BOOK REVIEWS

Anderson (B. W.). *Gem Testing*. London and Boston (Butterworths), 1980. xvi+434 pp., 142 figs., 12 colour plates. Price £12 (hardback).

To have produced nine editions of *Gem Testing* (the internationally accepted standard work) over a period of 38 years is an achievement of no mean order and gives some indication of the perseverance and skill of Basil W. Anderson who founded the Laboratory of the Diamond, Pearl, and Precious Stones Testing Section of the London Chamber of Commerce in 1925. The present edition follows the general scholarly lines of its predecessor but since the previous edition there have probably been more changes in the science of gemmology than in any other comparable period and this is reflected in additional text which increases the pages from 384 in the eighth to 434 in the present edition. The enormous range of new materials needed for space programmes and its technology has speeded the development of crystal growing to a precise science and has provided a wide range of new synthetic gems and other hard synthetic materials which have found applications in gemmology.

Among the new diamond simulants, cubic zirconia is given detailed treatment, and other synthetics (such as GGG) are fully described. For the detection of these simulants new instruments have been developed; there are adequate descriptions of several new reflectivity meters and of the newly developed Riplus refractometer which has heated prisms and will read up to 2.21. The new Ceres Diamond Probe (a thermal conductivity meter) is described, as is the 'Gen Diamond Pen' which depends upon the well-known propensity of diamond for greasy substances and its reluctance to be wetted by water. However, the reader will search in vain for mention of some of these new instruments in the index.

Detailed tests are given for the detection of the Gilson synthetic opals which have been developed since the last edition and of the Slocum stone, a convincing glass imitation of opal. Descriptions of the synthetic turquoise and lapis lazuli produced by Pierre Gilson are given also. Other new materials described include synthetic alexandrite and corundum gems made by processes other than the well-known Vernueil method.

The detection of stones which have been improved in colour by oiling, impregnation, staining or radiation receives treatment in various parts of the book and attention is especially directed to irradiated 'aquamarine' which fades rapidly on exposure to sunlight and to blue topaz which appears to be permanently coloured after radiation.

Natural stones from new localities are described including rubies of fine colour from Kenya and Pakistan, fine-coloured emerald from Lake Manyara in Tanzania, and the rich-green grossular garnets from the Tsavo area of East Africa. Fuller details are given of the blue zoisite (tanzanite) from Tanzania.

Another new feature of the book is a description of the methods used in the London Gem Testing Laboratory for checking the purity and grain size of diamond grits and powders.

For many years gemmologists on the respective sides of the Atlantic have rued the convention in absorption spectroscopy which put 'red' on the left of diagrams in textbooks in the UK but on the right in the USA. Anderson has neatly overcome this problem, by showing both styles on facing pages. To accomplish this the plates have been turned left to right and top to bottom which results in species 1 to 7 on the left-hand page appearing as 7 to 1 on the right-hand page. The system is captioned correctly for red, yellow, and blue stones but the plates have not been reversed (top to bottom) for the green stones (pages 188–9) and the spectra are wrongly labelled.

Other minor points which will catch the eye of the mineralogist are 'haematite' still retained and 'spessartite' for the garnet will offend some English readers, but it is unlikely to trouble many Americans. On page 106 the 'O' and 'H' in the Vernueil furnace diagram should be reversed.

In the tables at the end of the book cubic zirconia is shown in the SG table but not in the RI, and lithium niobate and carborundum appear in the RI but not in the SG table; all properties appear in the alphabetic list. These inconsistencies may be deliberate or related to lack of space on the page, but many readers might prefer to see entries in all three tables. Several new colour plates form welcome additions to the book, but some black and white photographs could be improved.

This revised edition, the best textbook in English, is an indispensable aid for all concerned with gemstones and their testing.

E. A. JOBBINS

Hurlbut (C. S., Jr.) and Switzer (G. S.). *Gemology*. New York and Chichester (John Wiley and Sons Ltd.: Wiley Interscience), 1979. xiv+254 pp., 265 figs., 12 colour pls. Price £13·50.

It has always been accepted as appropriate that the authors of textbooks on gemmology should be professional mineralogists, as their training ensures that they possess the necessary scientific knowledge

of minerals and the techniques for their identification. But gemmology has now become so specialized a subject, with its own instruments and methods of identification which are particularly applicable to faceted stones, that the mineralogist must be at pains to understand the use of these thoroughly before venturing to act as an authority on the subject. Unfortunately in their new textbook *Gemology* the eminent mineralogists who are it's authors have made a number of surprising and important errors which, until corrected, will mar the reputation of what should have been a worthwhile addition to the literature on gems.

The book has an unusual format for its sober purpose, its dimensions of $7\frac{1}{2} \times 9\frac{1}{2}$ inches causing it to stand out on a shelf of more standard volumes. This choice of size may have been influenced by the decision to include a dozen coloured plates (mostly borrowed from A. Ruppenthal) which are an ameliorative feature of the volume. Also curious are the massive chapter headings, each taking up more than half a page.

After a brief introduction the book opens with a readable account (taken from a previous article by the senior author) of the origin and geological occurrence of the gem minerals, and this is followed by chapters on crystal chemistry and elementary crystallography which contain as much information as the gemmologist needs to know on these subjects. In the chapters which follow on the physical and optical properties of gems the student begins to smell the sweet scent of practical application. 'Gems and Light' describes and advises on the gemmologist's most important instrument for identification, the refractometer, and it is here that surprising errors occur. One of these (which in practice matters very little) is the statement that all refractometers are based on a hemisphere or hemicylinder of highly refractive glass, whereas for more than forty years Rayner refractometers have been using a 60° truncated prism—a variation initially found practical in constructing special instruments using blende, diamond, or spinel in place of the customary glass. Far more important is the statement on page 68 that the dispersion of a gemstone can be measured on the refractometer simply by taking a reading of the shadow-edge in red light and subtracting this from the reading in violet light. Even one single attempt to carry out this programme would reveal its fundamental fallacy. The position of the shadow-edge depends upon the relation between the refractive index of the stone and that of the glass hemisphere or prism of the refractometer for the wavelength used, and since the dispersion of the glass is invariably higher than that of the stone tested the shadow in red light gives a *higher* reading than in violet light. To obtain any exact figure for dispersion from such a simple-seeming experiment entails full details of the dispersion of the glass and some tricky calculation and any result obtained is of negligible diagnostic importance. A further error occurs on page 78 where it is stated that when taking refractometer readings on a biaxial stone the value of β will be given by both the lowest reading for γ' *and* the highest reading for α', whereas in the general case these two values are not the same and readings on a differently inclined facet are needed to be sure which represents the true β reading. Incidentally, on the same page the draughtsman, in a diagram intended to represent two glass hemicylinders in a refractometer has omitted two necessary lines and produced an 'impossible' figure which teases the eye. Earlier in the same chapter in a paragraph on luminescence the cause of fluorescence is ascribed to traces of the transition metals in the mineral concerned—'iron and manganese' being particularly effective as activators. In actual fact iron is known to have a strong *quenching* effect on fluorescence.

In Chapter 7 the microscope (and pocket lens) is disposed of in less than five pages and the spectroscope receives similar scant treatment in the next chapter. Here, in an extraordinary confusion between the spectra of glowing vapours and of solids, the bands and lines seen in the absorption spectra of gemstones are said to 'occupy positions identical to those seen in an emission spectrum'. Inclusions are dismissed in a mere two pages, then follows a chapter giving a summary of the methods used in gem synthesis and another on imitation, composite and treated gems. None of these sections on such important subjects are adequate in length or content. In Chapter 12 fuller treatment is given to the cutting and polishing of gems, the text being interrupted by the intrusion of twelve plates in colour, some of which are excellent.

This brings us to a chapter on descriptive gemmology which extends to nearly 100 pages and is probably the most useful part of the book. The gem species treated are divided into three groups, 15 'Important Gemstones', 44 'Less Important Gemstones' and 18 'Other' gems and ornamental stones, concluding with organic gems and synthetics. The decision as to which species to include in such descriptions is bound to be difficult in the case of the non-commercial or very rare stones, but it does seem curious that here as in other recent texts the inclusion of painite should have been allowed. Only two crystals of this rare mineral are known (both are in the British Museum (Natural History)). There are no cut specimens and the colour is too deep a red to be attractive.

The book ends with a series of tables of gem

properties, an appendix on interference figures, an ordinary index, and a gem index which also serves to give a résumé of the properties of each stone mentioned. The reviewer prefers not to specify the numerous misprints included in the book, as these are not so important to the student as are the several serious errors noted. None the less, it is hoped that these, too, can be eliminated in any future editions of what potentially is an important book.

B. W. ANDERSON

Elwell (D.). *Man-made gemstones*. Chichester (Ellis Horwood Ltd., distributed by John Wiley and Sons Ltd.), 1979. 192 pp., 46 figs., 9 colour pls. Price £15·00.

The history of the progress of mineral synthesis from its roots in the nineteenth century to its present-day state of successful activity is a fascinating subject in itself to any scientist, and since it is the gem minerals, starting with ruby, emerald, and diamond which have always been favourite targets of the crystal growers it is of vital importance to anyone connected with the jewellery trade to be well informed about the products themselves and their distinguishing characteristics.

Since 1926 when H. Michel wrote his remarkable work *Die Künstliche Edelsteine* until the present day there has been no comprehensive book dealing with the subject, and the details concerning each newly manufactured gemstone have had to be culled from articles in the gemmological journals. The appearance of Elwell's *Man-made Gemstones* is thus very welcome, the more so in that it is attractively produced and clearly written without any unnecessary padding. The fact that Dr Elwell is himself a crystal grower of repute enables him to write with authority on the complicated techniques involved and it is also a pleasant surprise to find him sympathetic to those in the jewellery trade and gem testing laboratories who have to cope with the difficulties entailed in discriminating between natural and man-made gems.

The chapters deal with the gemstones more or less in the chronological order in which their synthesis was achieved, beginning with the first partial successes by French scientists in the nineteenth century culminating in the dramatic breakthrough to commercial importance brought about by Auguste Verneuil's invention of his inverted oxy-hydrogen blowpipe (chalumeau) whereby, early in the twentieth century, factories sprang up in districts where electric power was cheap, producing gem-quality corundums and spinels in millions of carats annually. The successful preparation of ruby, emerald, and diamond each entailed a long history of failure or partial success before reaching its present degree of efficiency, and the story of each is recorded with accuracy and just sufficient technical detail in the book, aided by plentiful diagrams and with a long list of references to the relevant literature at the end of each chapter.

The synthesis of diamond, though only in the form of tiny crystals of industrial quality, became an established fact in 1954, when a team of scientists of the General Electric Co. of America first announced their (independently authenticated) success, but the later technical triumph by the American scientists in making gem-quality diamond in a variety of colours proved too costly a process to vie with natural gem diamonds. As a result, though man-made *industrial* diamonds have long competed with fair success with natural crushed boart, the tempting commercial field for synthetic products which can simulate diamond with fair success has been assiduously explored and we have had in succession (each complete with its advertising ballyhoo and fancy names to cloud the truth) synthetic white spinel, rutile, strontium titanate, yttrium aluminate, and finally cubic zirconia produced in quantity by various methods to serve as substitutes for this most universally desired gemstone.

Quartz is another man-made mineral which has great industrial importance owing to its piezoelectric properties which enable it to control frequency in radio transmission and in electronic clocks and watches. Production grew apace in World War II and although there is no demand for colourless synthetic quartz as a gem material there has recently been significant success, particularly in Russia, in producing synthetic quartz in green, blue, and yellow colours which have now entered the market and posed for the gemmologist some difficult problems in identification.

Outside the field of crystalline gemstones, Pierre Gilson, who had already scored a notable success in the growth of fine emerald crystals (a field pioneered by Carroll Chatham) proceeded to conquer the problem of producing supremely beautiful gem opals in his laboratory, following this with more dubious versions of lapis lazuli, turquoise, and even coral which, as an organic growth, cannot be truly synthesized.

In his last chapter rather misleadingly entitled 'The Value of Gemstones' Elwell gives a brief but useful summary of the methods by which synthetic stones can be distinguished from their natural counterparts, and the book ends with an odd assortment of appendices which includes a recipe for growing your own rubies, a list of suppliers of man-made gemstones, and a bibliography, followed by an index.