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THE JOURNAL OF GEMMOLOGY

and

PROCEEDINGS OF THE
GEMMOLOGICAL
ASSOCIATION
OF GREAT BRITAIN

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SAINT DUNSTAN'S HOUSE, CAREY LANE
LONDON, EC2V 8AB

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"1925 . . . AND ALL THAT"

By B. W. ANDERSON, B.Sc., F.G.A.

(being the substance of a talk given to the Gemmological Association in London at Goldsmiths' Hall on 29th January, 1973)

THE title chosen (by Mr. G. F. Andrews) for my talk this evening is, of course, derived from that well-known skit on a schoolboy's garbled version of history, "1066 . . . and All That", as he thought it indicated my theme sufficiently well, while sounding less dry-as-dust than would a more fully descriptive title. The story I have to tell may also seem to you to be "ancient history": but whereas "1066" aimed chiefly at being funny, in my case the amusement will be merely incidental, as I shall be trying to give you as accurate a picture as my memory and the limitations of time will allow of our early struggles in London's Precious Stone Laboratory to come to grips with our science and enlarge its scope and accuracy.

The forty-six years during which I was in charge of the Laboratory of the London Chamber of Commerce can be considered conveniently to consist of four periods. The first (1925–1930) was concerned almost exclusively with pearl-testing. In the second period, ushered in by the World Trade Depression, we (I had been joined by C. J. Payne in 1928 as mentioned later) extended and im-

proved our techniques for gem-testing, and used the leisure forced on us by the Depression to carry out some fruitful research. This was ended by the outbreak of war, and the war, of course, was a very distinctive period of its own. And the last period began in 1946, when, faced with an enormous increase in work, Robert Webster and Alec Farn were added to the strength—our well-balanced team of four thereafter working together for the next twenty-five years.

The Hatton Garden of 1925 which I entered as a young man fresh from the University was very different from the Hatton Garden of today: more romantic, more obviously a street utterly obsessed with the trade in diamonds, pearls and gemstones of all kinds. Only two shops in the street, and one of these a jeweller's sundriesman—in doorways and along the kerbstone, brokers and small dealers gesticulated and bargained and scrutinized through lenses goods fished from dirty stone-papers. Old buildings, long since demolished, were human rabbit-warrens where at the end of dark passages or reached by crooked stairways lapidaries, mounters and other specialists worked long hours in an atmosphere laden with coal-gas.

To begin with, my story was purely a *pearl* story. In the jewellery trade of the 1920s the oriental pearl was queen—incomparable for its beauty, prestige, value, and profit-making possibilities. Recovered from "oysters" which were fished from the waters of the Persian Gulf or the Gulf of Manaar by naked divers operating from sailing dhows much as they had done for some 2,000 years, the pearls were shipped to Bombay, and there prepared for the world markets with amazing taste and skill. The pearls were cleaned, drilled by hand (more perfectly than by any mechanical means), graded for colour, size, shape, and lustre, and assembled into the wonderfully attractive "Bombay bunches", in which short strings of pearls (forming a "size") were finished at each end with braided silver wire and tassels and folded in blue silk. A parchment label attached to the bunch gave the number of pearls in each size, their total weight, average weight and the "once the weight" for the entire bunch. These bunches were imported into London and Paris (then the leading world markets for pearls) by a few wealthy houses, many of whose names, once so important (Max Mayer, Tanburn & Co., Mendes da Costa, Jerwood and Ward), are now remembered only by the veterans amongst us. These bunches were the raw material from which new necklaces were assembled with loving care

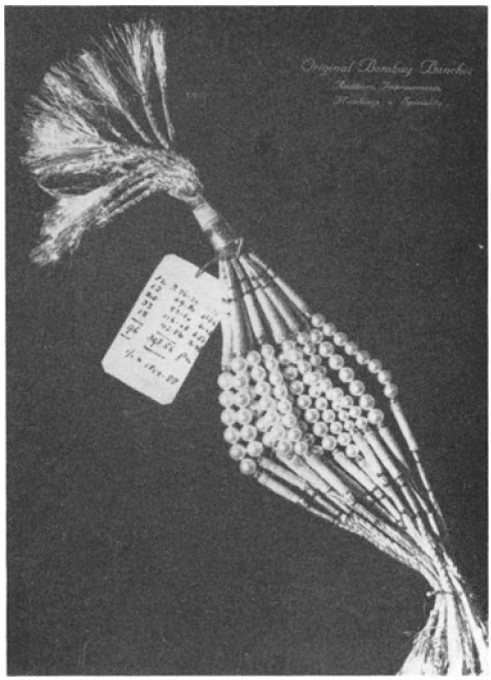


FIG. 1. A typical "Bombay Bunch".

by a few specialists at this work. Every dealer in pearls, as well as the larger jewellers, had their own pearl-stringer, and in Hatton Garden two "pearl doctors"—the Brockmans, father and son—were kept constantly busy improving pearls by removing blemishes, and drilling them or redrilling them.

Early in the 'twenties this profitable trade was rudely shaken by the advent of the whole cultured pearl, and by 1925 things had reached a pitch where the bold and far-sighted step was decided on by the leading dealers to establish an independent testing station under the aegis of the Diamond, Pearl, and Precious Stone Section of the London Chamber of Commerce. In their search for a suitable young scientist to take charge of the work, the Section's Committee were guided by W. T. Gordon, Professor of Geology in King's College (London University), who was on terms of friendship with some of the more important diamond and pearl dealers. I had taken my degree in chemistry (with subsidiary mineralogy) at King's in 1924, and had mercifully failed to find a suitable job as a chemist,

and Professor Gordon suggested that I might care to try my hand at forming and running the proposed new Laboratory in Hatton Garden. It sounded interesting, so I accepted. I had a thorough scientific training in chemistry, and some in mineralogy: I had enthusiasm and an enquiring turn of mind—but of pearls I knew nothing, and had everything to learn. After a short stay in Paris to find out what I could in the methods being tried there to distinguish between natural and cultured pearls, I returned with a heavy piece of apparatus called the "Lucidoscope" and a box of accessories, and with this dubious equipment and a commissionaire who was lacking in geniality and intelligence, I was installed in a small L-shaped room at the top of Diamond House and started to learn my job.

This was in July, 1925. I don't like to remember those first few months. The "Lucidoscope" was essentially a brass turret with a powerful, water-cooled lamp in the base, light from which passed through the pearl to be tested, resting in a saucer-shaped diaphragm on the glass base of a metal cell containing cedar-wood oil or monobromo-naphthalene. In cultured pearls there is a greater transparency to light in directions parallel to the layers of the enclosed mother-of-pearl bead, and, by turning the pearl with forceps in the "Lucidoscope" and observing it from above through a head-loupe, characteristic "stripes" showing the mother-of-pearl structure could often be seen. This was positive enough, but *proof* that a pearl was natural was far from conclusive. Following some work by Paul Kerr in America, I carried out a number of density tests, and established the markedly higher density *on average* of the cultured compared with the oriental pearl—which helped a bit, but it wasn't until the arrival of the first Endoscope in January 1926 that I was freed from the agonizing worry of making decisions, on which thousands of pounds might be at stake, with inadequate apparatus and (far worse) inadequate knowledge and experience.

After a little practice, the endoscope provided a 100% certain test between natural and cultured pearls, assuming these were drilled: and the improved model devised by the pearl dealers Réné and Simon Bloch on the original design of the inventors, Chilowsky and Perrin, enabled one or two hundred pearls to be tested in an hour. And that, for the years 1926, 1927, and the greater part of 1928, was my job. The growing reputation of the Laboratory and the disturbing fact that the freshly imported bunches were being increasingly contaminated with cultured pearls naturally led to more

and more work. The mere 5,000 pearls tested in 1926 had increased to twice that number in 1927 and to 49,000 in 1928, towards the end of which I was working flat out in Lab. hours, and doing overtime testing unofficially for certain firms where an endoscope had been installed. It should be explained that to allow two endoscopes to be sold to the Laboratory at the moderate price of £96 apiece the Committee had to agree to purchase 25 of the instruments, and I had the dubious pleasure of fitting these on their specially designed two-decker tables in odd corners of some of the big jeweller's stores or dealer's offices in Hatton Garden, Holborn Viaduct, and the West End. I call this a "dubious" pleasure, because neither by nature nor by training am I a good electrician, and the endoscope had a highly irregular circuit whereby the body of the instrument itself was "live", and could give rise to considerable electric shocks for the user if there was a direct current supply, unless insulated by a rubber mat. Added to this, the member of the staff chosen to operate the apparatus was usually the unfortunate pearl stringer, who was a scared and reluctant learner, quickly broke the bulk of the delicate needles, and telephoned for help whenever the carbons of the arc lamp needed recharging.

A point was reached where additional staff was essential, and (also through Professor Gordon) the Committee engaged C. J. Payne, who had taken an Honours degree in Geology at King's, to assist me. Payne's first report was issued on 6th November, 1928. And from then until the outbreak of war our work was closely interwoven.

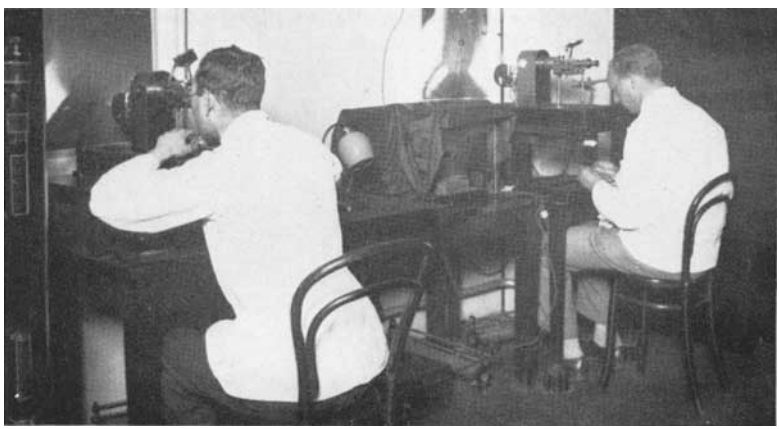


FIG. 2. 1929. In full swing with the endoscope. Anderson (right) and Payne at 55 Hatton Garden.

We continued to be largely chained to our endoscopes, testing bunch after bunch of pearls as well as vetting the whole pearl stock of some of the larger West End shops. But the lack of X-ray apparatus which alone could give decisive results with undrilled and part-drilled pearls was a drawback which had to be remedied, and in July 1929 we moved to much larger premises at 55 Hatton Garden, where running water and dark-room facilities were available, and there our first X-ray equipment was installed. The set was manufactured by Watson & Sons, and designed by C. G. Osment of that firm—a brilliant and resourceful electrical engineer who became a close friend of ours, and later was to design the more versatile X-ray set which is still in daily use in the Laboratory. The use of X-ray

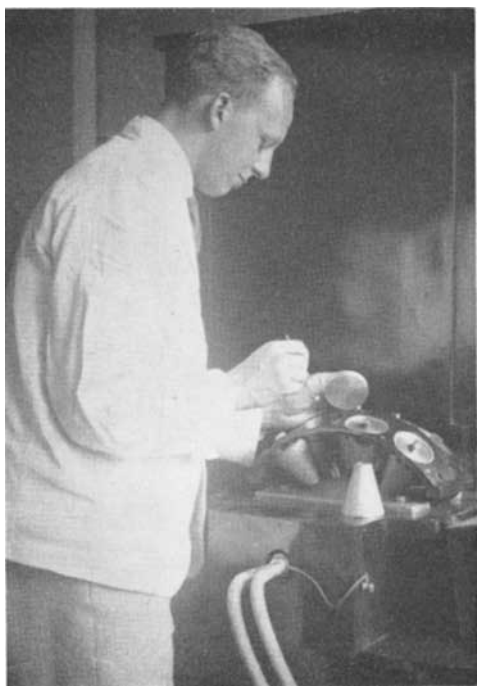


FIG. 3 Anderson using first x-ray diffraction unit for pearl testing at 55 Hatton Garden.

diffraction methods in testing pearls had been proved feasible by Dauvillier (1924) in France and the technique improved by Gallibourg and Ryziger. I paid a visit to Paris to study their methods,

travelling by air in a terrible little 'plane containing one other passenger and a consignment of Amplion loud-speakers. This achieved the journey in a series of swoops and lurches, and I felt so ill that I was reluctant for many years to travel by air again.

In February 1929 what was to become the terrible World Depression in trade had already started in America, and the demand for pearl-testing lessened slightly, and continued to fall, reaching its lowest point in 1931, when only 7,000 pearls were tested. But our interests were beginning to widen and extend to the study and official testing of gemstones of all kinds.

Research Begins: (1) The Refractometer

To the tragedy of the Great Depression we undoubtedly owed the fact that for several years we had enough time to spare from routine testing to carry out quite elaborate and time-consuming experiments. These were usually a happy blend of the practical and the academic. Both Payne and I were sufficiently "dyed in the wool" scientists to rejoice in discovery for its own sake, but, as practising gemmologists, we were delighted when such investigations could be used to good effect in everyday gem-testing.

One of our earliest concerns was to increase the range of the refractometer. For some time the only refractometer available to us was Herbert Smith's 1907 model, made by Steward—a remarkable little instrument which had for the first time made scientific gem-testing possible for the student and the enlightened jeweller. Its weakness lay in the limited scale, extending to 1·79, and this, combined with a contact liquid (sulphur in methylene iodide) which when stale had an index not higher than 1·785, made clear readings for the important corundum gems quite a difficult business. A new refractometer, designed by the jeweller-gemmologist B. J. Tully and manufactured by Rayner and Keeler, employed a hemisphere of very refractive lead glass, allowing the scale to extend temptingly to 1·86. But in practice readings were limited to a bare 1·78 by the contact liquid, and if one attempted to boost the index of this liquid by dissolving iodides of tin, arsenic, antimony, etc., the resulting "soup" played havoc with the surface of the glass.

Our attempts to overcome these difficulties followed two lines. Firstly, to find some contact liquid, known or not yet known, of high enough index to extend the range of such a refractometer as the Tully while not attacking the surface of the glass, and secondly to

explore the possibility of using some isotropic high-index transparent mineral less chemically vulnerable than glass which could be used for the hemisphere of the instrument. The latter experiments were only possible by means of the ready co-operation of Mr. J. Pike of Rayners and his technicians, but the liquid preparations, which were smelly and dangerous, were "all our own work"—and, without the facilities of a chemical laboratory such as a fume cupboard to take away the poisonous vapours and without sinks and running water to deal with water-cooled condensers and so on, would be rightly condemned as foolhardy by a knowledgeable chemist. Smelly gases we removed through a long rubber tube which dangled from the window. Neighbours blamed the mysterious stinks on faulty drains. Water-cooled condensers we filled at one end from a jug and emptied the water from the lower end into a beaker periodically as it grew too hot. We searched the literature for likely compounds of sulphur, selenium, iodine, arsenic, etc., which were known to yield compounds of high refractive index, and studied methods for their preparation which might be possible with our resources. Of the many substances prepared, three seemed to have practical possibilities: the yellow crystalline compound of iodine and carbon known to chemists as tetra-iodoethylene (C_2I_4), which dissolves readily in the previously standard sulphur-saturated methylene iodide to form a liquid of index 1·81 which does not appreciably attack the glass table of the refractometer; selenium bromide (Se_2Br_2), a very dark red liquid which decomposes spontaneously to some extent in air, re-dissolves the separated selenium, and forms a liquid of index rather more than 2·00; and phenyldiiodoarsine, an orange fluid with an index of 1·85. Both the last two fluids attack the glass of the refractometer and the phenyldiiodoarsine ($C_6H_5.As.I_2$) is closely allied to one of the war gases and has a vicious blistering effect on the skin. Nonetheless, when we published our results in *Nature* in January 1934, a transparent liquid of so high an index was welcomed by mineralogists and its manufacture undertaken commercially by Hopkin and Williams. As for the 1·81 fluid, this has become the standard refractometer fluid throughout the world.

We measured the refractive index of all these liquids by introducing them into small hollow glass prisms made from pieces of microscope slides cemented to a glass base, and employing the minimum deviation method on a table spectrometer. This table

spectrometer, which I bought with my own money for only £25, proved enormously valuable to us in many of our researches, and was very much a favourite instrument of C. J. Payne who used it with great skill and "wrote it up" in *The Gemmologist.**

Working on the other line, the most favourable mineral appeared to be zinc blende, which is cubic and has an index of 2·37. This is obtainable in clear yellow pieces from sources in Spain and Mexico. Blende is fairly resistant chemically, but is soft and difficult to fashion and polish on account of its ready dodecahedral cleavage. Attempts to make hemisphere segments with zinc blende were not very successful, and this led Rayners to try the effect of utilizing a truncated 60° prism instead. A successful little blende instrument was in fact constructed, complete with scale reading to 2·20, and with this Payne and I were able to measure the refractive indices and birefringence of a range of zircons for the first time in history. The contact liquid we used for that purpose, by the way, was a phosphorous mixture proposed by West, which tended to burst spontaneously into flames, and lost popularity with me after an accident in which my hands and clothes were badly burned.

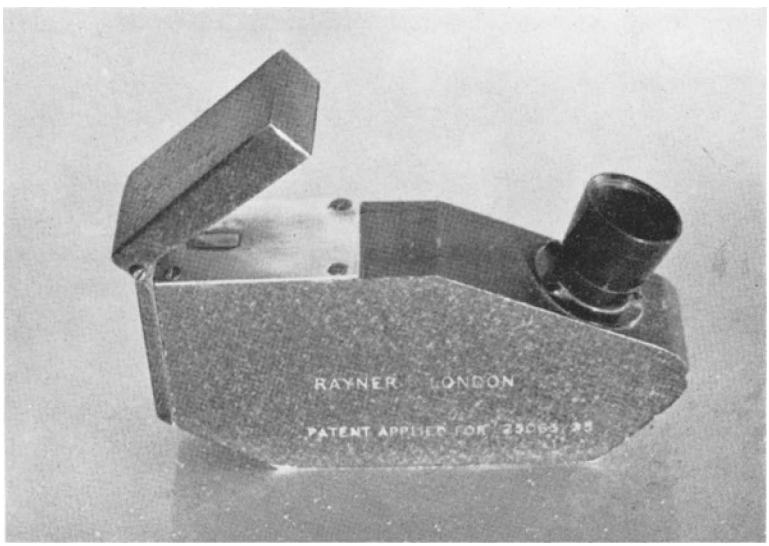


Fig. 4. Experimental Blende refractometer—prototype of Rayner refractometers.

**Gemmologist*, 6, 207-218, April 1937

This change to a prism-shaped refractometer block had far-reaching consequences. It made possible the manufacture of a satisfactory and inexpensive standard glass refractometer: it encouraged Rayner to make for us the first diamond refractometer, the diamond for which was generously given by the Diamond Corporation: and it also enabled that most useful instrument, the spinel refractometer, to be made on a commercial scale. It can thus be seen that our experiments and concern in this field did lead to very practical advantages for gemmologists the world over.

(2) The Spectroscope

The next stage in our progress concerned experiments with the spectroscope which were destined to open up a neglected field of gem-testing which has since become of ever-growing importance.

In the autumn of 1932 an astronomer friend of mine gave me a Maclean's Star Spectroscope for which he had no further use—and "trying this out" with a large green zircon, we were thrilled to see an impressive series of sharp absorption bands when we passed light through the stone. We had read, of course, of Church's discovery of such bands way back in 1866. By a curious chance (there have been many such in the Laboratory's history) this particular zircon was one of those very rare metamict zircons which show an anomalous spectrum, as we were to realize much later. The important thing was that, seeing these bands "for real" and not just as a text-book reference, so excited our interest that we began looking for absorption bands in other coloured gemstones and, to our astonishment, to find them. Previous work by various scientists was hidden away in the journals, as I was to discover subsequently. But, so far as we then knew, the path was still untrodden, and we had all the excitement of almost daily finds of new absorption bands in the many specimens available to us. Our little prism instrument, which we nicknamed "Eustace", was excellent for showing the fine lines in the red due to chromium in ruby, emerald and alexandrite, but its dispersion was too great for proper study of the blue and violet, and for this we switched to "Stubby", the small diffraction-grating spectroscope with adjustable slit, made by Beck. This needed a powerful light-source, and soon we were using a 500-watt projection bulb, with reflector, housed in a large tea-tin which had a suitable circular outlet. C. J. Payne found that a streak-free spectrum was readily obtained by placing the stone to be tested on the microscope

stage, reflecting a powerful beam through it, and using the spectroscope in place of the eyepiece. Soon, we were measuring the wavelength of bands through a Beck "Wavelength" spectrometer, with an accuracy of within ten Ångstroms. For narrow and important lines, such as those in zircon, ruby, emerald, etc., we achieved maximum accuracy by comparison with established emission lines of suitable elements on the table spectrometer, and it is a gratifying tribute to our accuracy that our published measurements have been used and accepted by all subsequent authors.

We sent an adequate description, with wavelengths of the most important absorption spectra, to Dr. Herbert Smith, who incorporated it verbatim in the re-written 1940 edition of his famous book *Gemstones*, and information was also provided in Webster's *Compendium* (1937 and subsequent editions) and my own book *Gem Testing* (1942, etc.); thus I did not feel any pressing need to attempt a complete account of the subject until 1953, when I started a series of no fewer than 40 papers which were published monthly in *The Gemmologist* and illustrated with drawings by my friend the late T. H. Smith. By then the Beck 2458 prism spectroscope or its equivalent by other makers had established itself as the most favourable type for gem identification. I haven't time to dwell further on this important subject. But I often wonder, in a detached sort of way, how we gemmologists would have managed to tackle some of today's problems (such as the detection of stained jadeite and treated diamonds) without its aid, and just how many man-hours and headaches the reassuring detection of the 4500Å band in natural sapphire, the 6535Å line in zircon and the 4155Å line in diamond have saved us in our Laboratory alone.

And now I want to move away from the Laboratory for a while and give you a glimpse of the Evening Classes in Gemmology as they were in the autumn of 1933 when I was invited to teach there in succession to Mr. I. G. Jardine, as I think that as past or present students this may interest many of you. Mr. Jardine had done a tremendous job in organizing these classes, and had been running them very successfully for many years. He had to abandon them suddenly when offered the important post of Inspector of Schools in the Borough of West Ham. Jardine was an excellent organizer and a good teacher in a schoolmasterly way. But the training in practical gem-testing which made the classes so popular amongst the young jewellers of the day was largely left in the capable hands of his

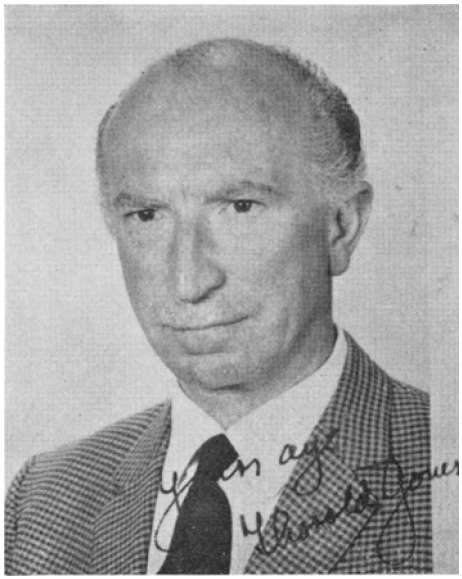


FIG. 5. Thorold Jones—The students' best friend at Chelsea Polytechnic.

assistant, Thorold Jones, whose day-time work was in the Geological Museum as assistant to Dr. H. H. Thomas.

Thorold Jones had a warm and friendly personality and was an excellent practical gemmologist, and I was lucky indeed to have his help until the outbreak of war. He knew where all the instruments were and kept them in good trim, and he knew all the scarred and chipped gem specimens by their Christian names. Conditions for practical gemmology at Chelsea were pretty primitive at that time. There were too few microscopes, and the Herbert Smith refractometers were mounted in cradles for greater ease of reading, while sodium light for these was provided by salt introduced into the flame of a Bunsen burner. I was supremely lucky in my first Diploma class, which included such notable students as Robert Webster, R. K. Mitchell and Ross Popley. I stimulated them with my first-hand news of testing methods used in the Laboratory and with unfamiliar specimens from my own growing collection, while they stimulated me by their enthusiastic response. There were no failures when they took their Diploma examination. The "Chelsea"

colour filter, which was devised in our Laboratory, serves in a way as a memorial to that class. Ross Popley wrote it up in *The Gemmologist*,* and all the students were so convinced of its usefulness that we persuaded the Gemmological Association to market it with the name "Chelsea" attached. Even today it is a most useful gadget to have in one's pocket, provided one has enough knowledge to use it with discretion.

(3) Cleaning up the Constants

If I had time, I should like to tell you of our discoveries of the zinc-rich "gahnospinels" and of kornerupine which lay unsuspected in the Ceylon gem gravels, but I feel that our campaign to improve the accuracy of the "constants" (refractive indices and, more particularly, density) in the standard text-books was of more general importance to gemmology, and can usefully form the last episode I shall give this evening of our struggles to improve our knowledge and techniques and raise the status of our science. This long-term undertaking (or "concern" as Quakers would call it) derived from a rude shock we had when testing for a dealer beads from a fine necklace of lapis lazuli. Despite their convincing appearance, replete with glistening particles of pyrites, when we found that the density of the beads ranged from 2·85–2·87, we felt these figures were so far from the 2·38–2·45 given unanimously by all the best-known text-books, that there must be something wrong with them. Hasty comparison with our own specimens, during which my best uncut piece of lapis got broken in the excitement, and later with some 500 specimens borrowed for the purpose, showed that 95% of the samples had densities between 2·75 and 2·90, the conclusion being that the beads were all right but the books were all wrong. Searching back through the literature, I found that the error had crept into Dana's *System of Mineralogy* between the 1844 and 1850 editions, and derived from a determination quoted by Breithaupt in his *Handbuch* (1847) on "quite pure grains" of lapis, which gave a density of 2·405. Dana's 1850 edition gave this figure a "safety margin" spread of 2·38–2·45, and for nearly 100 years this utterly misleading figure for the rock had been slavishly copied by authors of all the standard books.

That such a thing could happen badly shook our confidence in all the figures (particularly for the density) of gemstones given in

**Gemmologist*, 4, 57, September 1934

text-books, and we set to work to check their accuracy and compile our own tables. First, we had to set our own house in order, and we found it curiously difficult to obtain really consistent results, except by flotation. But eventually, by using a heavy cage and a very fine suspending wire in conjunction with a liquid of low surface tension such as ethylene dibromide, we began to achieve consistency in our hydrostatic work to within one or two units in the third place of decimals. In the course of our studies we became impressed with the fact that gemstones, being pure examples of the minerals they represent, mostly showed "constants" which really *are* constant. They are worth measuring and recording with care, since they are our mainstay in gem identification: and where there *are* variations, these are of significance, serving to sign-post differences in trace elements in different localities, or revealing the ultra-pure composition of a synthetic stone. As with our absorption-spectrum work, we considered the re-written 1940 edition of *Gemstones* a good opportunity for revised constants to be made available to fellow-gemmologists and students, so we handed Dr. Herbert Smith quite a formidable dossier containing our suggestions, of which he very courteously and readily took advantage.

Already before the war (which must put an end to this part of my story) specimens of the German synthetic emerald had become available for examination and caused considerable consternation from the fact that they were grown as crystals, and had natural-seeming inclusions, with none of the features associated with the Verneuil synthetic corundums to which the trade had become accustomed. And here at once the slightly lower constants of the new synthetics made the accurate measurement of these of high importance in establishing their origin. These "Igmeralds" might be said to be a cloud on the horizon "as small as a man's hand" which heralded the post-war shower of synthetics, which now threatens to become a deluge under which only the continued efforts of specialized laboratories such as ours can save the trade from being submerged.

SYNTHETIC QUARTZ FROM THE UNITED STATES

By M. J. O'DONOGHUE, M.A., F.G.A.

THE writer recently received, by courtesy of Dr. Baldwin Sawyer, of Sawyer Research Products, Ohio, some specimens of hydrothermally-grown synthetic quartz. Interest centres around a fine synthetic citrine, weighing 49·28 ct. and cut as a gem. The stone is golden yellow, the colour evenly distributed and the constants are those expected for quartz, SG. 2·651, R.I. 1·544, 1·553. Examination of the stone under a binocular microscope, using dark-field illumination, showed small grouped inclusions, resembling the familiar "breadcrumbs" seen in other material of this type. In this instance they appeared to be grouped in a trefoil pattern, probably fortuitously however. It has been suggested that these inclusions may be particles of the sodium-iron silicate acmite, slender brown monoclinic crystals of which occur in natural quartz; in the hydrothermal process it has been suggested that acmite forms through the reaction of iron with sodium and silica in the solution. As was to be expected, no significant luminescence or absorption spectrum was observed.

Some large crystals of the material also given to the writer showed very clearly the mode of growth from the seed. The ends of the seed are $(10\bar{1}0)$ which face grows very slowly; the sides are (0001), $(2\bar{1}10)$ and (2110) which grow more rapidly. Surrounding the seed is a veil-area, which is usually discarded for optical and electronic use; were it to remain in a cut gemstone, this would furnish a valuable clue to the origin of the material.

The makers state that they can make the growth regions of the crystals visible by subjecting the crystal to ionizing radiation (10^6r) which activates the colour centres, which give rise to the smokiness of smoky quartz. A clear photograph in the literature supplied with the specimens shows the irradiated darkened patches very well.

The rough quartz which is used in the manufacturing process is clear Lascas quartz. A rough green specimen appeared dark and had a distinct colour zone which was probably due to the specimen having been sawn from an area near the colourless seed.

As far as can be seen, the inclusions furnish the only possible clue to the origin, and as these can also be found in some natural stones, they cannot be completely diagnostic. The "paint-splash" inclusions found in some of the other synthetic quartzes were not seen in this specimen.

The writer is indebted to Dr Baldwin Sawyer for his generosity and to Mr Allan Jobbins of the Institute of Geological Sciences, London, for providing the facilities for microscopic examination.

A NEW DEPOSIT OF RHODONITE IN TANZANIA

By RUDOLF E. THURM

A NEW deposit of rhodonite, a spectacular silicate of manganese, $MnSiO_3$, of extraordinary deep purple-red colour (so-called "Imperial Red"), was discovered in Tanzania, near the town of Same, Upare, three miles south-east of Daghaseta school.

The authorized miner and mine manager of the Chambongo magnesite mine, Mr. W. Andersen, was digging there for pyrolusite, a high class ore of manganese, and found an outcrop of very coarse-grained rhodonite on top of Daghaseta hill.

The large boulders, which have been laid free, are completely covered with pyrolusite and have to be blasted with low % gelignite or gunpowder to avoid shattering.

The rhodonite outcrop is in the middle of a highly mineralized quartz lens with a dip of 45°, containing zinc blende, bornite and blooms of native copper on the hanging and on the footwall.

After shifting the outcrop, rhodonite-pyrolusite mining will have to be done underground by room and pillar-system.

Up to now two varieties of rhodonite have been mined. The fine-grained type with cristallites of $\frac{1}{4}$ to 1 mm diameter is of an attractive rose-pink without any brownish tinge, while the coarse-grained type with cristallites of 2 mm diameter and more is of an intense purplish red. Larger crystals are found sporadically, which might be suitable for faceting.

All the rocks have to be cut open and freed from larger parts of black hydroxides of manganese and sorted into different grades, so that the output of gem-quality rhodonite is about 10%.

Daghaseta rhodonite is worked into fine and very attractive cabochon gemstones by the Tanzania Lapidary Corporation Ltd., in Arusha. Other rhodonite material with black veins of manganese hydroxide and yellow veins of spessartite garnet is used for the manufacture of ash-trays, book-ends and clock faces.

Large quantities are exported to Hong Kong for the manufacture of dishes, vases, snuff-bottles, animal sculptures and statuettes. Tanzanian rhodonite should last for many years to come.

Mr. W. Andersen by an outcrop of rhodonite at Daghaseta Hill.

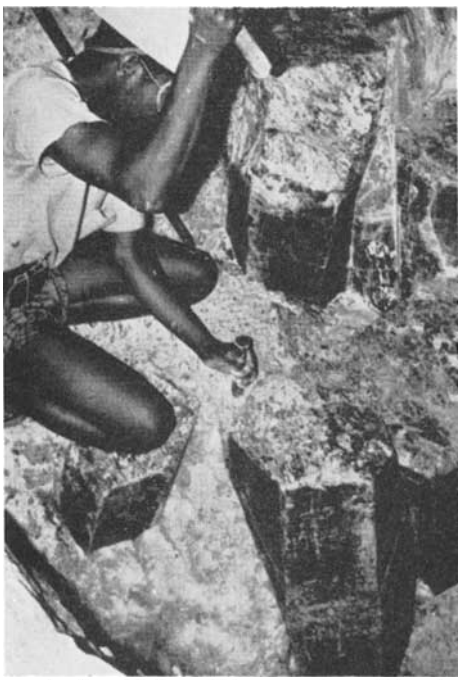
NEW GEM LOCATIONS AND THE PRESENT TREATMENT OF GEMSTONES

JULIUS PETSCH Jr, from Idar-Oberstein, Germany, was the speaker at a meeting of the Gemmological Association in Goldsmiths' Hall on 17th April, when he made his subject new gem locations and the present treatment of gemstones.

Mr. Petsch said he was the third generation of a family in Idar-Oberstein working in gemstones and some 15 years ago he was launched upon his career of finding new gem locations in Africa and Brazil. While gemmologists were mostly used to speaking and thinking of cut and polished stones, he wanted to show how uncut stones were first located. It was not the big mines he was interested in but the little workings, where sometimes a single digger was working under very difficult circumstances. Some 60 per cent, even 70 per cent, of the world's gemstones came from diggings of which few people had heard.

Mr. Petsch then presented a series of coloured slides, upon which he gave a running commentary. The first slide was of a very big safe in his company's offices—the end of a very long journey for the stones from Africa or Brazil. From the safe the stones went to the cutters and from the cutters to the jewellery trade.

The first country visited by slides was Tanzania, a country very rich in stones such as rubies, sapphires, a new emerald deposit, tanzanite and zoisite, tourmaline, and nearly all the fine stones one



Enormous beryl crystals from which aquamarine could be extracted.

Entrance of the Platveld Amethyst mine.

could imagine. Some 20 years ago the Longedo ruby mine, near Arusha, was opened up, and it was a long slow business following the zoisite veins to discover the rubies imbedded in them. Tanzanite, a blue zoisite, was prized by diggers and was rising in price; one of the reasons was that the diggers had to cut a long deep trench and hope they would come upon a vein. The stone was not always blue; sometimes it was brown and sometimes brownish-blue, but heat treatment to many hundreds of degrees centigrade usually caused the stone to turn to cornflower blue.

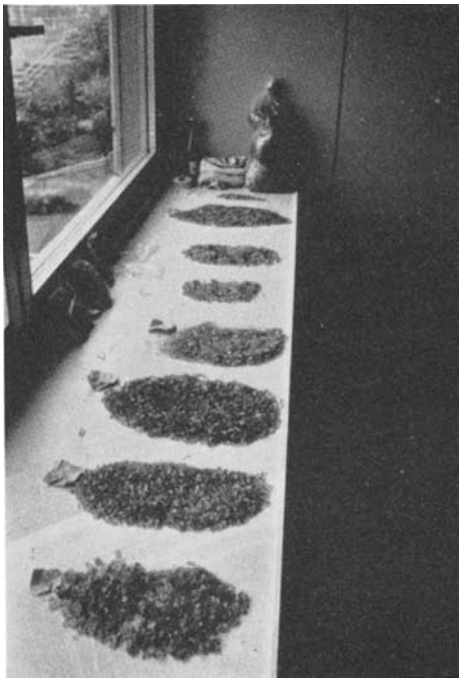
In Madagascar, the second country on Mr. Petsch's imaginary journey, his company was responsible for founding a small company to search for aquamarine; notwithstanding that, it had been said that all the workings in that country had been played out. Madagascar was a country of few good roads; the rest were dirt lanes and tracks, and those seeking stones had usually to get from place to place by man-power. The aquamarine mine had some 160 workers, but to reach it one had a good march of something like 35 kilometres, and everything—food, personal baggage and suchlike—had

Large beryl crystal which contains aquamarines suitable for cutting.

to be manhandled to one's destination. Another slide showed a number of large aquamarine crystals weighing something like 2,500 kilogrammes each; this may have been a rare occurrence. It took two years to find them. Previously only small pieces were being found. The stones were something like two or three metres long, but not much of the material was of gem quality.

Mr. Petsch was of the opinion that Moçambique would be the country of the future for mining fine gemstones; already emerald

Beginning of an emerald mine in Moçambique.



Blue aquamarine, cleaned, hammered and prepared for sale to cutters.

workings there were producing qualities that equalled Colombian stones. Turning then to Brazil, he mentioned the emerald discovery there in 1945. Today some of the mines were 50 metres deep, but there were no lifts or other mechanical devices to take the miners down; they were let down on ropes. Gemstone buyers actually congregated at this mine and made on-the-spot purchases.

During question time Mr. Petsch was asked if it was possible to distinguish stones from different diggings by their inclusions. He replied that it was possible, but only providing one had examined samples from the various locations and was aware of peculiarities and characteristics.

To another question about there still being stones around Idar-Oberstein, he answered that stones—agates—were found there some 2,000 years ago and were still being found there in 1875. In more recent years, however, occurrences had been so small, that it had not been worth looking for them.

MEASUREMENT OF REFRACTIVE INDICES BY MEANS OF A MICROSCOPE AND DIAL-TYPE DEPTH GAUGE

By HAROLD A. OATES, F.G.A.

THE principle is not new. It also is not as accurate as the refractometer, but it is helpful on stones over R.I. 1·81 and on stones which do not have a very good polish. The "apparent depth" method appears in most of the literature, of which Webster's "Gemmologists Compendium" is an example.

$$\text{The formula used is R.I.} = \frac{\text{Real Depth}}{\text{Apparent Depth}}$$

To apply the above principle it is necessary to have a means of accurately measuring the depth of the stone. In this case a dial-type depth gauge was used. See Fig. 1. This one is manufactured in England by J. E. Baty & Co. Ltd. for Scherr-Tumico of America.

The specifications are:

Model CX1	Diameter $2\frac{1}{2}$ in
Reading ·01 mm	Graduation 0-100 mm
Range 12 mm	Cost £5·90(U.K.)

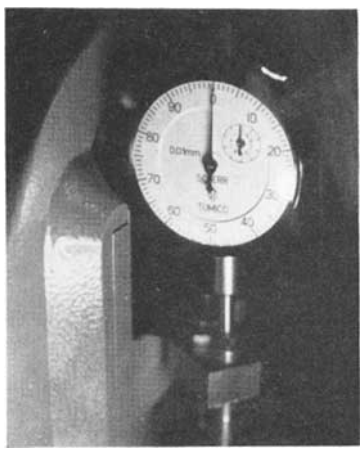


FIG. 1

The gauge can be installed on any good microscope. The one used in this discussion is a Vickers Model 14. Installation was simple. A hole was drilled vertically through the upper part of the arm using a #3 drill and tapped with a $\frac{1}{4}$28 threading die. Mount the dial on the vertical $\frac{1}{4}$ in. rod with adjusting collar. See Fig. 2.

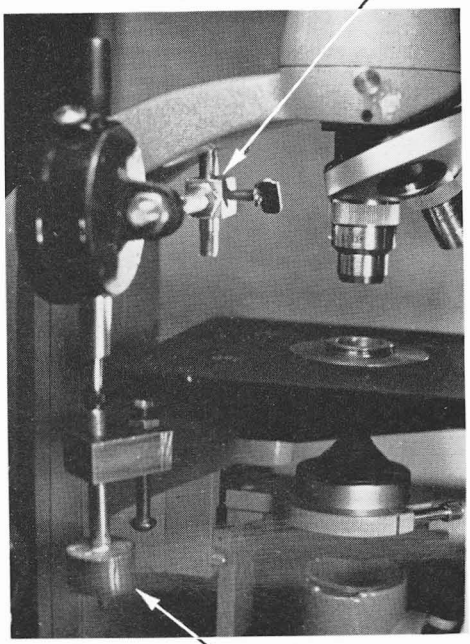


FIG. 2

To arrive at the R.I., the stone in question is placed on a microscope slide with the culet touching the glass (this is important, because if not touching it will give too great a real depth reading—also important is having the table parallel with the top of the glass slide for similar reasons). To hold the stone in place, use putty or beeswax. See Fig. 3.

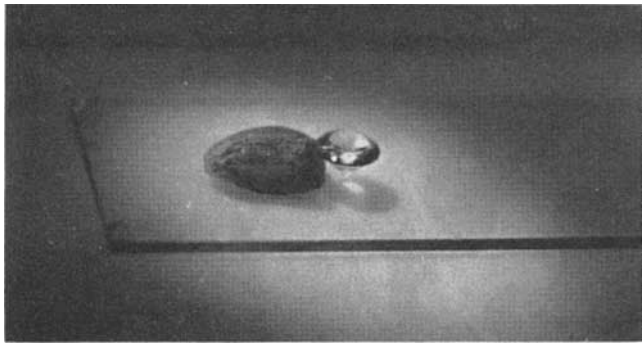


FIG. 3

Focus the microscope (25 × is a good mangification to use) on the table of the stone. See Fig. 4. This is easy because there is always dust on the table. Focus on a small particle of dust. Now zero the indicator using the adjusting screw. See Fig. 2.

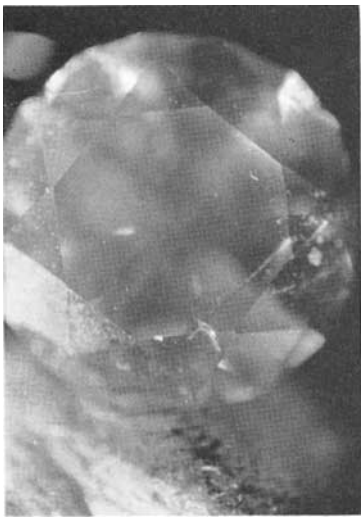


FIG. 4

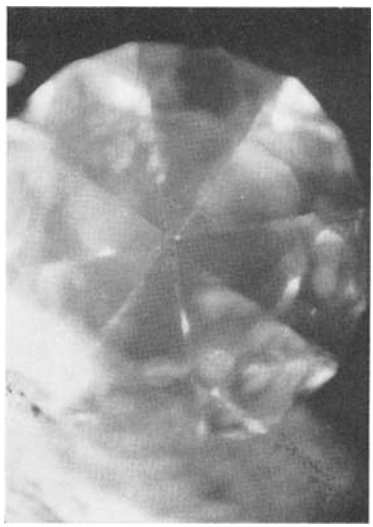


FIG. 5

The next step is to focus on the culet; this is not so easy, but with practice it can be done. (See Fig. 5). The reading on the dial is the apparent depth. Suppose the apparent depth reads 2·03 mm. The slide is moved laterally very slightly so you can focus the dust on top of the slide. Make sure you are not focusing

the dust on the bottom of the slide. The dial on the indicator is read again, 3·90 mm. This is the real depth.

To calculate the R.I. divide the real depth by the apparent depth according to the formula.

$$\text{R.I.} = \frac{3{\cdot}90}{2{\cdot}03} = 1{\cdot}92\text{—probably zircon (the Ordinary ray)}$$

I find that observational discrepancies make it advisable to take more than one reading. I usually take five readings and the average is taken. This takes less time than it sounds.

Below are a number of actual readings taken from several stones:

Blue Zircon: 6 mm round brilliant-cut

Real depth	Apparent depth	R.I.
3·90	2·00	1·95
3·86	2·00	1·93
3·90	2·03	1·92
3·89	2·02	1·93
3·92	1·99	1·97
		9·70/5 = 1·94

Diamond: ·33 ct. round brilliant-cut

Real depth	Apparent depth	R.I.
2·78	1·17	2·38
2·70	1·10	2·45
2·74	1·14	2·40
2·80	1·14	2·46
2·75	1·15	2·39
		12·08/5 = 2·42

White YAG: 1 ct. round brilliant-cut

Real depth	Apparent depth	R.I.
3·71	2·00	1·86
3·67	2·06	1·78
3·68	1·99	1·85
3·70	2·04	1·81
3·66	2·03	1·80
		9·10/5 = 1·82

Almandine Garnet: 4 mm round billiant-cut

Real depth	Apparent depth	R.I.
2·44	1·34	1·82
2·39	1·34	1·78
2·34	1·28	1·83
2·38	1·32	1·80
2·41	1·33	1·81

9·04/5 = 1·81

Yellow Chrysoberyl: 1 ct. round brilliant-cut

Real depth	Apparent depth	R.I.
3·71	2·13	1·74
3·72	2·13	1·75
3·74	2·11	1·77
3·73	2·14	1·74
3·78	2·14	1·77

8·77/5 = 1·75

Quartz: 6 × 8 mm cushion-cut

Real depth	Apparent depth	R.I.
7·38	4·76	1·55
7·47	4·78	1·56
7·42	4·78	1·55
7·41	4·76	1·56
7·47	4·82	1·55

7·77/5 = 1·55

It is interesting to note some other uses for this instrument. The real depth of a mounted diamond which cannot be measured using a Moe or Leveridge gauge can be measured. Just re-arrange the formula $\text{R.I.} = \frac{\text{Real Depth}}{\text{Apparent Depth}}$ to read Real Depth = R.I. × Apparent Depth.

Also one can read the diameter of the girdle of a stone by standing it up on edge on the slide.

I hope that someone who reads this will start thinking of a better method of doing it. It find it is quite useful.

Acknowledgement: to my son Lou for the photography.

Gemmological Abstracts

BALFOUR (I.). *Les plus gros diamants taillés dans le monde* (The largest cut diamonds in the world). Bulletin, Association Française de Gemmologie, 1973, 34, 6-9.

A list in tabular form of the 40 largest known cut diamonds in the world with their size, colour, cut and present owner, where known.

M.O'D.

BANK (H.). *Leucite, boracite, gaylussite.* Z. Dt. Gemmol. Ges. 1973, 22, 1, 33–38.

Transparent colourless and grey leucite from Italy was examined and it was seen that this stone is found in a cubic form (isotropic) and in a tetragonal form (anisotropic with slight double refraction). A transparent green boracite was examined; this stone is sometimes grey in colour and is found in Germany, U.S.A. and Bolivia, has a hardness of 7 and gets its name from its high content of boric acid. Two colourless, transparent stones were found to be gaylussite, a monoclinic soft ($2\frac{1}{2}$) stone with strong cleavage, making cutting difficult. The stones were found in Kenya, but are supposed to be found also in S.W.Africa, Venezuela and Nevada, and are produced synthetically in soda factories.

E.S.

BANK (H.), SAUL (J.), BERDESINSKI (W.). *Schleifwürdige Olivine aus Kenya* (Gem olivines from Kenya). Z. Dt. Gemmol. Ges. 1972, 21, 4, 216–218.

The authors describe a secondary find of olivines in Kenya; the stones were first thought to be cummingtonite and then recognized as forsterite. Characteristics similar to the Norwegian olivine which is also very rich in Mg.

E.S.

BANK (H.). *Blauer und dunkelgrüner durchsichtiger Lazulith aus Brasilien* (Blue and dark green lazulite from Brazil). Z. Dt. Gemmol. Ges. 1972, 21, 4, 219–221.

Opaque lazulite has long been known in Brazil. Now in the Minas Gerais there was a find of transparent blue lazulite in all colours from dark blue to green. The most important characteristics are listed.

E.S.

BANK (H.). *Die maximale Doppelbrechung als diagnostisches Merkmal* (Maximal double refraction as identifiable property). Z. Dt. Gemmol. Ges. 1972, 21, 4, 225–227.

The determination of the maximal double refraction is most important as this can be used as identification, especially together with minimum refraction. It was shown that it is not sufficient to take the reading along the length as well as the width of the stone, but that it is essential also to take a reading of the reverse side.

E.S.

CASANOVA (R.), SIMON (B.), & TURCO (G.). *A repeated twin in natural diamond from Tortiya, Ivory Coast.* Amer. Min., 1972, 57, 1871–1873. 2 figs.

The geometry of a cyclic twin has been established by X-ray methods. It consists of five tetrahedra in (111) twin position, all having a common [110] direction.

R.A.H.

CHERMETTE (A.). *La fluorine* (Fluorspar). Bulletin, Association Française de Gemmologie, 1973, 33, 11–15; 34, 12–15.

A review of fluorspar with an extensive account of its mode of occurrence and its main localities. Most attention is paid to the French occurrences and France is stated to be the world's fourth largest producer.

M.O'D.

DENNEN (W. H.) & PUCKETT (A. M.). *On the density and colour of amethyst.* Canadian Mineralogist, 1972, 11, 448–456.

The cause of colour results from the replacement of some silicon by ferric iron, with subsequent irradiation. The colour-

banding suggests changes in the growth environment, possibly involving a change from reducing to oxydizing conditions, a change in solution composition from Fe-poor to rich, Al-rich to poor, a rise in temperature and a drop in pressure.

M.O'D.

ELBE (M. G.). *Erstaunliche Schmuckeffekte an Brillanten* (Amazing gem effect in brilliant-cut diamonds). Z. Dt. Gemmol. Ges. 1972, 21, 4, 189–212; 1973, 22, 1, 1–23. 22 illus.; bibliography.

The effect of a brilliant-cut diamond is determined by the angles of the facets towards each other. The author suggests the use of angles which produce a higher reflection of the pavillion facets and claims this to have the optimal effect and also minimum weight loss. The rough stone is put to better use and also yellowish material is improved. The diamond is polished in an improved manner using a diamond-bonded wheel, the pressure on the stones being variable and two stones being polished simultaneously. A special new measuring arrangement is described, which carefully measures angles of facets and surface quality. To obtain the maximum brilliance from this new cut, it is important that the pavillion facets are not hidden by the setting. A suggestion for a suitable setting, holding the stone in four claws, is illustrated.

E.S.

EPPLER (W. F.). *Spodumene.* Z. Dt. Gemmol. Ges. 1973, 22, 1, 24–28.

The name spodumene derives from the Greek "spodios" = ash-coloured; the crystals being not very attractive and also not transparent. A transparent green crystal was found in 1879 in U.S.A. and named hiddenite; the rose-violet coloured variety, kunzite, was found in U.S.A. in 1902. The article deals with etch marks found in these two varieties and describes etch tubes, showing them in magnification of 30 ×, 65 ×, 194 × and 610 ×.

E.S.

FEININGER (T.). *Emerald mining in Colombia; history and geology.* Mineralogical Record, Winter 1970, 1, 4, 142–149.

An illustrated account of the present-day use of the mines comprising the National Emerald Domain of Colombia. Production is still greatly hampered by the activity of smugglers and it is

estimated that only 10% of the total output reaches commercial channels by approved routes. Details of the occurrence of emerald are given.

M.O'D.

HOGARTH (D. D.). *Lapis-lazuli near Lake Harbour, southern Baffin Island, Canada.* Can. Journ. Earth Sci., 1971, 8, 1210–1217. 4 figs.

Two occurrences of lapis-lazuli are recorded in marble near the cores of synforms in southern Baffin Island. The main occurrence covers an area of 3,500 m^2 and contains four zones. The lapis-lazuli consists mainly of haüyne, diopside, plagioclase, and calcite; phlogopite, nepheline, tremolite, and scapolite are abundant locally. The rock could have originated during metamorphism through an exchange of elements between evaporites and interbedded shales. The blue haüyne has an absorption maximum at 600 nm, but at best the absorption coefficient of unheated Baffin Island haüyne is about 2/5 that of average haüyne from Siberia; pale greenish blue haüyne from the smaller Baffin Island outcrop has a second absorption maximum at 400 nm. On heating in air for 30 minutes at 530°C the 600 nm peak is greatly extended and both green and blue haüyne become deep blue. The longest zone at the main occurrence could possibly supply commercial-grade gem and ornamental stone, although the fractured nature and pale colour are handicaps.

R.A.H.

LANDAIS (E.). *Absorción del berilo en el infrarrojo proximo. Su contribución a la diferenciación de las esmeraldas naturales y las suitéticas* (Absorption of beryl in the near infra-red region. Its usefulness in distinguishing natural from synthetic emerald). Boletin de la Asociacion Española de Gemologia, Oct./Dec. 1970, 2, 8, 7–14.

Although the author has been able to distinguish emeralds grown from the melt from the natural stones, it was not possible to do the same with those stones grown by the hydrothermal method. A low-voltage tungsten lamp with a special filter was used as the light source.

M.O'D.

LENZEN (G.). *Ein laser-gebohrter Diamant-Brillant* (A laser-drilled brilliant-cut diamond). Z. Dt. Gemmol. Ges. 1973, 22, 1, 39–41. 4 illus.

Description and photomicrographs of a 1·64 ct. diamond showing eight holes drilled by laser to remove black piqués. The colour of the stone was improved as the "coal" had been changed to white "snow", but the inclusions, i.e. drill holes, which were light in colour, were increased so that the stone was downgraded from 2nd piqué to 3rd piqué, although the overall appearance was lighter. It is suggested that the grading is not really altered by laser drillings.

E.S.

SANTOS MUNSURI (A.). *El jade* (Jade). Boletin del Instituto Gemologico Español, Sept./Oct. 1972, 1, 2, 10–22.

An account of the jades and their simulants, of which 22 are listed. Photographs in colour include the fibrous structure of nephrite magnified 750 times.

M.O'D.

THOMAS (A. E.). *Gem Trials of Rhodesia.* Lapidary Journal, 1973, 26, 11, 1654-1661.

The Miami mica fields and other workings for golden beryl, garnet, staurolite, tourmaline, aquamarine and amethyst are described. A map and photographs are included.

M.O'D.

WEBSTER (R.). *Photographic Techniques in Forensic Gemmology.* Forensic Photography, 1973, 2, 3, 2–8.

Contains a number of useful hints on the use of photography in the realm of the gemmologist. The difficulties and problems involved in photographing jewellery and inclusions in gemstones.

S.P.

BOOK REVIEWS

BECKWITH (J. A.). *Gem Minerals of Idaho.* Caxton Printers, Caldwell, Idaho, 1972. pp. 123, maps and illustrations in black-and-white. $2.95.

The state of Idaho is rich in gem materials. The Idaho batholith, which covers the central area of the state, and the mineral-rich basalts and andesites of the Hell's Canyon region provide garnet, opal, corundum and a number of quartz varieties. The Spencer opal mine is regularly worked and furnishes good-quality material. Other gemstones found include sillimanite (opaque varieties only), tourmaline and spinel. The book contains useful sketch-maps for field trips in gem-rich areas.

M.O'D.

BOLTIN (L.) and WHITE (J. S.). *Color under ground. The mineral picture book.* Charles Scribner's Sons, New York, 1971. Illus. in colour. pp. 62. $6.95.

One of the Scribner Portfolios in Natural History, this book does not consist entirely of high-quality photographs, but contains a useful and lucid introduction to mineralogy. The crystal systems are illustrated in diagrammatic form and each photograph caption includes details of the crystallization of the subject. The minerals covered include those which display the most attractive forms. There is a short bibliography.

M.O'D.

COX (K. G.), PRICE (N. B.) and HARTE (B.). *An introduction to the practical study of minerals.* McGraw-Hill Publishing Co., London, 1967. pp. vi, 233. £2.70.

The publishers have directed this book at first-year geology students and the text concentrates on the practical aspects of crystal and rock identification. Opening chapters cover the crystal systems and a particularly valuable treatment is given on the appearance of thin sections between crossed Nicols. A chart of the polarization colours is provided and the explanation is lucid. The commoner minerals and rock types are discussed with some useful text diagrams of modes of occurrence. This would be an excellent choice of text-book for the gemmology student who wishes to accompany gemmological studies with a degree of mineralogical knowledge.

M.O'D.

DRAGSTED (Ove). *Ædelstene i farver.* Politikens Forlag, Copenhagen, 1972. pp. 345. Illustrated in colour. Kr. 38.00.

An introduction to gem materials and gem-testing enlivened with spirited illustrations. Together with the customary data on crystal systems, which are particularly well illustrated, the author gives details on the setting of stones in jewellery. A large number of gem materials are reviewed in a separate section in which details of absorption spectra would have been welcome.

In the section on pearl, Lauegrams are illustrated, but examples of direct radiography, a method of testing more commonly employed, are omitted. This is a book for the alert jeweller rather than for the gemmologist. A comprehensive bibliography is provided, from which, however, journals are omitted.

M.O'D.

DRAGSTED (Ove). *Guld & aedlestene.* 3rd edition. Høst & Son, Copenhagen, 1972. pp. 114. Illustrated in colour. Kr. 39.50.

Accompanied by illustrations first used in 1953 and now, particularly those of opal, wearing badly, the text of this pocket-book reviews most of the better-known gem materials, giving the usual data with the exception of the absorption spectra where appropriate. A short bibliography is provided and basic testing techniques are described.

M.O'D.

HENRY (D. J.). *California gem trails.* 3rd revised edition. Lowell R. Gordon, Long Beach, California, 1957. pp. 101. Maps. $2.50.

A good example of the amateur prospector's pocketbook, this book loses somewhat through not providing an index of mineral species or of locations in alphabetical order. Useful descriptions and sketch-maps lead the reader right up to the gem-bearing spot. Minerals other than gems are included.

M.O'D.

LADURNER (J.) and PURTSCHELLER (F.). *More about minerals.* Pinguin Verlag, Innsbruck, 1972. pp. 187. Illustrated in colour. 229 schilling.

Nearly one-third of this attractive book is devoted to the study of the principles of mineralogy. Succeeding chapters describe the commoner minerals and there are tables in which the chemical

composition, crystal system, hardness, specific gravity, etc., are given for the species covered by the book. Refractive index is not given, nor is it included in the individual mineral descriptions. Apart from the high quality of the colour plates, a useful feature of the book is the provision of a diagram showing common habit by each mineral description.

M.O'D.

McConnell (D.). *Apatite.* Springer-Verlag, Vienna, 1973. pp. xvi, 111. Applied Mineralogy Series No. 5. U.S. $14.90.

A review of the crystal chemistry, mineralogy, utilization and geologic and biologic occurrences, this advanced book is written for the graduate student who wishes to study further in a field where a good deal of work remains to be carried out. Apatite has been synthesized to provide a single-component white phosphor for the fluorescent lamp industry. Hydrothermal production demands the rigorous exclusion of CO_2. Apatite has been found in lunar rocks, in one instance as inclusions within a new mineral, pyro ferroite.

M.O'D.

MacInnes (D.). *Synthetic gem and allied crystal manufacture.* Noyes Data Corporation, New Jersey, 1973. pp. 221. 42 line drawings. Cloth bound. $24.00.

An unusual book from which much information can be culled. It can best be described as abstracts from patents issued in the United States of America "sewn" together. This purely American aspect limits the story of synthetic gemstone production and is probably the reason why 105 pages are allotted to diamond syntheses and only 102 pages to the rest of the man-made stones.

The first recorded patents described are on synthetic sapphire and dated 1911, so that the opening sentence of the chapter on corundum which states, "The first synthetic gemstones of good quality were synthetic sapphires produced by A. V. L. Verneuil", is not completely true, for no mention is made of the earlier synthesis of ruby. A patent, ascribed to E. G. Sandmeier (Swiss Jewel Company) for "oriental emerald" (green sapphire) describes the use of cobalt oxide, vanadium oxide and a nickel salt. Other patents inform on the methods and apparatus used to produce rod, disc, and slab-shaped boules, and there is one patent describing the hydrothermal growth of corundum.

A patent of 1971 describes a method of producing single crystals of corundum by a "casting" process; and another, by R. A. Dugdale (United Kingdom Atomic Energy Authority) describes a sapphire growth technique using an electron beam process. Some mention is made of various methods of producing a surface gloss on rod boules and other shapes, and on surface coatings for the protection of the polish of different materials. There are patents describing the production of asteriated corundum, and one which tells of the production of star rutile by the addition of magnesium oxide to the boule. Little to do with synthesis are the star stones produced by scratching fine lines at 60° on the base of synthetic and other materials cut as cabochons, and a composite stone has the fine lines engraved on the rear surface of the central part of the triplet.

A three-tube burner is used for the growth of synthetic rutile and other titanium gems. It is interesting to note that there are variations in the distribution of the gases through the tubes in some cases. For rutile the inner tube carries the oxygen and feed powder, the intermediate tube the hydrogen and the outer tube oxygen so as to give an excess, but in some of the methods patented for the growing of other titanium crystals the excess oxygen is carried down the intermediate tube and hydrogen through the outer tube, and this has a larger relative diameter. The resultant boules are black and need subsequent heat treatment to produce the transparent material. There are patents mentioned on the production of strontium titanate and on titanates of other metals in colourless and coloured boules.

The production of single crystals of lithium niobate by the Czochralski "pulling" method is mentioned and so are patents on the hydrothermal growth of many crystals, many of which are not gem materials. The flux growth of synthetic emeralds is covered by the report of only one patent, that of the Union Carbide Corporation granted in 1967. There is no mention of Chatham's flux method —it was believed not to have been patented—nor of Linde's hydrothermal production.

The patents on the diamond syntheses by the General Electric Company of America being more recent are well covered and thus provide a very good understanding of diamond synthesis. There are, too, reports of syntheses in other countries which have patented their processes in the United States. Such are those of Sweden, South Africa and Japan. Patents describing some "off-beat" methods of

diamond synthesis are discussed and there is a section on the modification of the colour of diamonds by radiation. A method of colouring diamond by radiation from Americium 241 is mentioned. This treatment is said to produce stones of a natural green colour and, after heat treatment, a very good shade of gold. The colours produced are stated to be better than those obtained with cyclotron or pile treated stones. The report states that the diamonds irradiated by this means to an emerald green colour show absorption bands at 4980Å and 5040Å and an absence of the 5920Å line and therefore the spectrum is that of naturally occurring diamonds and unlike those of pile or cyclotron treated diamonds. The reviewer cannot agree with this for it is only the "greened" diamonds which have subsequently been heat-treated to yellow which show the 5920Å line (now remeasured as 5940Å).

There is no general index, the Table of Constants, which is more comprehensive than usual, being considered to be all that is necessary. There are short indexes of inventors names and of United States patent numbers.

The book provides much valuable information on the technical production of gem crystals, but being confined to United States patents only it loses much of the colourful history of gemstone synthesis. The gemmologist would find the omission of any information, or even a table, of the constants of the crystals discussed rather irksome and a major defect.

R.W.

OLES (F. and H.). *Eastern gem trails.* Gembooks, Mentone, California, 1967. pp. 80. $2.00.

Written as an account of personal experience in gem exploration, this book also serves as a useful guide to the gem areas of the states of New Jersey, Pennsylvania, North Carolina, Maryland and Virginia. Celebrated localities include Cowee Creek, Amelia Court House, Franklin N.C. and Franklin N.J. Photographs of some of the areas are included and there are some maps.

M.O'D.

VARGAS (G. and M.). *Descriptions of gem materials.* Desert Printers, Palm Desert, California, 1972. pp. x, 155. $7.50.

An alphabetical list of gem materials, giving in each case the chemical composition, crystal system, hardness, specific gravity,

colour, critical angle, refractive index and birefringence, cleavage, dispersion where appropriate and optic sign. Care has been taken to ensure the accuracy of the constants quoted and the authors add useful details of locations, rarity and suitability for cutting. There is a separate section on synthetics which states that zincite has been synthesized in a yellow colour. Concluding sections list materials under their specific gravity, refractive index and under alternative names.

M.O'D.

WARRING (R.). *Rock collecting and making semi-precious jewellery.* Stanley Paul, London, 1972. pp. viii, 112. Illus. in black-and-white and colour. £2.60.

The greater part of this book covers techniques already quite well dealt with in other contemporary works. Unfortunately this section, which is at least unexceptionable, is preceded by an introduction to the gem species which is loosely written and in part inaccurately illustrated. The diagram of the crystal systems does not distinguish the orthorhombic and monoclinic systems; the supposedly twinned quartz is not a twin. Streak is included as a test in a section dealing specifically with gem materials; some exotic specimens occur in the list of gemstone materials, presumably for making into jewellery—they include alunite, anglesite, and jamesonite. Chrysoprase is wrongly spelt. It would seem that out-of-date textbooks have been uncritically raided for the bulk of the information contained in this unsatisfactory book.

M.O'D.

WRIGHT (R. V.) and CHADBOURNE (R. L.). *Gems and minerals of the Bible.* Harper & Row, New York, 1970. pp. xii, 148. $4.95.

Sixty-two materials, not all gems, are reviewed in this interesting book. Each material has a section headed by a description of its nature and properties and a passage from the Bible in which it is mentioned. The Biblical references are not extensive and somewhat uncritical, while the greater part of each entry is devoted to a general account of the stone. The stone "bdellium", which has puzzled scholars, is here surmised to be opal. Historical notes, other than biblical, on the stones are useful. A select concordance would have been useful.

M.O'D.

ASSOCIATION NOTICES

MEMBERS' MEETINGS

London

Mr. Julius Petsch, Jr., Idar-Oberstein, gave a talk, illustrated by many colour slides, to members at Goldsmiths' Hall, London, on Tuesday, 17th April. A full report is given on page 265.

Scottish Branch

The Annual General Meeting of the Branch was held on the 12th April at the North British Hotel, Glasgow. Mr. A. Armstrong and Mr. G. M. Turner were re-elected Chairman and Secretary respectively.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to the following for gifts presented to the Sir James Walton Library:

Mr. M. J. O'Donoghue, M.A., London, for a copy of the 1965 edition of Theophrastus' *De Lapidibus*, edited with translation and commentary by D. E. Eichholz.

Mr. E. F. Borgatta, Ph.D., Vermont, U.S.A., for specimens of rough peridot from Arizona with "flying saucer" inclusions—as mentioned in T. F. Zook's article in the *Journal*, Vol. 13, No. 4 (October 1972), p. 133.

Mr. Robert Webster, London, for a specimen of lithium niobate and a large piece of turquoise matrix from St. Austell, Cornwall.

OBITUARY

The Council of the Association has noted with deep regret the death, in February of this year, of Dr. Edward H. Kraus, Ph.D., Sc.D., who had been Vice-President of the Association since 1956. Dr. Kraus celebrated his 97th birthday in December 1972.

GORDON F. ANDREWS

On Tuesday, 20th March, members of the Council of the Association, together with the Council of the National Association of Goldsmiths, attended a dinner held at Goldsmiths' Hall, London. The occasion was to honour Mr. Gordon F. Andrews on his retirement as Secretary. It was a most enjoyable and memorable occasion and the President presented Mr. Andrews with a cheque to which many members throughout the world had subscribed.

Mr. and Mrs. Andrews at Goldsmiths' Hall.
(photo by courtesy of the *Watchmaker, Jeweller and Silversmith*).

ANNUAL GENERAL MEETING

The 43rd Annual General Meeting of the Association was held on Wednesday, 2nd May, 1973, at Saint Dunstan's House. Mr. Norman Harper, Chairman, presided, and in commenting upon the work of the year said:

"Although mentioned in the annual report, I would like to thank the Officers and Secretaries of the Midlands and Scottish

Branches. They were very active during 1972 and held a number of interesting meetings and outings. The Midlands Branch was most enterprising in arranging a successful day-trip to Amsterdam. The Council decided last May that each Branch Chairman should be invited to Council meetings during his year of office.

"Once again entries for the examinations were very high, with a large proportion of overseas candidates. Mr. Alan Jobbins was awarded the Tully Medal and prize and I will have the opportunity very shortly of welcoming him as a member of the Council.

"During the year various gifts were made to the Association, from books to gem specimens (both as crystals and cut stones). Gemmological Instruments Ltd., the subsidiary company which acts as distributory agents for Rayners, gave the Association a diamond refractometer. The new Dialdex refractometer produced a few teething problems with production which, with the large number of orders, has resulted in a delivery delay of about six months. Everything possible is being done by Rayners to reduce this period.

"On a sad note, M. Georges Gobel, who was Director of the Paris Gem-Testing Laboratory for many years, died in July. He was one of the very few persons elected to Honorary Fellowship of the Association.

"As you are all aware, Mr. Gordon Andrews announced that he would be retiring as Secretary of the Association in 1973, and it was decided to ensure that his close interest was maintained by appointing him Librarian. In fact, Gordon Andrews has now retired as Secretary and Mr. Harry Wheeler has taken up the post in his place. His brother, Mr. Douglas Wheeler has been appointed Assistant Secretary."

Mr. David Kent seconded the adoption of the Annual Report and Accounts. Dr. G. F. Claringbull, Ph.D., F.Inst.P., F.G.S., was re-elected President; Mr. Norman Harper was re-elected Chairman; Mr. Douglas King was re-elected Vice-Chairman; and Mr. F. E. Lawson Clarke was re-elected Treasurer. Miss I. Hopkins and Messrs. J. M. B. McWilliam and P. W. T. Riley were re-elected, and Mr. E. A. Jobbins, B.Sc., elected, to serve on the Council.

The Chairman announced that Messrs. Watson Collin & Co., chartered accountants, had signified their willingness to continue as auditors.

On behalf of the Association, the Chairman then took the opportunity of expressing thanks to the Goldsmiths' Company for

placing at our disposal various rooms at Goldsmiths' Hall for meetings.

DIAMOND AND PRECIOUS STONE BOURSE IN IDAR-OBERSTEIN

A new diamond and precious stone bourse will be opened in the old gem trading and cutting centre of Idar-Oberstein in western Germany early in 1974. The building will be 22 storeys high. There will be a large hall suitable for holding auctions, as well as large safe deposits, Post Office, banking and insurance facilities and two exhibition halls, one used for samples of stones, jewellery and fancy goods for the convenience of customers, the other for an extensive exhibition of gemstones and gem materials open to the public.

Some of the floors are reserved for offices and showrooms; these are already partly let to firms in Idar-Oberstein and from other places in Germany and from abroad. The upper storeys will house a hotel with 170 bedrooms, conference rooms, a restaurant and bars.

It is hoped that the bourse will not only get wide-spread local support, but will make its contribution to the international market.

NOTTINGHAM AND DISTRICT

It is proposed to form a Nottingham and District Branch of the Association and to hold an inaugural meeting in September. Will any member who is interested in the formation of such a branch communicate with the Secretary, Gemmological Association, Saint Dunstan's House, Carey Lane, London EC2V 8AB.

INCLUSIONS

The Association Française de Gemmologie (Paris) has produced a plastic folder containing 48 coloured slides on 35-mm. film, each in a separate pocket in four "pages". They illustrate the inclusions seen in gemstones and have been produced for readers of the French Gemmologists' Association's journal. The slides are extremely good as regards colour, the choice of inclusions and the photography. The slides illustrate inclusions in diamond, natural and synthetic ruby and sapphire, emerald and synthetic emerald, of which a highly magnified picture shows a spectacular view of three-phase inclusions in a Colombian emerald. To compare with

the emerald inclusions there are slides of a green doublet, a green paste and one of green fluorspar. Other slides illustrate inclusions in aquamarine, garnet, morganite, topaz, tourmaline and spinel. The slide of chrysoberyl cat's-eye seems to have been photographed with the notion of producing a dual effect (the inclusions and the cat's-eye streak) and the result is less successful than the rest of the slides which are so very good. There are two slides of amethyst which show similar inclusions and it might have been better to have replaced one of these by a slide showing the "tiger-stripes" so characteristic of amethyst. The beautiful slides of a "sunburst" of asbestos fibres in a demantoid garnet, masses of profilated bubbles in a synthetic corundum, the banding in a citrine, and the slide of zircon which shows not only the inclusions but also the facet edges doubled, make informative teaching slides. There are slides of moss agate and another showing the flakes of green fuchsite mica in an aventurine quartz. A colourful slide of opal makes an excellent finale. The folders are available from the Association Française de Gemmologie, 163 Rue Saint Honoré, Paris 1, France, price £10 sterling.

COUNCIL MEETING

At a meeting of the Council of the Association held on Tuesday, 17th April, 1973, the following were elected to membership:

FELLOWSHIP

Garcia I Ainoza, Joan, Barcelona, Spain. D. 1972
De Fatima Granda, Maria, Barcelona, Spain. D. 1972
Ferrandiz Torrents, Pedro, Barcelona, Spain. D. 1972
Margarit Morant, Eugenio, Barcelona, Spain. D. 1972
Marin Calvo, Maria Luisa, Barcelona, Spain. D. 1972
Munoz Aisa, Maria Teresa, Barcelona, Spain. D. 1972
Pujante Garzon, Francisco, Barcelona, Spain. D. 1972
Ratera Oliva, Jaime, Barcelona, Spain. D. 1972
Willams, Robert, Birmingham. D. 1971

ORDINARY

Barlow, Peter Lewis, Lusaka, Zambia
Beng, Goh Kong, Petaing Jaya, West Malaysia
Bristol, Anthony Paul, Peterhead, Scotland
Bruder, Edward Roy, Brighton

Carter, William Nicholas Fox, Nr. Bracknell
Chapomba, Charles Nash, Blantyre, Malawi
Clayton, Rosamond Susan, Hong Kong
Cross, Willam Henry, Stone Mountain, Ga., U.S.A.
Dean, Joseph John, Ossett
Din, Richard Aziz, Edgware
Douglas-Irving, Ian, St. Georges, South Australia
Dunn, Harry Lee, Endwell, N.Y., U.S.A.
Faulkner, William, Gt. Missenden
Forsey, Stella Ann, Wellington, New Zealand
French, Frank Geoffrey, Wallington
Furumiya, Minoru, Osaka-Fu, Japan
Gray, Sheila Margaret, Crooksbury, Surrey
Gustin, Irene, Hong Kong
Haji, Mohamed, Tanga, Tanzania
Harris, Margaret Rose, Pulloxhill, Beds.
Henmi, Naomitsu, Sinagawa-ku, Japan
Hewitt, Leonard Eric, Lincoln
Inoue, Kazuo, Setagaya-ku, Japan
Inoue, Shigekichi, Nagahama-shi, Japan
Janot, Bernard, Melun, France
Jermansky, Irving, Miami, Fa., U.S.A.
Kawakami, Sadaharu, Kofu-shi, Japan
Kobayashi, Hisatsugu, Kofu-shi, Japan
Kobayashi, Sachiko, Kofu-shi, Japan
Levi, Lennart, Sollentuna, Sweden
Lim, Lily, Petaling Jaya, West Malaysia
McLaughlin, Edward Peter, Glasgow, Scotland
Matsuda, Katsuyoshi, Marugame-shi, Japan
Miller, Charles R., Southfield, Michigan, U.S.A.
Need, Mary, Lelant Downs, Cornwall
Nercessian, Arminé, Rio de Janeiro, Brazil
Nicol, William Maxwell, Dunstable
Nolan, John Gordon, Bradford
Paine, Thomas Hallsten, Everett, Washington, D.C., U.S.A.
Przybyla, Christopher, Whitehaven
Rooney, Eugene A., Alexandria, Virginia, U.S.A.
Round, Anthony William Reginald, Epsom
Shah, Anita, London
Takagi, Takashi, Tokyo, Japan
Turner, Oswald Edward, Port Elizabeth, S. Africa
Van der Laan, George, Utrecht, Holland
Wailes, Rosemary Margaret, Hong Kong
Yamaguchi, Takashi, London
Yamamoto, Satoru, Yamaguchi-ken, Japan

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