirusa deer-pig of Indonesia!).

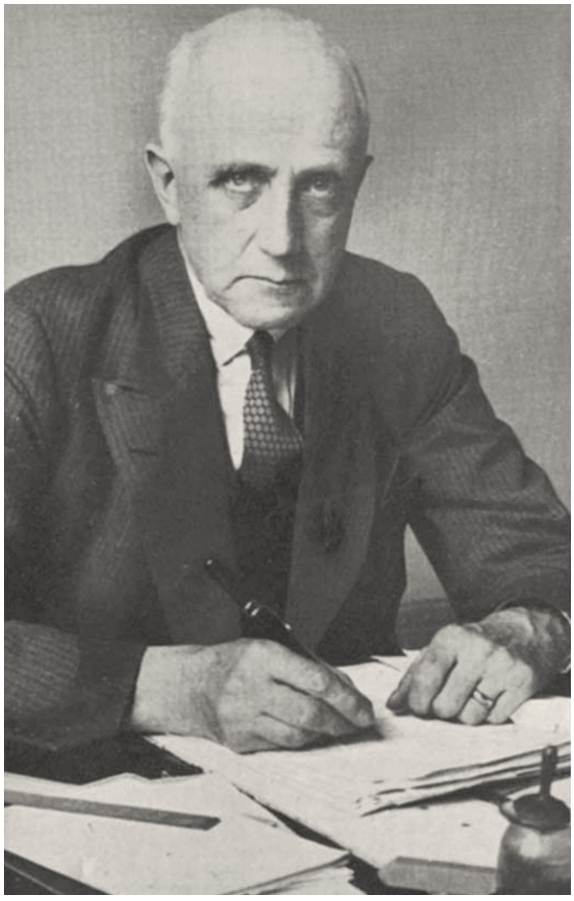
The ivory-bearing animals (with the babirusa labelled as 'c' within the second page).

Minor changes included the addition of rutile as a newly manufactured gemstone,[6] with brazilianite and zincite being added to the text as natural gemstones (the discovery of man-made zincite would occur in the 1970s as an accidental by-product of zinc smelting).

Edition 12, 1952

The twelfth edition was the final version of *Gemstones* to be published within Herbert Smith's lifetime. Having contributed so much to the emergence of modern gemmology, he died suddenly in 1953 whilst still undertaking the role of President of the *Gemmological Association*.

Two new gemstones were added to the edition. The first was taaffeite; a gemstone most famous for being discovered in an already facetted state (by the Irish nobleman Richard Taaffe). Having been perplexed by its identity, Taaffe had sent the stone to Anderson (at the London *Gem Testing Laboratory*). Anderson, alongside his colleague Payne (as well as Frank Claringbull and Max Hey of the Natural History Museum), confirmed the specimen as both a new mineral and a new gemstone in 1951 (six years after receiving Taaffe's stone!). The second new gemstone was sinhalite; a brownish gemstone that had long masqueraded as olivine (discovered by Claringbull and Hey in 1952).[7]



**Dr. G. F. Herbert Smith, M.A., D.Sc.
President of the Association
(as pictured for the first edition of the Journal of Gemmology, 1947).**

Edition 13, 1958

For the thirteenth edition, the reins of *Gemstones* were handed to Frank Phillips; a lecturer on mineralogy and petrology at the University of Bristol.

Phillips' great skill as a teacher was evident from his revisions.[8] He consistently pared back the text to expose the most relevant material. The six crystal systems and thirty-two sub-classes described in the tenth edition were therefore replaced by the seven systems still taught today (with the trigonal system split out from the hexagonal). A new chapter on 'The Microscope' highlighted the significance of gem inclusions (in distinguishing natural stones; in determining a stone's original locality; and in providing information on 'paragenesis' – how a stone had been formed). New Images of inclusions were provided by Eduard Gübelin, who would go on to publish his first influential book, *Internal world of gemstones*, in 1974.

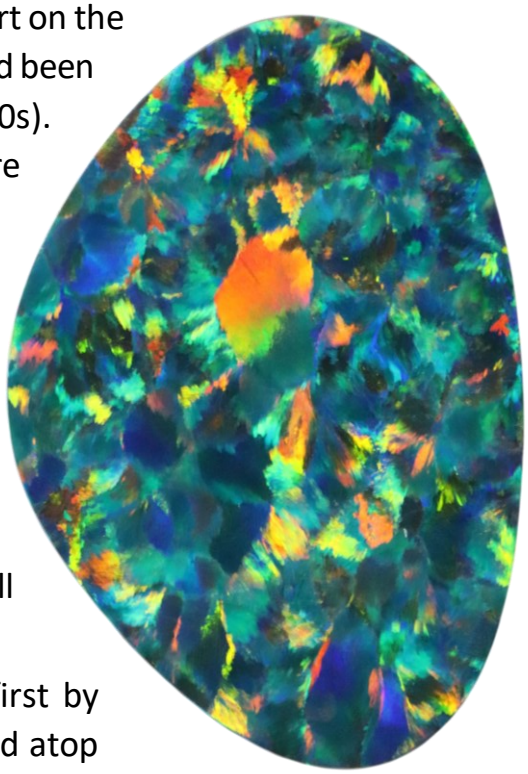
A 'salmon pink' Linde star-sapphire

Several new gemstones were added, including: painite (a rare gemstone whose discovery had been announced by Claringbull, Hey and Payne in 1956); strontium titanate (aka 'starilian'); stichtite; amblygonite; and manufactured star-ruby & star-sapphire.

Elsewhere, the varying effects of 'short-wave' and 'longer wave-length' UV light were briefly considered (though not in relation to the tiny diamonds that were being manufactured by General Electric).[9]

Edition 14, 1972

For the final edition of *Gemstones*, Phillips could report on the newly-understood structure of precious opal (which had been discovered through electron microscopy in the 1960s). But not on the newly-created opals produced by Pierre Gilson (revealed by GIA in 1972). Manufactured gems were now being developed at a phenomenal pace, to the great concern of the jewellery industry:



A Gilson opal doublet

- Gem-quality diamonds weighing roughly a carat had now been grown, but at a cost far greater than for natural stones.
- Corundum could now be grown from a solution; both by flux-fusion (as practiced by Bell Telephone Laboratories) and hydrothermally.
- Hydrothermal emerald had been developed; first by Johann Lechleitner as an overgrowth of emerald atop a pale beryl, and later with the removal of the natural seed crystal (as practiced by Linde).
- Manufactured periclase was noted, though without any outstanding properties.
- Strontium titanite (now known as 'fabulite') was moved to a new section for manufactured gems lacking a natural counterpart, where it was joined by lithium niobate (aka 'linobate') and 'garnet-like structures'. This latter category included the diamond simulant YAG (yttrium-aluminium garnet, aka 'Diamonair'), which was grown through the newly-mentioned Czochralski method (aka 'crystal pulling').[10]

Elsewhere, opal doublets and triplets were described, as was the newly-passed *Trade Description Act* (UK) – which placed a greater significance on disclosing such creations.

In terms of natural gemstones, ekanite made its first appearance, alongside the newly-discovered tugtupite (known for its phosphorescence and tenebrescence). Meanwhile, zoisite was upgraded from the section on 'ornamental stones' to that of 'gemstones', with the discovery of blue-violet crystals of zoisite in 1967. It took just a year for these

A tsavorite garnet crystal[13]

crystals to be discovered in Northern Tanzania, rebranded by Tiffany's, then unveiled to the world as 'tanzanite'. No less remarkable was the green variety of grossular garnet found nearby (and in the same year).[11] Tiffany's would similarly introduce the world to green grossular, having rebranded the stone as 'tsavorite'.[12] However, this would not occur until 1974. So, for the purpose of *Gemstones*, tsavorite was simply mentioned as a transparent green, yellow and brown grossular that had been recently reported in Tanzania.

In the sixty years covered by *Gemstones*, the greatest change to the gemmologist's toolkit had occurred at the outset, with Herbert Smith's newly-released refractometer. Less conspicuous were the gradually increasing prominence of the microscope and the slow shift in social attitudes, such that the thirteenth edition finally devoted a chapter to the microscope, whilst the fourteenth removed the last overt reference to 'Kaffirs' (an offensive term for black Africans).

The remainder of the twentieth century would see further shifts in social attitudes (especially in relation to ivory); the discovery of a vibrant blue-green elbaite tourmaline from Paraíba (Brazil); the introduction of newly-manufactured diamond simulants; and the emergence of spectroscopic equipment so powerful that the methods described in *Gemstones* would be increasingly regarded as 'classical'!

Notes

[1] In reality, the first manufacture of diamond would take place in 1953: first by William Eversole and the Union Carbide Corporation using a 'chemical vapour deposition' technique; then by Erik Lundblad and the Swedish company ASEA using a 'high pressure, high temperature' approach (Evans, 2022). Herbert Smith's overestimation of Moissan's success was corrected for the ninth edition of *Gemstones* (published 1940), which concluded that *'it is generally accepted to-day that diamond has never yet been artificially formed'* (Herbert Smith, 1940, p.138). The tenth edition (published 1949) then outlined Hannay's earlier experiments – whilst removing the clear conclusion from the previous edition and noting that Hannay's work had been *'all but forgotten except by those few who ventured to prospect in the same field of research'* (Herbert Smith, 1949, p.180). The fourteenth edition (published 1972) finally stated that *'diamonds could not possibly have crystallized in the conditions attained in Hannay's experiments'* (Phillips & Herbert Smith, 1972, p.177). But of course, by this point, manufactured diamonds were indeed a reality.

[2] Spencer also worked in the Minerals Department of the Natural History Museum and would later precede Herbert Smith in the role of Keeper of Minerals.

[3] Within the following edition (published 1949), Herbert Smith would describe two small polaroid plates *'which are optically at right angles to each other'*, as the polarizing dichroscope crept further towards existence (Herbert Smith, 1949, p.101).

[4] Image of morganite by Finesell / Shutterstock.com. The colour of morganite is not dissimilar to that of padparadscha.

[5] Anderson considered this expansion an amusing over-reaction to Robert Webster's Research Diploma on *Ivory and its substitutes* (Anderson, 1976, p.155).

[6] Rutile was described by Herbert Smith as an *'astonishing object'* on account of *'its high refractivity and enormous double refraction'* (Herbert Smith, 1949, p.194). In reality, it's the gem's extreme dispersion that makes it a wonder to behold (an error corrected by Frank Phillips within the thirteenth edition of *Gemstones* – published 1958).

[7] Claringbull had served as an examiner at the Gemmological Association since 1938. He would go on to become Director of the *Natural History Museum* from 1968 to 1978, and president of the *Gemmological Association* from 1972 to 1990. Aside from his expertise in gemstones, Claringbull had worked as an explosives expert for the *Special Operations Executive* during the second world war, and was reported to have grown the largest ever

crystal of nitro-glycerine – assuring colleagues it was probably not dangerous unless they dropped it! (Radford, 2004).

[8] An example of this skill is provided by Phillips' explanation of the polaroid plate and its development from microscopic crystals of herapathite (Phillips & Herbert Smith, 1958, p.119).

[9] The earlier success of the Swedish company ASEA would be acknowledged in the fourteenth edition (published 1972).

[10] Phillips deemed such material to be 'garnet-like structures' rather than 'garnet', as he considered the material to be lacking in silica (which was present in natural garnet).

[11] Zoisite and grossular are often found together, due to their similar chemical formulas (Bridges, 2009).

[12] Tsavorite was named after *Tsavo National Park* in neighbouring Kenya.

[13] Image by Albert Russ.

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