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GEMMOLOGICAL EXHIBITION 1951

Reviewed by *GERALD CARR*

THE spirit of the Festival of Britain was re-animated in the Goldsmith's Hall on October 9 to 12 when the Gemmological exhibition was presented by the Gemmological Association. Once again, as in earlier exhibitions held to celebrate the Festival at the Hall, there were visitors from all over the country and even from abroad. The theme of one hundred years provided the idea for several of the stands where one could study and marvel at the great progress that has been made in gemmology, little known as a word in 1851.

Once again Queen Mary honoured the Association by spending an hour looking at the exhibits and there were many other distinguished visitors. A further feature was the record attendance and the fact that the majority of the visitors were not connected with the trade. The 1951 exhibition is probably the best so far.

The range of exhibits was so wide that there was much to interest everybody from the happy and amusing idea of goldfish set amid ultra-violet rays and swimming against a background of lovely fluorescing minerals to the grim reminder of present day problems still unsolved, made by pieces of quartz fused from the sand of New Mexico when the first atom bomb was exploded. More educative, perhaps, but no less interesting were the exhibits showing the different styles of cutting, excellently carried out by an amateur lapidary, or those illustrating with specimens the stages of production of gem stones from the raw material.

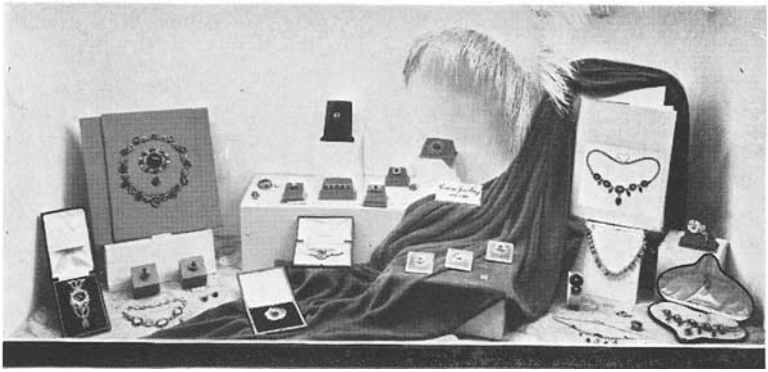
Many of the exhibits had been devised and prepared by Fellows of the Association and bore the hallmark of enthusiasm and care. Although in most cases the exhibits were self-explanatory, or could be understood from the adjacent descriptions, the presence of stewards, always ready to help both the expert and the tyro, was another mark of the keeness of members which made the exhibition leave a more than fleeting impression on the visitor and enabled all to get the most out of it.

The West of the exhibition room was mainly occupied with a series of displays showing the use of stones from primitive days to the present. Here there was much to interest students of many lores. Beauty and cruelty were combined in the finely shaped war club of nephrite once used by the Maori. Wielded by them, I believe, they could scalp an opponent as neatly as any American Indian. But, of course, they used their nephrite for more peaceful purposes as well, as could be seen from the ornaments they made from it. Another war-like exhibit came from India, a sword and a dagger handle in quartz, again shaped and finished so well as to possess inherent beauty. Other ornaments of the past were a Graeco-Roman ring with a sard intaglio of Eros of the 3rd century B.C. and a delightful Graeco-Egyptian gold mask decorated with garnets. The peaceful uses of stones were aptly demonstrated, and brought to date by an adze and mallet used by the Eskimos up to the 19th century. So, pausing a moment before the intervening case which showed attractive examples of native gold and diamonds, the visitor was ready to inspect the use of gems in jewellery during the past hundred years. Here the Victorian jewellery did not noticeably clash with the modern, though the latter naturally stood out with its greater use of diamonds and open setting. One piece used a fine golden sapphire as its focal point and another made good use of a moonstone, while a third exhibit showed a fine suite of garnets. Another interesting aspect of the past was that of a diamond polishing table similar to those which were used in the 18th century. Here the experts were amused to note that it showed little difference from those used now, with the exception of the dops—and the driving power. Then

Queen Mary at the Exhibition with the President and Sir James Walton (left).

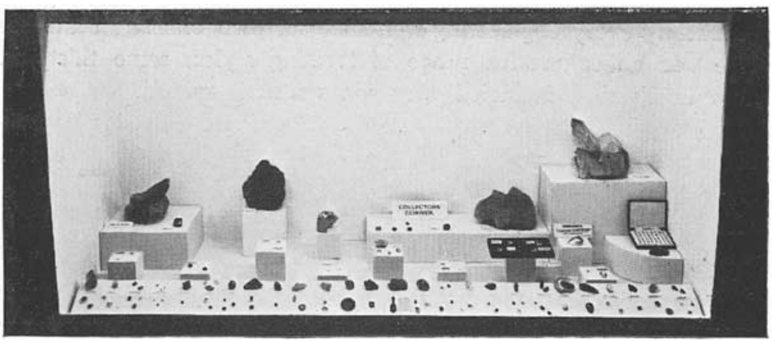
the tables were turned by women, operating a large wheel by a ratchet device. Now, of course, electric motors do the work. And the diamonds that are polished? There were several displays which told of their story, showing them in the blue ground, telling of the 33 tons that are mined and pulverized and sifted before probably a single carat's worth of stones are claimed. There were specimens of fine diamonds and such unusual ones as a $50\frac{3}{4}$ ct. dark brown one and a 65 ct. green stone, together with the handmaiden of industry, the industrial diamonds so necessary in practically every engineering workshop for their tools. In another case was an exhaustive range of faceting styles, some thirty in number, listed and carried out upon synthetic spinels.

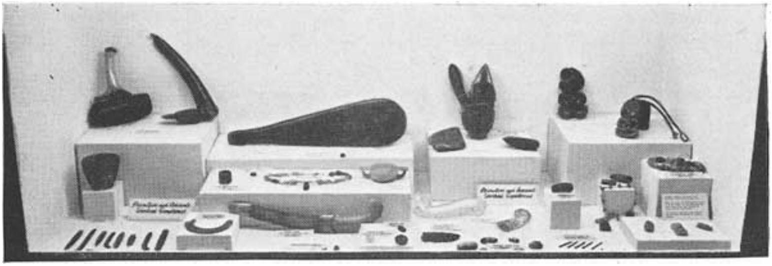
But I am getting away from one of the fascinating aspects of gemmology, the study of the manifold varieties of stones. Everyone knows of diamonds and the stones that are commonly seen and worn. Only the gemmologist has the secret key to understanding and knowing about many equally beautiful stones of which only their names fail to suggest glamour. Kyanite, epidote, thomsonite, tremolite, sodalite. Thank goodness the scientists,



Gems in Jewellery during the past hundred years.

yes, even the gemmologists, were not there when the older stones were named! The visit of Princess Elizabeth to Canada was brought to mind by an exhibit of Canadian gem materials, for probably she will see some of these in her travels. Here were some of the " ites " and also purple bloodstone, cat's eyes and agates. The latest " ite," shown in Collector's Corner, naturally attracted interest. These were the only two specimens of Taaffeite yet found and here were other rare stones such as colourless Hessonite and Datolite, while other attractive specimens with their fantastic patterns of quartz and topaz showed the beauty of the commoner stones. These wonders of nature were renewed again with their beauty of pattern that could provide a theme for any designer in the display of mineral forms and in the examples of rocks in which gems occur. The man-made models of these crystal forms may have pointed the lesson, but they could not

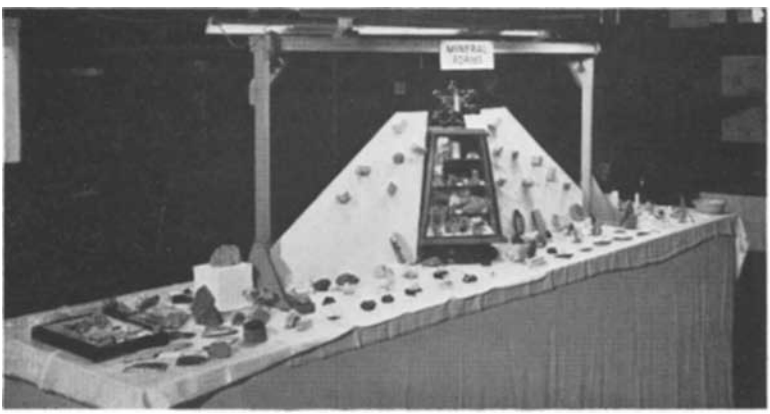




Primitive and Ancient worked Gemstones.

capture the free flow and variety of frond-like growth; of fan-like crystals; of stalactitic growth; and plant formation frozen into rock showed by these exhibits. Here the interests of gemmologists and geologists began to merge and one wished for a hammer and a " rock " holiday in the West.

Then back from stones in their beginnings to stones in their endings—though they hardly ever have an end—and the fine collections of gems loaned by various Fellows and friends of the Association. First, because I have a weakness for them, I should like to comment on the lovely collection of opals, notably the huge 74.93 ct. triangular specimen, the water opals and the intricately carved opal matrix depicting Cupid and Psyche in the clouds at the approach of dawn, and the specimens from Australia with their varied hues and colours. Then there were diamonds from South Africa, rubies from Burma, pearls from the Persian Gulf and elsewhere. Incidentally, there was a delightful " push



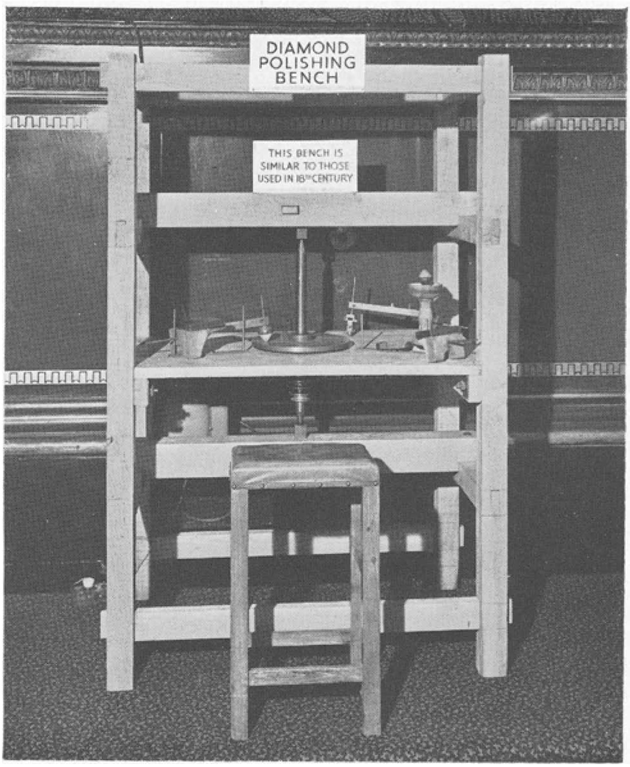
Dr. E. Gübelin (right) explains his new Spectroscope.

button " set-piece linked up with a map of the world from which visitors could find out, on pushing the button bearing the name of a gem, from where the gem came.

Special exhibits of particular stones had a particular interest, because each of them added a little bit of extra knowledge concerning that stone. One, it was true, proclaimed a mystery still to be solved. How the stress figures that made a necklace of amber beads so attractive, had been produced? It appeared that it had been done artificially by some unknown manufacturer, but it has not yet been possible to duplicate the results. The Beryl group had a display to themselves, showing the wide range of colour varieties. Or there was the story of two gems, diamond and ruby, and the various stages of design, arrangement and planning which led to the first drawing, the wax mount, the metal mount and the setting that ended with a modern piece of jewellery featuring these gemstones.

The story of synthetic gem stones could not be omitted, and here the gemmologist could study the huge colour range produced and some of the first examples of synthetic rutile made experimentally in a British laboratory. What a contrast is this laboratory controlled production from the actual mining, so well shown in the colour film, taken by a Fellow who had recently visited Ceylon, which was shown at frequent intervals during the day.

Getting closer to the science of gemmology was the exhibit which dealt with the specific gravity of gems and with stones both rough and cut, from the garnet and chalcedony groups, gave their s.g. Then there was the display of enlarged pictures of inclusions found in various stones, the " finger prints " of a gem. These exhibits brought one naturally to the stands on which stood all the complicated apparatus in use today for delving into gems. Here the story of 100 years of gemmology could be seen in the



development of new devices, whose introduction was necessarily urgent with the arrival of synthetic and other types of artificial stones. Those early instruments, brought out from the cupboards and the years of dust swept off them have looked clumsy and strange, but they did their job. They were an efficient front line defence against the early synthetics and they must have saved jewellers hundreds of thousands of pounds. Not so many of us can remember those days in the beginning of the century, but they were to be duplicated after the first world war when cultured pearls were marketed, quickly to be followed by the invention of an instrument that could explore their interiors.

* * *

The Council of the Association is grateful to the Wardens of the Worshipful Company of Goldsmiths for kindly making the Hall available for the exhibition and to the following persons, companies and organizations for assistance with technical advice, the loan of exhibits or participation in the exhibition as stewards or organizers:

Messrs. B. W. Anderson, K. A. Webster, R. Webster, H. J. B. Wheeler, D. Wheeler, K. Parkinson, O. Fahy, G. Clarkson, L. F. Cole, R. F. Corfield, K. Pellett, R. W. Yeo, R. L. Rait, N. Deane, A. M. Ramsay, H. Lee, F. E. Lawson Clarke, M. L. Crombie, A. R. Popley, L. C. Trumper, P. Grodzinski, A. Stokes, Kelsey Newman, I. Whetstone, W. Nathanson, A. Monnickendam, H. C. Fishberg, D. S. M. Field, N. H. Day, A. Coleman, Charles Mathews, J. C. Ginder, Ltd., Mrs. A. M. Sharpe, Miss W. Allan, Mrs. M. Chisholm, Miss M. G. Biggs, Miss K. Gibson, Mrs. G. Parry, Mrs. G. Ash, Messrs. Spink & Son, Ltd., Research Laboratory of G.E.C., Chelsea Polytechnic, J. W. Benson, Ltd., H. A. Byworth, Ltd., Australian Pearl Co., Ltd., Chas. Mathews & Son, Sybil Dunlop, Wilson & Gill, Ltd., Crombie (Fine Jewels), Ltd., R. W. Yeo, Ltd., British Museum (Natural History), H.M. Geological Survey & Museum, Rayner & Keeler, Ltd., The Diamond Trading Co., Ltd., Chance Bros., Ltd., Wood & Whitelaw, Cartier, Ltd., Dr. G. F. Claringbull, Dr. W. Campbell Smith, Dr. E. H. Rutland, Dr. J. Phemister, Dr. W. F. Fleet, Sir James Walton, Lt.-Col. G. N. Sprague, Dr. W. Stern, Dr. E. Gübelin, and G. F. Andrews.

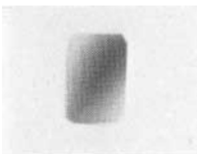
CURVED COLOUR BANDS

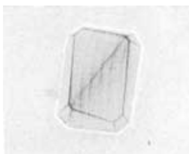
By B. W. ANDERSON, B.Sc., F.G.A., and R WEBSTER, F.G.A.

GEMMOLOGISTS are familiar with the curved colour bands in synthetic blue corundum which follow what were formerly the surface contours of the growing boule. In synthetic blue spinel, for reasons not properly understood, the colour is nearly always homogeneous, so that no striae of any kind can be seen.

We were surprised, therefore, to receive from Mr. Hans Myhre of Oslo a specimen of synthetic spinel showing very clearly curved bands of cobalt blue. The stone weighs 8.34 carats, and is cut in fancy style with large triangular facets set at a low angle. The properties are quite normal, the refractive index being 1.7271 for sodium light and the density 3.629: a cobalt spectrum could be seen.

Since the colour bands are somewhat diffuse and widely separated they would not show up well in a photomicrograph, so we decided to photograph the bands by less conventional means. The left photograph reproduced here was taken by direct radiography at 48 kV., and shows fairly clearly, as we hoped, the slightly greater opacity of the coloured bands to the X-rays owing to the greater concentration of cobalt within the bands. The second photograph was taken without apparatus, by simply immersing the stone in a plastic dish containing monobromonaphthalene placing underneath a piece of printing paper, and exposing to an overhead light. The resulting picture is rather charming, and the bright line effect makes one wonder whether this simple process might not have some practical value in the visual demonstration of the principles of the well-known immersion methods of refractive index determination. It should be remembered that in both these photographs it is the *pale* bands that represent the dark bands of colour in the actual stone.





In concluding this brief note, we should like to express our thanks to Mr. Myhre for presenting us with this interesting stone.

Bookstall Discovery

By A. E. FARN, F.G.A.

I AM one of those people who can never resist the lure of a curio shop or a " junk " stall and am quite an inveterate bargain hunter who has at times found minor bargains, and also a few " white elephants."

Browsing over some secondhand books recently I was interested in a book which seemed to be a veritable miscellany of general scientific information and write-ups of all types. The book was entitled " Curiosities and Wonders of Nature, Science and Art or The Intellectual Observer " was published by Groombridge & Sons, Paternoster Row, and contained many prints in colour. It was chiefly these which caused me to purchase it for a few shillings.

Keener interest was aroused when I found therein a letter from (then) Professor Church, telling of his experiments with the microspectroscope and announcing his discovery of the absorption spectra of Almandine Garnet and Zircon. I showed the volume to Mr. B. W. Anderson who was thrilled with it and at once asked the date of the book. To our astonishment there was no date on its title page, or indeed anywhere in the volume except incidentally in the text where several references to the year 1865 were found.

Enquiries made from the Chief Librarian of the British Museum elicited the information that they had no copy of the book. On the suggestion of Mr. Anderson I ventured somewhat diffidently to the Patent Office Library and looked it up there. The volume was checked page by page and found to be Volume 9, February—July, 1866. There were volumes of the same journal published from 1862 to 1868. Before that it was known as " Recreative Science " and later it continued as " Student." For the interest of readers of the Journal the pages showing Professor Church's historic letter are reproduced here.

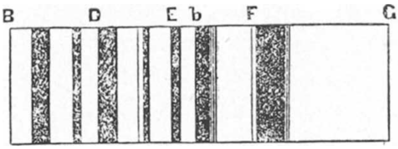
MICRO-SPECTROSCOPE INVESTIGATIONS.

LETTER FROM PROFESSOR CHURCH.

The Editor has received the following interesting letter from Professor Church.

"Have you tried the experiment with chloride of cobalt, which I mentioned to you? If you take the saturated cold solution of this salt it will give the spectrum roughly sketched in Fig. 1,* a *thinner* film of the *same* solution, heated (on a glass slide with thin cover) over the candle or lamp gives the spectrum drawn in Fig. 2.† You will notice two black bands, I had almost said lines, in the red. As might be predicted from the change of colour on heating, the solution is afterwards much more transparent to rays beyond D. The chloride of copper and nickel also give very interesting results.

But I think you will be most pleased with the experiment I have now to relate. I have worked lately on the spectra of pleochroic minerals and salts. Among the minerals recently examined were several fine specimens of the true zircon or jargoon, a silicate of zirconia. These gave a beautiful and most characteristic system of seven dark bands quite different from those belonging to any other substance yet examined. They are roughly sketched in the following figure. Zircons as colour-



less as common glass shew these bands as well, perhaps better, than those possessed of colour. They are to be observed with zircons which have been ignited as well as with those still in their natural condition. But some zircons show the phenomenon better than others, this difference not being due apparently to the colour of the stone or the thickness through which the light traverses. I am not quite sure, but I incline to think that those zircons which have come from some localities shew the bands better than those from others. Several Expailly specimens scarcely exhibit anything of this kind; all

* The Figure alluded to shews the red darkened, the orange light, and a broad dark band commencing to the right of the yellow and extending beyond the line F, the remainder of the spectrum is cloudy.

† Fig. 2 shows the narrow black bands in the red, modified tints replacing the broad dark band of Fig. 1, the blue coming out clear. The experiment is a very beautiful one.

those from Ceylon and Norway show the bands well. From this observation I am induced to hazard the conjecture that it may be, after all, the presence of Swanberg's *norium* which determines the difference. You are aware that the orange jacinth, a variety of zircon, is very precious, and that the essonite of cinnamon-garnet is constantly sold for it. Curiously enough, the cinnamon-garnet, or essonite, (a lime-garnet), has no conspicuous dark absorption-bands at all, and so the spectroscope may be brought to bear upon the discrimination of these two stones. We have thus a much more ready process than that of taking the density of the specimens. The lime-garnet is of comparatively small value. The iron-garnet of different shades (carbuncle, almondine, etc.) gives a beautiful and very characteristic spectrum with several intensely deep absorption bands.

I write these particulars of my experiments at once, for I thought you might like to make a little paragraph about them for the readers of the INTELLECTUAL OBSERVER.

I ought to add that the absorption bands of zircon resemble those of didymium, discovered by Gladstone, in their sharpness and in their being produced by the passage of light through a colourless medium. Silica, the other constituent of zircon, gives no bands.

Professor Church's letter reproduced from "Curiosities and Wonders of Nature Science and Art or the Intellectual Observer." Groombridge, London.

Gemmological Abstracts

ANON. ***New gem substitute resembles emerald.*** Gems and Gemology, Vol. VII, No. 1, p. 29. Spring 1951.

A " soudé " emerald in which the more usual quartz crown and pavilion is replaced by synthetic (white?) spinel; the usual green cement joining the two halves. The spinel is flawed (probably by heat), which gives the completed composite stone the appearance of a slightly flawed emerald.

R. W.

TRUMPER (L. C.). ***Lighting for the gemmologist.*** Gemmologist, Vol. XX. No. 239, pp. 129-132. June 1951.

A resumé of suggested lighting equipment for the gemmologist. The sodium discharge lamp (Street lighting type) for use as a source of monochromatic light; the " Black lamp," a type of high-pressure mercury discharge lamp with a Woods glass outer bulb, as an ultra-violet light source and the low-pressure fluorescent discharge tubes for colour matching are discussed. A suitably housed 250 or 500 watt projection bulb is mentioned as being a suitable source of continuous spectrum light source for absorption spectroscopy. Three wiring diagrams are given and a short and not wholly accurate table of fluorescent colours is appended.

R. W.

GUBELIN (E. J.). ***Some additional data on Indian emeralds.*** Gems and Gemology, Vol. VII, No. 1. Spring 1951.

An excellent resumé on the Indian emerald. The localities of the mines, type of occurrence and methods of mining of the Udiapur emeralds are given. The external appearance of typical specimens of these emeralds are commented on, and the physical and optical properties determined by the author and other workers, are listed. The absorption spectrum is discussed in relation to the lack of a red residual colour through the usual emerald filter. A very full investigation has been made of the characteristic inclusions. Mica tablets are found to lie always parallel to the basal plane and in conjunction with them are rectangular or square-shaped cavities, often with movable libella, in a direction at right angles to the plane containing the mica plates, that is they are parallel to the direction of the optic axis. Under low power these cavities are further characterized by a projection at one corner. Under higher magnification, and better with dark-ground illumination, these "comma-like" cavities are shown to be negative crystals of emerald habit, the comma effect being caused by the joint formation of such negative crystals, one of which is longer and more slender than the cluster of shorter companions. 10 photomicrographs; 1 absorption spectrograph and 1 map.

R. W.

POUGH (F. H.) and SCHULKE (A. A.). ***The recognition of surface irradiated diamonds.*** Gems and Gemology. Vol. VII, No. 1, pp. 3—11. Spring 1951.

A general survey of the distinguishing factors, as far as observation on available specimens allows, of diamonds coloured by radiation. A short historical background is given and also the negative result of placing diamonds (also yellow sapphire, kunzite, and pale yellow scapolite—which did colour in a similar manner as they do when bombarded by x-rays). The negative result in the case of diamonds being ascribed to the fact that the radium was packed in brass and glass containers which let through only the gamma radiation and not the alpha and beta rays which are known to cause colouring in diamond. Some notes on the cyclotron and on the methods of mounting the diamonds in the beam (deuteron, protron and alpha particle beams being used) are given. Green colours usually obtained by cyclotron bombardment, but if the beam be intense a golden brown colour may be induced. This brown coloration being ascribed to the heat of the beam at higher intensities. Colour penetration is only a surface effect, and in the case of alpha particle and proton experiments the colour was found to have only about one half the depth of the deuteron coloration. Alpha particle bombardment seemed to give more brown than green colours, but whether this was due to higher intensity—thus higher temperature, or is a constant characteristic of the particle used, has not been decided. Crown-treated stones show, when viewed on a white paper with the culet up, a dark ring around the stone between the table and girdle. Pavilion-treated stones similarly placed do not show this ring, but do so if viewed table facet uppermost. In all cases a careful lens examination shows a cubistic pattern of reflections that show varying intensities of green colour. 7 illustrations. R. W.

DIXON (C. G.). ***Report on investigations in the Kurupung and Meamu diamond fields,*** British Guiana. Rep. Geol. Survey British Guiana, 1949, pub. 1950, pp. 5-25.

The Kurupung and Meamu river are tributaries of the Mazaruni river and the report deals with the numerous diamond workings in the area of these tributaries. The main source of diamonds is the alluvial deposits of the streams. A. G.

G.R.C. ***Inclusions in Synthetic Emeralds.*** The Loupe, Vol. IV, No. 3, 1951.

The occurrence of a fingerprint of a two-phase inclusion in synthetic emerald is reported. The stone examined, approximately three-quarters of a carat in weight, also contained a transparent colourless crystal. Refractive indices were 1.558-1.563. The stone fluoresced strongly under ultra-violet light. G. A.

RICHARD M. PEARL. ***Colorado Gem Trials.*** Sage Books, Inc., U.S.A. 1951, 141 pp., 15 photos and various sketch maps.

Here is a book by an assistant professor of geology and an enthusiastic gemmologist which will entertain and interest the gem collector even though an opportunity of taking a Colorado gem trail does not come his way. Mr. Pearl has provided an extremely useful guide that will prove invaluable for those fortunate to go. The author has been at pains to provide would-be collectors with much information about local travel land ownership and collecting conditions. Information about gem and mineral societies that may be contacted. It may well encourage the production of similar books about other localities.

The text is pleasantly readable and not spoiled by comments, which would have detracted from its usefulness as a guide. The photos show the type of country likely to be encountered but are otherwise not very helpful. The sketch maps would have been more useful if their scale had been indicated adequately.

GUBELIN (E.). ***Edelstein-Einschlüsse als Art-Merkmale.*** Gem inclusions as family characteristics. Gold und Silber, 1951, 4 (6/7), 36-38.

In modern gemmology the study of inclusions is of as much consequence as measuring refraction and observing the absorption spectrum. Admixtures and inclusions in gems permit not only determination of the gem family but also of the individual member and of the origin. Inclusions are formation characteristics which lately have become of increased importance for crystallography, genetic mineralogy and especially for the study of deposit distribution. Solid, liquid and gaseous inclusions from characteristic patterns. Twelve typical and extremely beautiful photomicrographs show inclusions in diamond, Burma ruby, Ceylon sapphire, Siam ruby, Siam sapphire, Colombian emerald, aquamarine and demantoid.

—— Ibid. Gold und Silber, 1951, 8, 10-12 (cont. from 6/7, pp. 36-38).

The article brings six further interesting photomicrographs depicting tourmaline, green zircon, topaz, moonstone, African peridot, and andalusite. Apart from these species, descriptions are given of microscopic inclusions and other characteristics in garnets, spinels, Colombian, Ural, and Indian emeralds. E. S.

SCHLOSSMACHER (K.). ***Neues uber Edelsteine.*** News about gems. Gold und Silber, 1951, 4 (6/7), 39.

In a lecture about new gem developments, Prof. Schlossmacher mentioned the importance of American inventions, i.e., the synthetic emerald, the synthetic rutile and the synthetic star sapphires and star rubies. The second part of his lecture dealt with the more exact methods in gem determination and examination, i.e., the colorimeter, the diamolite and the coloriscope. The diamondoscope was mentioned and the importance of examining cultured pearls by x-ray luminescence apart from the classical method of x-ray interference pictures. E. S.

HARDY (E.). ***The literature of the pearl.*** Gemmologist, Vol. XX, No. 240, pp. 152-153. July 1951.

A useful survey of the literature of the pearl. Listing works on the formation, the fisheries and legends. R. W.

Colour Filters for Gem Testing

By L. C. TRUMPER, B.Sc., F.G.A.

GEMMOLOGISTS will be familiar with the Chelsea filter and its use in checking a parcel of emeralds. Illuminated by a strong electric light source (not fluorescent) emeralds appear pinkish to a strong red, depending upon the quality of the emerald, whereas paste remains green.

It is true that other green stones exhibit the same colour change, notably green zircon, green fluor, alexandrite, green chrysoberyl and demantoid garnet, due to the fact that in these cases the colour as in emerald is due to chromium—these stones can however be eliminated quite easily by other simple tests. Other remarkable colour changes are also brought about, thus synthetic stones or paste coloured by cobalt which are deep royal blue in colour turn bright cherry red. Synthetic spinels of deep aquamarine colour turn bright red. Amethysts, purple sapphires, etc., turn red and almost colourless aquamarines take on a peculiar blue/green colour which is most characteristic.

The following table gives a comprehensive list of the colour changes observed:—

COLOURS OBSERVED THROUGH CHELSEA FILTER USING 60 WATT ELECTRIC LIGHT

Green Stones	**Colour Observed**
Alexandrite	bright red
Avanturine quartz	brown
Andalusite	green
Apatite	greenish
Aquamarine	distinct apple green even if very pale stone
Chrysoberyl	red
Demantoid Garnet	red or bright pink
Dioptase	deep emerald green
Doublets	green
Diopside	blue green
Emerald	red or pink
Euclase	reddish

Green Stones	Colour Observed
Enstatite	green
Epidote	dark green
Fluor	red
Hiddenite	genuine Hiddenite shows pink
Nephrite	green
Paste	green
Peridot	green
Sapphire	blackish green
Smithsonite	greenish
Stained green chalcedony	red
Pale apple green stained chalcedony	green
Synthetic corundum to imitate Alexandrite	bright red
Synthetic green sapphire	red
Synthetic green Spinel	green (may show red)
Tourmaline	green
Variscite	grey
Zircon	reddish

Red Stones	Colour Observed
Almandine garnet	dark red
Almandine/Glass doublet	dark red
Kunzite (pink spodumene)	flesh pink
Paste	dark red
Pyrope garnet	dark red
Pink Scapolite	flesh pink
Magenta Tourmaline	pale purplish
Pink Tourmaline	brownish
Morganite (pink Beryl)	bright pink
Ruby	bright fluorescent red
Rubellite Tourmaline	bright pink
Rhodochroisite	pink
Rose quartz	pink
Spinel	bright fluorescent red
Pink Topaz	bright pink
Pinkish golden Sapphire	bright pink
Zircon	red

Blue Stones	Colour Observed
Apatite	blue
Aquamarine	distinctly apple green
Deep blue Beryl	green
Fibrolite	dirty pink
Fluor (mauve)	red
Iolite	brown
Kyanite	navy blue
Doublets	red or greenish
Euclase	pink

Blue Stones	Colour Observed
Sapphire	black
Purple Sapphire	red
Spinel	reddish brown
Synthetic Spinel	bright red or orange
Smithsonite	yellow green
Sodalite	grey
Tourmaline	bluish green
Topaz	greenish blue/colourless
Turquoise	greyish
Zircon	greenish

Brown Stones	Colour Observed
Brown Zircon	reddish
Hessonite garnet	red

Purple and Violet Stones	Colour Observed
Amethyst	cherry red
Mauve Sapphire	red
Purple Sapphire	red
Purplish Tourmaline	blackish
Purple Zircon	reddish purple
Violet Sapphire	blood red
Mauve Sapphire	yellow

Yellow Stones	Colour Observed
Amber	yellow or orange
Apatite	pale yellow
Beryl	pale green
Brazilianite	yellow
Citrine (yellow quartz)	golden yellow
Chrysoberyl	yellow
Danburite	pale yellow
Fluor	yellow
Heliodor (golden Beryl)	yellow
Orange Zircon	orange
Orthoclase	yellow
Fire Opal	orange
Scapolite	pale yellow
Smithsonite	yellow
Spodumene	yellow
Spessartite	orange
Sphene	pinkish yellow
Topaz	yellow
Tourmaline	slightly pinkish
Yellow Zircon	yellow

So useful a guide is the Chelsea filter that in the Winter of 1946/47 the writer set about designing and constructing a viewing box, full details of which were published in the Gemmologist Vol. XVI., 1947, p. 97.

This enables rapid observations to be made at any time in any light by merely inserting the stone on the tray, closing the drawer, switching on the light and viewing with binocular and stereoscopic vision shielded from extraneous light under ideal conditions. (It may be pointed out here that the panel shown on the front is not a window but a framed and glazed copy of the printed instructions issued with the Chelsea filter).

Many gemmologists have since constructed similar viewing boxes. Suggestions in certain quarters that there would be a ready market for commercially made viewing boxes were however met with the comment " That the idea would be still better if it could be extended to a range of useful filters and why did I not do something on these lines."

This set me thinking. First of all such a filter to be useful to the ordinary jeweller needed to apply to stones in popular demand. Emerald being already adequately covered and with it some others, what about ruby? Now I reasoned out that the only filter that could possibly exactly match the wavelengths emanating from a ruby suitably illuminated was another ruby and by inference any other stone must look somewhat different.

The first step therefore was to have made a flat of synthetic ruby as large as possible to form a filter. I managed to get one made $\frac{3}{4}$in. x $\frac{1}{2}$in. and 3 mm. thick. This was then mounted to fit into one eyepiece of a viewing box, specially made up for filter experiments so that the filters could be changed rapidly.

There is no doubt but that the results are somewhat as had been anticipated. Rubies look exactly the same as without the filter, though perhaps a little deeper in tint as a result of additional thickness being superimposed. Red spinel, however, and red paste it must be admitted do not appreciably change in tint. The other stones take on a rather more orange hue. With many stones, some quite interesting changes do occur.

My next step was to superimpose Wratten colour filters over the ruby filter—some 100 different filters were tried and the changes which are set out below were noted in the case of those filters listed. For this particular test only red stones were examined and as far as possible stones were chosen where the colour was a reasonably close match to natural rubies. The stones used being

FIG. 3.—ORIGINAL CHELSEA FILTER VIEWING BOX. Construction of the light-tight box with shield, simple lamp house and switch, operating instructions on the front panel and the tray containing a number of selected gemstones for comparative purposes, together with spaces available to accommodate the stone under test (*on left*).

FIG. 4.—EXPERIMENTAL FILTER VIEWING BOX. Standard type of viewing box with simple lamp house, switch and light-tight shield, but with special provision for testing the 1½ inch square filters mounted between glass covers, one of the large number of Wratten and other filters employed in the tests (*on right*).

a Burma ruby of good colour, a synthetic ruby with a distinct carmine/magenta tinge, two pale rubies, a deep red spinel, a pale red spinel, two deep red zircons, two almandine garnets, a pyrope garnet and an almandine/glass doublet.

IN THE TESTS WHICH FOLLOW, THE RUBY FILTER 3 MM. IN THICKNESS WAS SUPERIMPOSED UPON THE WRATTEN FILTER

Filter No.	Name	Colour Changes Recorded and Other Remarks
25	A (Tricolor Red)	Ruby, lightened; remaining stones darkened
29	F	Ruby approaching a very pale tint—remaining stones unaltered in appearance
34	D (Light)	Difference outstanding, ruby pale rose red, remaining stones very much darker
35	D	Similar
36	Methyl Violet B.R.R.	Ruby pale rose red; spinel similar, remainder much darker
38	Toluidine blue	Ruby imperial purple; rest red
38 A	Dark Toluidine blue	Ruby violet/blue, spinel dark red, pale pink spinel mauve, rest dark red (quite good)
40	Ciné Green 1	Ruby imperial purple; rest definitely red
40 A	Ciné Green 2	Ruby deeper purple, rest red—the advantage that background is white
43	Minus Red 2	Rubies purplish, pale rubies blue, pale pink spinel blue
44	Minus Red 4	Ruby violet, rest dark red except pale pink spinel which is mauve
44 A	Minus Red 5	Similar but ruby a deeper violet
60	P	Ruby violet, rest dark red
64	Minus Red 3 (light)	Rubies violet or deep blue, red spinel red, pale red spinel pink, rest dark red or brown
65	Minus Red 3	Ruby violet, dark red ruby deep violet
67	Filter blue-green	Ruby less violet, pale spinel pinkish/mauve, rest red or brownish black
68	Fast green-blue shade	Rubies violet, rest deep red
70	A (Contrast R)	Rubies almost colourless. Remainder dark
71 A	B	Similar
75	N	Rubies deep violet—rest dark red
89	Signalling Red (light)	Rubies nearly colourless, remainder dark

USING THE SAME RED GEMSTONES, ALL THE FILTERS WERE THEN TRIED WITHOUT THE RUBY SLICE

Filter No.	Name	Colour Changes Recorded and Other Remarks
29	F	Rubies pale red, pale pink spinel pale, remainder darker
30	Rose Bengal	Bright red colour of ruby accentuated
30 A	Q	Bright red colour of ruby accentuated
31	Minus Green 1	Bright red colour of ruby accentuated
34 A	—	Rubies and spinel pale fluorescent red, dark red spinel dark red
38 A	Dark Toluidine blue	Rubies deep violet; dark red spinel very deep purple; pale spinel mauve
38	Toluidine blue	Rubies magenta; pale spinel similar, remainder red
44	Minus Red 4	Rubies violet, zircon a dirty violet; pale spinel pale violet, rest dark red
45 A	Blue-Green	Rubies blue; pale spinel slightly reddish, rest dark red
47	C5 Projection blue	Rubies dark green, rest dark
40	Ciné Green 1	Rubies violet, pale ruby blue; pale spinel darker, rest dark
40 A	Ciné Green 2	Rubies beetroot purple, pale ruby paler violet/blue, pale pink spinel pinkish, rest dirty red
35	D	Rubies bright fluorescent red, rest dull and dirtier
60	P	Rubies deep violet/blue, pale spinel bluish, rest dark or dark red
67	Filter Blue-Green	Rubies deep violet, pale pink spinel slightly mauve, rest dirty brown
97	Dichroic filter	Rubies fluorescent red, rest dark red; pale spinel very similar to ruby
57	B2 (light)	Close to 40 A, pale pink spinel not quite so pink as red spinel not so distinctly red, rest red or brownish
34 A	—	Rubies and spinel pale fluorescent red. Deep red spinel still dark red
59	Projection green	Almost identical to 40 A, very good colour change

IN THE FOLLOWING TESTS, TWO WRATTEN FILTERS WERE SUPERIMPOSED UPON ONE ANOTHER

Filter Nos.	Colour Changes Recorded and Other Remarks
38 A and 31	Rubies pale green; pale spinel reddish, rest red.
40 A and 31	Rubies lilac, rest brownish.
68 and 31	Rubies fluorescent red, rest dark red or brownish.
70 and 31	Rubies nearly colourless, rest dark.
38 A and 34	Rubies dark green—quite good.

Filter Nos.	Colour Changes Recorded and Other Remarks
36 and 68	Rubies bright fluorescent red.
35 and 40 A	Rubies almost colourless, rest dark; pale pink spinel slightly darker.
46 and 40 A	Rubies almost colourless, rest dark; pale pink spinel slightly darker.
38 and 40 A	Rubies deep violet, pale ruby blue, pale pink spinel mauvish, rest darker.

The most difficult separation was found to be the pale spinel though frequently almandine/glass doublet came very close indeed to the Burma ruby. The other red stones usually appeared quite different and usually a blackish tint of red or dark brown.

Concurrent with the above tests, I started to develop the prototype of a " Filter viewing Box " providing for rapid interchangeability of colour filters. A similar type of viewing box was built to those previously designed comprising a light tight box with base 7in. x 7in. and about 7½in. high with a drawer fitting into the base to take the stone or stones under test.

A simple lamp housing carries a 60 watt tungsten filament gas filled electric lamp with provision for changing the bulb with the lamp arranged to strongly illuminate the interior of the box without any direct light reaching the eyes.

A light-tight viewing shield is built into the front of the top centred so as to provide the correct angle of vision to the centre of the base of the tray.

Rectangular apertures about 1in. x ¾in. about 2in. centres apart are provided in the top of the box and a similar pair about ½in. above and built into the viewing shield. Between these two, provision is made for a circular disc about 4½in. diameter with a milled edge capable of rotation about a central pivot, which pivot is removable to enable the discs to be removed or changed. This disc carries four pairs of colour filters mounted between glass covers ½in. x ¾in. and spaced 53 mm. centres apart.

At first glance it might have been supposed that a better shape for the pairs of filters would have been round or square. The oblong shape was decided upon solely to provide for variation between the width of the eyes in different individuals. This shape clearly allows for a variation of at least ¼in. between a possible minimum and maximum. All that is necessary is to rotate the disc with the finger by means of the milled edge to bring each of the four filters successively into position. A small slot in the cover

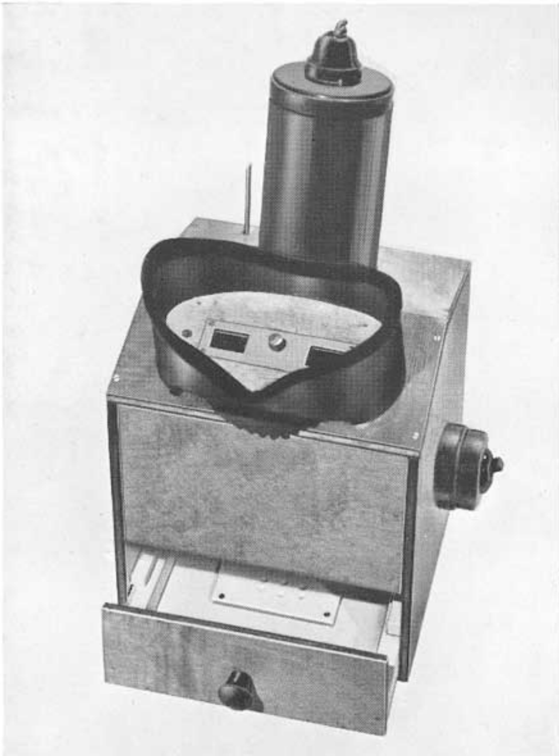


FIG. 1

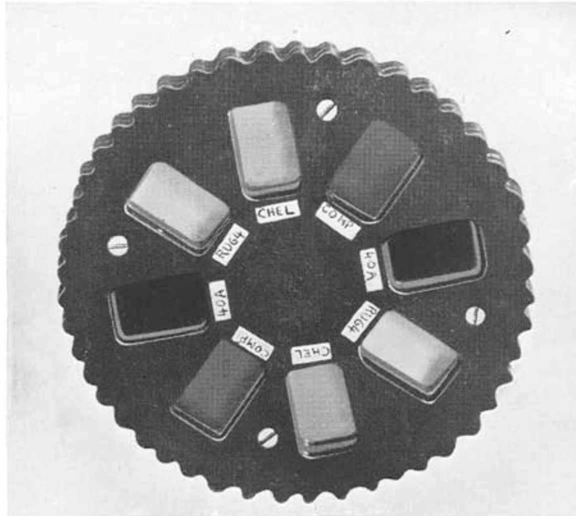


FIG. 2

Interchangeable disc of filters. Construction of the rotating disc carrying the four pairs of viewing filters.

The Trumper Interchangeable Filter Viewing Box. Left of the lamp house is the lever for bringing the complementary blue filter over the light source. Within the light-tight viewing shield between the two eyepieces, which in the commercial model will be fitted with lens and prisms, is the pin for withdrawing the rotating pairs of filters. Above the pin is the window through which appears the name of the filters in position. To the front of the viewing shield may be seen part of the knurled rotating disc of filters.

enables the name of the appropriate filter to appear as it is rotated. The switch at the side of the box enables the light to be switched on and off promptly thus preventing over heating of either the box or the filters.

Most colour filters are stable, but some do change after prolonged exposure to daylight. It will be seen, however, that three of the four pairs of filters will at any one time be covered both sides from the light and an added precaution would be to have a simple dust cover with a small handle that could be placed over the eye pieces when the viewing box was not in use.

The advantages of such a viewing box will bear repeating. Immediate availability of the appropriate illumination screened from daylight or any other source of illumination and the great benefit of both binocular and stereoscopic vision. To this has now been added the availability of alternative colour filters. To make my final choice of filter for the testing of rubies, I next selected a number of rubies of varying tints and depths of colour and checked these up along side a number of red spinels also of varying tints and depths of colour.

The following table shows the results using the most likely filters selected in the earlier examinations which I was satisfied already differentiated sufficiently from the remaining red stones.

FINAL FILTER TESTS

Filter No.	**Name**	**Colour Changes Recorded and Other Remarks**
64 + Ruby	Minus Red 3 (light) + Ruby	Rubies violet, pale rubies blue, deep red spinel deep red, medium red spinel pale purple, pale pink spinel distinctly pinkish or purplish, red zircon brownish red, garnet black or distinctly red, almandine/glass doublet deep red. On the whole this is the best filter for differentiating ruby from other red stones
67 + Ruby	Filter blue green + Ruby	Rubies violet tinged slightly with purple, pale rubies blue, deep red spinel dark red, pale pink spinel slightly mauvish. Red zircon inclined to be purplish black or brown, garnets distinctly red. Doublet deep red. This filter is practically as good as the one above for determining rubies

Filter No.	Name	Colour Changes Recorded and Other Remarks
40 A or 59	Ciné Green 2 Projection Green	Rubies distinct beetroot purple, pale rubies greyish blue, deep red spinel dark blackish red, garnets and zircon reddish brown to almost black. Deep Bohemian pyrope almost black, pale spinel distinctly pink, medium red spinel pale blackish red. This filter is quite a good one for identification of ruby.
38 A	Dark Toluidine Blue	Rubies violet or deep blue, zircons dirty brown or blackish, pale spinel deep mauve but difficult to determine, red spinel a deep blackish purple, garnets brownish red. Almandine/glass doublet deep red. This filter could be used with practice
40 A—38	Ciné Green 2 +Tolluidine Blue	Rubies a very deep violet, red spinel black, garnets and zircons dark brown, pale pink spinel brownish. Almandine/glass doublet very deep red. Garnets black or dark brown
38 A—31	Dark Toluidine Blue—Minus Green 1	Rubies dark to very dark green tinged with red. Pale spinel pink, all other stones distinctly red. Not a sufficiently marked colour change
40 A—67	Ciné Green 2	Rubies deep violet or deep blue, pale pink spinel pinkish brown, all other stones black or dirty brown. This combination of filters also provides a reliable separation with some practice

My final choice fell upon the 3 mm. slice of synthetic ruby with Wratten filter No. 64 Minus red 3 (light) superimposed thereon. With this filter rubies appear distinctly violet whilst all other stones are generally deep red. blackish or purplish.

Spectroscopic examination of this compound filter to which I have given the Code Number RU64 shows as was to be anticipated complete absorption of the violet up to about 4,500 angstroms, the usual lines in the blue attributable to ruby namely a line at 4,700 and a doublet around 4,770, considerable absorption in the green between 5,300 and 5,700 and complete absorption above 6,200 Angstroms.

The resultant colour of the filter is a pale blue and in general it will be seen that the light transmitted is blue and orange with a trace of red.

I also considered it worth while to include in the first disc of interchangeable filters, Wratten filter No. 40A (No. 59 is in fact nearly identical and may supersede No. 40A). With this filter rubies appear distinctly a beetroot or maroon purple, pale Siam rubies appearing a greyish blue whilst deep red spinel shows dark red, pale pink spinel distinctly pinkish and other red stones blackish, brownish or distinctly red.

Spectroscopic examination of the filter 40A shows that there is complete absorption in the violet and in part of the blue up to 4,580 angstroms with some absorption in the red, complete between 6,500 and 6,680.

Whilst both of these filters have been specifically chosen for their value in identifying rubies, colour changes do occur in many other gemstones. It has in particular been observed that both filters change the colour of peridot to a distinct brown whereas without exception all other green stones remain a similar green colour when viewed through the filters.

The full list of observations follow.

THE TRUMPER INTERCHANGEABLE FILTER VIEWING BOX—
COLOUR CHANGES OBSERVABLE

Green Stones	**RU64 Filter**	**40A Filter**
Alexandrite	greenish blue	emerald green
Andalusite	dark green	green
Aquamarine	bluish	sea green
Aventurine quartz	green	green
Apatite	dark green	green
Chrysoberyl	green	green
Chrysoprase	leek green	leek green
Chalcedony (stained green)	green	green
Demantoid garnet (emerald green)	yellow green	bluish green
Demantoid garnet (bluish green)	bluish green	bluish green
Demantoid garnet (yellow green)	yellow green	green
Diopside	dark green	green
Dioptase	dark emerald green	dark emerald green
Doublets (simulating emerald)	green	green
Enstatite	green	green
Epidote	blackish green	dark green

Green Stones	RU64 Filter	40A Filter
Euclase	bluish green	bluish green
Emerald (of good colour)	emerald green	emerald green
Emerald (pale colour)	bluish green	green
Fluor	yellowish green	green
Hiddenite (emerald green spodumene)	dark green	green
Kornerupine	brownish green	dirty green
Malachite	dirty green	dirty green
Nephrite	green	green
Paste	green	green
Peridot	light brown	light brown
Sapphire (natural)	green	green
Sapphire (some synthetics)	green	green
Spinel (natural)	green	green
Spinel (synthetic)	green	green
Synthetic Corundum simulating alexandrite	blue	blue
Smithsonite (Bonamite)	greyish	greyish green
Tourmaline	green	green
Variscite	green	green
Zircon	olive green	olive green

Blue Stones	RU64 Filter	40A Filter
Apatite	blue	blue
Aquamarine	pale blue	sea green
Azurite	royal blue	royal blue
Beryl (deep blue)	blue	greenish blue
Benitoite	blue	yellowish green
Euclase	bluish green	bluish green
Fibrolite	pale blue	grey
Iolite	dark green	dark green
Kyanite	royal blue	blackish
Lapis lazuli	dark blue	dark greenish blue
Lazulite	bluish	greenish blue
Sapphire (Burma)	black	blackish
Sapphire (Ceylon)	blue	greenish blue
Sapphire (Kashmir)	deep blue	inky green
Sapphire (Montana)	blue	bluish green
Sapphire (Australia)	black	black
Sapphire (Synthetic)	black	black
Spinel (natural)	inky blue	inky blue
Spinel (synthetic)	blue	blue
Smithsonite	greyish blue	greenish
Sodalite	blue	greyish
Topaz	pale blue	sea green
Turquoise	bluish	greenish
Tourmaline	blue	greenish blue
Zircon	blue	pale green

Red, Purple and Violet Stones	RU64 Filter	40A Filter
Almandine garnet (red)	very dark red	black
Almandine garnet (pink)	Imperial Purple	blackish
Almandine garnet (purple)	purplish/black	dark brown
Almandine/Glass doublet	red	orange red
Amethyst	deep blue	grey
Carnelian	chocolate	pale chocolate
Fluor (mauve)	pale blue	bluish green
Kunzite (lilac spodumene)	pale greyish	yellowish pink
Morganite (pink beryl)	greyish blue	pale yellow
Paste	red	red
Pyrope garnet	very dark red	black
Red Jasper	chocolate	chocolate
Rhodochroisite	fawn	fawn
Rose quartz	grey	colourless
Ruby (Burma)	deep violet	beetroot purple
Ruby (Siam)	violet	pale beetroot purple
Ruby (pale)	pale violet	purple
Sapphire (Amethyst colour)	medium blue	pale violet
Sapphire (purple)	inky blue	violet
Sapphire (violet)	violet	violet
Sapphire (mauve)	grey	grey
Scapolite (pink)	colourless	colourless
Spinel (deep red)	deep red	blackish red
Spinel (medium red)	purple/maroon	blackish pink
Spinel (pink)	pale purple	pinkish
Spinel (purple)	Imperial Purple	brownish
Tourmaline (rubellite)	amethyst	pink
Tourmaline (pink)	mauvish brown	brown
Tourmaline (magenta)	purple	red
Tourmaline (purple)	Imperial Purple	dirty brown
Topaz (pink fired)	greyish blue	colourless
Zircon (red)	blackish brown	blackish brown
Zircon (purple)	purple	greyish

Orange and Yellow Stones	RU64 Filter	40A Filter
Amber (reddish)	brown	brown
Amber (yellow)	yellow	yellow
Apatite	colourless	colourless
Beryl	pinkish yellow	yellow
Heliodor (Golden Beryl)	pinkish yellow	yellow
Brazilianite	pale yellow	pale yellow
Chrysoberyl	flesh pink	yellow
Citrine (yellow quartz)	pale brown	yellow
Danburite	colourless	colourless
Fluor	yellow	yellow
Hessonite garnet	reddish brown	reddish brown

Orange and Yellow Stones	RU64 Filter	40A Filter
Orthoclase	colourless	pale yellow
Opal (Fire Opal)	orange	orange
Sapphire	flesh pink	yellow
Scapolite	colourless	pale yellow
Smithsonite	yellow	yellow
Spessartite garnet	orange brown	pale brown
Sphene	flesh pink	yellow
Smoky Quartz (Cairngorm)	brown	brown
Spodumene	colourless	yellow
Topaz	pale yellow	pale yellow
Tourmaline	greenish yellow	yellow
Zircon (yellow)	colourless	yellow
Zircon (orange)	orange	orange

I also decided that it was convenient to add still further to the value of the viewing box by providing a means of examining rubies and spinels for fluorescence by the use of two complementary filters as developed by S. Von Glisczynski and F. Vandrey and reported on in " Achat " 1949, 2 (7/8), pp. 270-272.

In this method two filters are employed one filter passes wavelengths from 3,200 A to 5,800 A, that is including the ultra violet and the other filter passes wavelengths from 5,800 A upwards.

With both filters superimposed in front of the light source, practically no light passes but if the rubies are placed between the filters then the bright red fluorescence excited in rubies and spinel by the light passing through the blue green filter is visible through the red complementary filter everything else remaining dark.

The viewing box is therefore provided with a Wratten Filter No. 44A, Minus Red 5, 2½in. square mounted between glass covers masked with black velvet and so arranged that by pressing a lever at the back of the box, it is brought over the light source—a ring of black velvet ensuring that no extraneous light escapes into the viewing box. Thus only light which passes this filter can illuminate the box. When not in use the filter drops out of the way. This filter is moderately stable and is unaffected by the heat of the lamp ; it is of course only in use for a matter of seconds.

The appropriate complementary filters are mounted in the rotating disc being Wratten filter No. 25A, Tricolour Red.

Finally, Messrs. Rayner have accepted the interchangeable filter viewing box for commercial production still further improved by the provision of combined lenses and prisms over the eyepieces.

PORTABLE DIRECT READING SPECIFIC GRAVITY BALANCE

By O. LeM. KNIGHT, B.E., Assoc.M.Inst.C.E., A.M.I.E.Aust.

IN the identification of gem stones, particularly in the rough, two of the most important properties are hardness and specific gravity. A knowledge of these, coupled with observed details of colour, crystal habit and mode of occurrence is sufficient, in most cases, for the identification of the stone.

In the field hardness can be readily found, but an accurate determination of specific gravity is not so easy, as none of the accepted forms of balance are very portable. To overcome this difficulty, the writer has developed a readily portable balance which reads specific gravity directly without calculation to a degree of accuracy that is sufficient for all practical purposes.

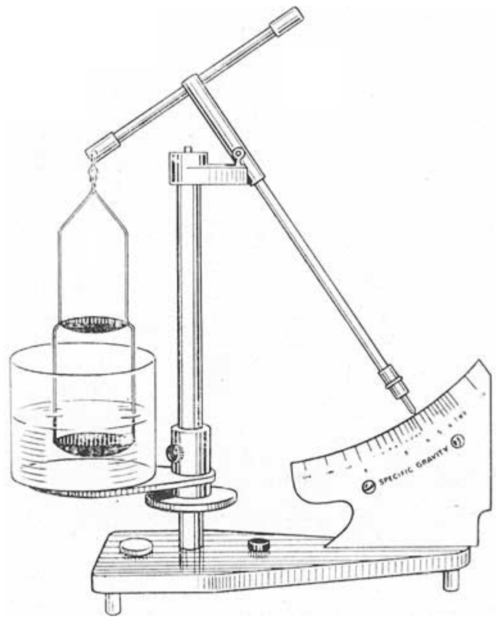


FIG. 1

The principle of the balance is simple. It consists of two pans, the lower immersed in water, carried on the one end of a balance arm, the other end of which moves in an arc and carries a suitable sliding counterweight. The stone to be tested is placed in the upper pan and balanced by the counterweight against a fixed point on the scale. The stone is then transferred to the lower pan, which is immersed in water, and the arm carrying the counterweight moves to a new position, where it just balances the reduced weight of the specimen. (Fig. 1)

If the balance arm and pans are so designed that they are in perfect balance for any position of the arm, the depth of immersion of the lower pan being kept constant, the amount of movement of the arm is proportional to the loss of weight of the stone when immersed in water and the scale can be suitably graduated to indicate the specific gravity.

It may be well to outline briefly the mathematics involved.

Fig. 2 shows the balance in its initial position with a specimen, weighing W, in air, in the upper pan, balanced by a counterweight C. The initial position, for various reasons, has been taken at 45°. L is the length of the balance arm to C and l the distance from the pivot O to the pan support.

Taking moments about the centre O we have

$$W \; l \cos. a = C \; L \operatorname{Sin.} 45°$$

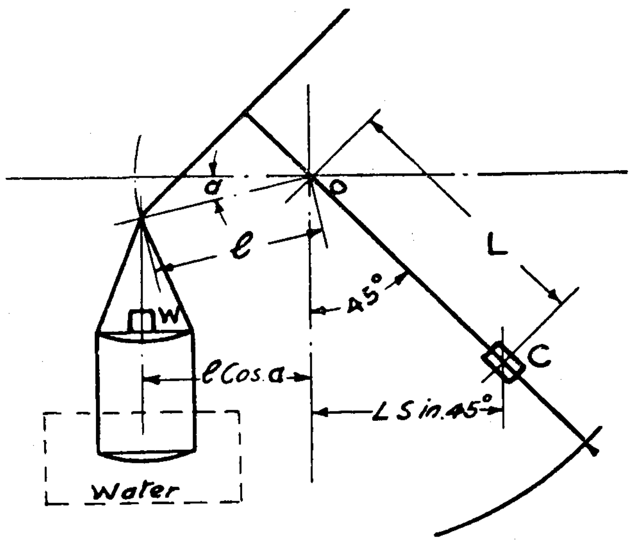


FIG. 2

The angle a is fixed by the design of the balance so that the pan support moves, over its useful range, approximately equal distances below and above the horizontal line through the pivot O.

From the above equation we see that

$$W = \frac{C\ L\ \text{Sin. } 45^\circ}{l\ \text{cos. } a}$$

Fig. 3 shows the position when the specimen has been transferred to the lower pan and now has an apparent weight of w. The balance arm has moved through an angle b to a new position and again taking moments about the centre O we have

$$w\ l\ \text{cos. } (b-a) = C\ L\ \text{Sin. } (45^\circ - b)$$

From this equation we see that

$$w = \frac{C\ L\ \text{Sin. } (45^\circ - b)}{l\ \text{cos. } (b-a)}$$

Now since

W = the weight of the specimen in air

and

w = the weight of the specimen in water

$$\text{the specific gravity} = \frac{W}{W-w}$$

substituting values for W and w from the two equations above we get

$$\text{Sp. gr.} = \frac{W}{W-w} = \frac{\dfrac{C\ L\ \text{Sin. } 45^\circ}{l\ \text{Cos. } a}}{\dfrac{C\ L\ \text{Sin. } 45^\circ}{l\ \text{Cos. } a} - \dfrac{C\ L\ \text{Sin. } (45^\circ - b)}{l\ \text{Cos. } (b-a)}}$$

This rather formidable looking expression reduces to

$$\text{Sp. Gr.} = \frac{\text{Cot. } b + \text{tan. } a}{\text{tan. } a + 1}$$

As mentioned before, the angle a is fixed by the design of the balance and is a constant value which can be substituted in the above equation, leaving the specific gravity proportional only to the co-tangent of the angle b.

For the dimensions of the balance made by the author the angle a was 12°, and as tan. 12° equals .21256 the formula can be written

$$\underset{(\text{Sp. gr.})}{g} = \frac{\text{Cot. } b + .21256}{1.21256}$$

A more useful form of the equation for calculating the scale is

$$\text{Cot. } b = 1.21256\ g - .21256$$

From this formula the angle corresponding to any value of g can be calculated.

So much for the theory of the balance. There are a number of practical considerations that are of importance, particularly if the balance is to be accurate when testing very small stones.

1st.—The whole of the moving parts, balance arm and pans, must be in perfect balance at any position on the scale, the lower pan being always immersed in water to the same depth.

This can be assured by balancing these parts about the pivot point in two positions: one with the arm in the vertical position and one with the arm in the horizontal position. If balanced in these two positions the moving parts will be in balance in any intermediate position.

This balance must be calculated when drawing up the design and finally corrected experimentally after making and assembling the parts.

2nd.—Friction at the pivots must be reduced to a minimum. The writer used hardened steel pivots working in sapphire jewels for the main pivots. The sapphire jewels were let into the cross

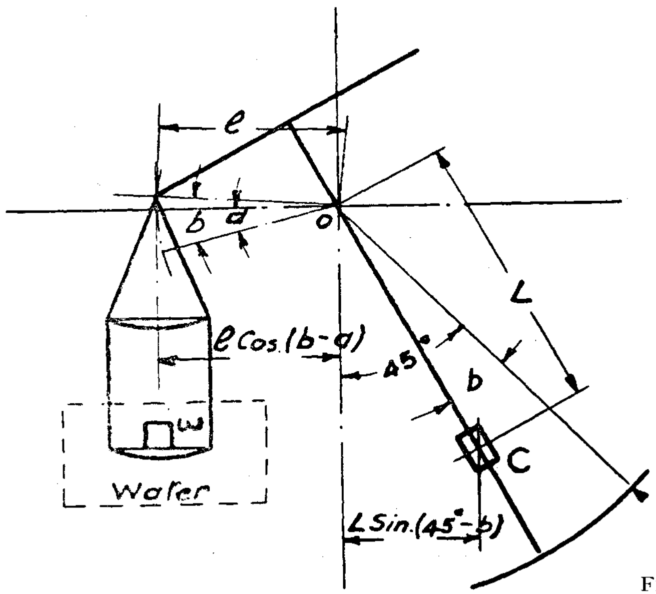


FIG. 3

spindle on the balance arm so that the pivot points were exactly at the centre of this spindle.

The pan suspension consisted of a wire hook suspended over an agate knife edge.

3rd.—The depth of immersion of the bottom pan must be maintained constant for any position of the balance arm. This can be arranged by a vertical screw adjustment for the bracket carrying the water container and a line marked around the container giving the level of the bottom of the pan.

4th.—It is advisable also to reduce the inertia of the working parts to a minimum. This can be accomplished by making the balance arm and pan supports of duralumin tube and the pans of thin aluminium sheet stiffened by pressing to dished form. Stiff wire for the pan supports can be made by drawing duralumin tube through a die plate.

5th.—The balance should be truly horizontal when in use and the insertion of a small bubble level in the base will permit this to be adjusted accurately.

In the balance illustrated the balance arm can be lifted off the pivots when not in use for ease and safety in packing. The pivot points are let into a U-shaped bracket and are $\frac{3}{4}$ inch apart.

The radius from the pivot to the scale is 5 inches and the distance from pivot to pan support is $2\frac{1}{4}$ inches. Pans are $1\frac{1}{4}$ inches diameter and are stamped from aluminium sheet .01 inch thick.

Weights are made to slide on the balance arm with a friction grip which permits of rapid adjustment. The actual value of the balance weights is unimportant, it being necessary only to have a range of weights that will balance the specimens likely to be tested.

Specimens from 2 grains to an ounce or more in weight can be handled rapidly and accurately in the field on this balance, though for stones less than one carat in weight considerable care is necessary.

The total weight of the balance packed in a case for transport is four pounds. The top of the case is provided with a screw for clamping the base of the balance when in use.

(Extracted with permission from the Commonwealth Jeweller and Watchmaker, May, 1951.)

ASSOCIATION NOTICES

REUNION OF MEMBERS AND PRESENTATION OF AWARDS

A reunion of Fellows and Members of the Association will be held at Goldsmiths' Hall, Foster Lane, London, E.C.2, on Wednesday, 7th November, 1951, between 6.15 and 7 p.m.

Following the reunion the presentation of awards gained in the 1951 examinations will take place at 7.15 p.m. Professor Kathleen Lonsdale has very kindly consented to present the awards.

TALKS BY FELLOWS

Kibe, V. R.: B.B.C. Overseas programmes. "Study of Gemmology" with special reference to the Gemmological Association of Great Britain, August 28th. "Gemmology," September 15th. (Recorded talks in the Marathi language.) Mr. Kibe is the first Indian to obtain the Fellowship diploma.

Warren, Mrs. K. G.: "Gemstones," Bromley Town's Women's Guild August 14th.

Blythe, G. A.: "Gemstones," Southend Rotary Club, August 21st. Baptist Church Guild, Southend, October 2nd. Prittlewell Evening Guild, October 3rd. Thorpe Bay Townswomen's Guild, October 4th. Royal College of Nursing (Southend and district, Rochford Hospital), October 8th.

Ash, G. A. (Mrs.): "Precious stones and the stories of some famous gems," Palmers Green and Southgate Townswomen's Guild, October 4th.

COUNCIL MEETINGS

JUNE

A meeting of the Council of the Association was held at 19/25, Gutter Lane, London, E.C.2, on Thursday, June 21st, 1951. Mr. F. H. Knowles-Brown presided.

The Council received with regret the resignation of Mr. Thorold G. Jones as a member of Council. He felt that he was unable to continue to serve because of the prior claims of his present work. The Council recorded its great appreciation of Mr. Jones' work for the cause of gemmology and the Association.

A report of the sub-committee appointed to consider matters appertaining to the examinations was presented and, after amendment, adopted. Among other matters the Council decided that the examiners for the time being should be co-opted as members of Council. During the previous Council meeting Dr. G. F. Herbert Smith announced that he felt that the time had now come for him to hand over the task of being Senior Examiner to some one younger. The Council decided to invite Mr. B. W. Anderson to act as an examiner with Dr. Claringbull.

The sub-committee also submitted that amendments should be made to the syllabus of examinations and these, mostly affecting the diploma examination, were agreed.

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AUGUST

Mr. F. H. Knowles-Brown presided at a meeting of the Council held at 19/25, Gutter Lane, London, E.C.2, on Wednesday, August 29th, 1951.

Mr. B. W. Anderson formally accepted his appointment as co-examiner in gemmology and in so doing expressed the appreciation and thanks of the Council to Dr. Herbert Smith for his great work as examiner to the Association and its predecessors since 1912. It was work the value of which could not be adequately expressed in words and had set a standard that had earned international repute.

The examiners presented their report on the 1951 examinations and the Council agreed to the award of prizes. (The examination results are set out in these notices.) In view of the difficulty of assessing the award, Mr. Anderson agreed to withdraw the prize given in connection with the practical section of the diploma examination.

The following were elected to membership:—

FELLOW:

Phillips, J. A., Los Angeles, U.S.A. (D. 1950).

PROBATIONARY MEMBERS:

Connolly, J., Auckland, New Zealand.
Sena, W., Singapore (D. 1951).

GIFTS TO ASSOCIATION

The Council of the Association acknowledges with gratitude a gift of gemstones from Dr. E. Rutland.

GERMAN GOLDSMITHS' MEETING, 1951, AT AUGSBURG

Over 400 jewellers, gold- and silversmiths attended the Augsburg meeting, and foreign delegates from France, Belgium, Switzerland and Austria participated again. Within the framework of this meeting, a number of lectures were given. Dr. E. Guebelin, of Lucerne, talked about "The introduction into gemmology" using coloured slides. Prof. Dr. K. Schlossmacher, of Idar-Oberstein, gave an illustrated lecture on the "colours of gemstones." The well-known art-historian, Father Dahm, of the monastery Maria Laach, gave a public lecture on "enamel, gold and gem objects, ecclesiastical and secular." The importance of the meeting is shown by the fact that its patron was the Bavarian Minister of State for Economics, Dr. Hanns Seidel, who opened the meeting on June 30th in the Small Golden Hall of Augsburg. Numerous discourses dealt with apprenticeship and examination, experts' problems and propaganda.

The main feature of the meeting was the opening of the exhibition of "gemstones, ornaments and precious utensils" in the historic halls of the Maximilian Museum of Augsburg. The exhibition was open until June 25th and showed historical Augsburg goldsmith craft, a gem exhibition from Idar-Oberstein, and a separate section under the heading "From apprentice to master."

Several resolutions were passed, directed to the States government. Strong protest was raised against the luxury tax, and it was urged that the State should initiate an emergency program (including important orders) for the gold- and silversmiths' workshops, which are especially hit by the economic crisis.

THE TECHNOLOGY OF DIAMOND AND OTHER HARD SUBSTANCES

After the successful conclusion of the first nine-lecture course on this subject at the South East London Technical College, the Mechanical Engineering Department has arranged for a second ten-lecture course on the Technology of Diamond and Other Hard Substances, commencing Monday, October 8th, 1951, with lectures every other Monday until February 18th, 1952. The lectures deal practically with all technical applications and try to give fundamental knowledge on the diamond as technical material. Special lectures are provided on Shaped Diamond Tools, Diamond Truing Tools, Diamond Dies, Production and Use of Diamond Powders, Production and Use of Diamond Grinding Wheels, Diamond Rock Drilling, and Production of Sapphire Bearings. The lectures will be given by experts in this field, including J. C. Dawkins, P. Grodzinski, F. C. Jearum, G. R. Leeds, J. D. McClure, B. Morgans and N. Smith. Applications should be sent to the South East London Technical College, Lewisham Way, London, S.E.4. Telephone: Tideway 1421.

GEM CLASSES IN BRISTOL

Classes in gemmology have recently been commenced at the Fairfield Grammar School, Bristol. Students will be prepared for the examinations of the Association. Mr. F. E. Leak has been appointed lecturer.

MEMBERS' MEETINGS

On Thursday, 11th October, at Goldsmiths' Hall, London, Dr. E. Gübelin, F.G.A., C.G., of Lucerne, gave a talk to members on the inclusions that occur in diamond. His talk, which was illustrated by coloured slides of photomicrographs, will be reported in the January, 1952, issue of the Journal.

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A meeting of members will be held at the British Council Cinema on Tuesday, 20th November, 1951, at 7 p.m., when, in response to demand, a further showing of the film "Atomic Physics" will be given. Tickets are required for this meeting.

1951 EXAMINATIONS IN GEMMOLOGY

The Association's 1951 examinations in gemmology were held in the United Kingdom, the United States of America, Canada, the Netherlands, Singapore, the Union of South Africa, Norway, Sweden, India, Switzerland, Ceylon and the Commonwealth of Australia.

One hundred and forty-seven candidates sat for the preliminary examination and ninety-two for the diploma. Upon the recommendation of the examiners the Tully Medal (Diploma examination) was awarded to Mr. J. D. Wade, Glasgow, and the Rayner Prize (Preliminary examination) to Mr. C. I. Belcher, Johannesburg.

The following is a list of successful candidates, arranged alphabetically:

PRELIMINARY

Aarons, A. (London)
Allen, H. (Newbridge, Scotland)
Andersen, A. T. (Toensberg, Norway)
Andriessen, D. J. (Bergen-op-Zoom, Netherlands)
Austin, L. F. (London)
Barker, Miss J. B. (Birmingham)
Bartram, Miss E. M. (Woodville West, S. Australia)
Belcher, C. I. (Johannesburg, S. Africa)
Blake, Miss D. I. (Plymouth)
Bochatay, A. (Geneva, Switzerland)
Boudreau, G. A. (Harrow)
Bould, D. R. (Plymouth)
Boundy, D. B. (Leamington Spa)
Bowditch, Mrs. P. E. (Bristol)
Boxall, W. J. (Edinburgh)
Brandsma, A. H. (Maastricht, Netherlands)
Brooks, Miss B. B. (Birmingham)
Bushell, J. C. (Oldbury)
Cameron, A. D. (Glasgow)
Cannon, J. (Gerrards Cross)
Carter, Mrs. N. E. (Bristol)
Chalmers, A. (Glasgow)
Clarke, C. L. (Hatfield)
Clay, Miss E. V. (Birmingham)
Clutterbuck, Miss M. E. (Birmingham)
Cohen, S. (Amsterdam, Netherlands)
Coxhead, R. M. (London)
Cranfield, A. S. (Croydon)
Craven, B. R. (Blackburn)
Cross, R. (Glasgow)
Crossingham, A. W. (London)
Crouchley, D. (London)
Cummins, W. G. (Blackburn)
Cutler, R. (London)
Davies, G. H. (Birmingham)
Davies, J. W. (High Beech)
Davis, A. W. (Potters Bar)
Denham, F. J. (Harrow)
Doulis, L. N. (Detroit, U.S.A.)
Dove, D. K. (London)
Drury, E. G. (Birmingham)
Dunk, L. A. (Morden)
Edwards, J. (Manchester)
Evans, Miss F. M. (London)
Fifield, L. J. (St. Albans)
Flood, F. (London)
Foreman, V. L. (Stockton-on-Tees)
Frenkel, A. O. (Montreal, Canada)
Furse, T. S. (Tavistock)
Grahame-Ballin, Miss A. M. (St. Albans)
Grantham, Miss L. O. (London)
Green, Miss P. D. (London)
Hall, J. A. (London)
Hardwick, D. G. (Burton-on-Trent)
Harper, A. J. (Swansea)
Harsheim, O. (Oslo, Norway)
Henderson, Miss A. I. (Houston, Scotland)
Hodne, H. (Kristiansand, Norway)
Hogervorst, Mrs. T. (The Hague, Netherlands)
Hudson, J. S. (Birmingham)
Hval, J. O. (Oslo, Norway)
Isaacs, D. (Glasgow)
Jacobs, R. E. (London)
Johnson, D. R. (Toronto, Canada)
Jones, A. D. (Birmingham)
Jones, V. G. (Sutton)
Kinnear, D. I. (Edinburgh)
Krashes, B. (New York, U.S.A.)
Lardeur, K. J. (London)
Levett, R. V. (Thorpe Bay)
Lewis, E. G. (Woking)
Light, D. A. (Sutton Coldfield)
Lubin, G. (London)
Lurcott, T. (London)
McAlpine, A. W. (Edinburgh)
McKay, Miss J. (Glasgow)
McRae, A. J. (Glasgow)
Mearns, Mrs. M. A. (Brisbane, Australia)
Mellish, E. (London)

Messer, R. C. (Edinburgh)
Middlemiss, A. E. (Erith)
Miller, L. R. (San Rafael, U.S.A.)
Oostwegel, L. H. (Heerlen, Netherlands)
Paterson, W. (Edinburgh)
Payne, L. (Bournemouth)
Peel, F. A. (Edmonton, Canada)
Pollington, K. I. (Welling)
Pye, D. T. (Methil, Scotland)
Rhodes, J. (Birmingham)
Rice, Miss J. M. (Birmingham)
Rice, R. A. (Birmingham)
Roe, A. J. (Newton Abbot)
Russell, W. E. (Port Alberni, Canada)
Short, Miss E. A. (Twickenham)
Siedle, L. C. (Colombo, Ceylon)
Silver, B. (Edgware)
Small, J. G. (Los Angeles, U.S.A.)
Smith, J. E. (Reigate)
Solomon, D. N. (Tavistock)
Spray, A. J. (London)
Stanton, A. I. (London)
Stevens, R. E. (London)
Sunde, G. (Oslo, Norway)
Svensson, K. W. (Lidingö, Sweden)
Tillander, A. B. (Helsingfors, Finland)
Towells, Miss M. J. (Bristol)
Urquhart, I. R. (London)
van der Heyden, C. J. (Zoeterwoude, Netherlands)
van der Velden, J. (Amsterdam, Netherlands)
Voyce, R. K. (London)
Walsh, J. F. (Birmingham)
Wardall, C. H. (Chester)
Watton, J. E. (Birmingham)
Wheelock, H. J. (Birmingham)
Whelan, K. (Hainault)
Woolley, T. W. (Birmingham)
Yaghobi, H. (London)

DIPLOMA

Qualified with Distinction

Bartram, Miss E. M. (Woodville West, S. Australia)
Belton, C. G. (Southend-on-Sea)
Brandsma, A. H. (Maastricht, Netherlands)
Breebaart, A. J. (Arnhem, Netherlands)
Crook, Miss W. E. (London)
Davis, G. W. (Birmingham)
Doulis, L. N. (Detroit, U.S.A.)
Gush, Mrs. I. N. (Johannesburg, S. Africa)
Kolb, H. F. (London)
Lumsden, Miss J. G. (Edinburgh)
Palmer, J. V. (New Westminster, Canada)
Scott, J. F. (Lincoln)
Small, J. G. (Los Angeles, U.S.A.)
van Loo, J. (Zeist, Holland)
Wade, J. D. (Glasgow)
Wright, T. J. (London)

Qualified

Alexander, D. (Glasgow)
Armstrong, A. H. (Stirling, Scotland)
Bishop, E. A. (Southend-on-Sea)
Bradbury, D. S. (London)
Bridges, R. J. (London)
Broadbent, Miss S. A. (Farnham)
Browne, P. C. (Nottingham)
Caffell, E. W. (Old Woking)
Cater, C. W. (London)
Clark, L. D. (Surbiton)
Clarke, Miss H. A. (London)
Cohen, S. (Amsterdam, Netherlands)
Craik, E. D. (Edinburgh)
Denyer, B. C. (Harrow)
Dew, R. G. (Croydon)
Ekanayaka, F. L. (Colombo, Ceylon)
Fine, H. D. (London)

Goodbody, R. F. (Petersfield)
Harris, D. I. (London)
Harrison, Miss M. A. (Lichfield)
Hogervorst, Mrs. T. (The Hague, Netherlands)
Instone, I. N. (Bexhill)
Jones, A. E. (London)
Kibe, V. R. (Indore, C. India)
Kirkpatrick, M. R. (Harrow)
Knowles-Brown, P. (London)
Leech, R. A. (Seven Kings)
Lerman, A. (Toronto, Canada)
Lynch, D. K. (London)
MacDonald, H. F. (Glasgow)
MacKenzie, I. (Greenock)
Miller, L. R. (San Rafael, U.S.A.)
Myers, G. (Wembley)
Myhre, H. (Ljan, Norway)
Oostwegel, L. H. (Heerlen, Netherlands)
Perry, J. A. (Southend-on-Sea)
Rae, J. W. (London)
Russell, B. T. (London)
Russell, W. E. (Port Alberni, Canada)
Stockwell, J. C. (Middlesbrough)
Stol, D. (Amersfoort, Netherlands)
Swettenham, G. W. (London)
Tillander, A. B. (Helsingfors, Finland)
Towe, E. G. (Edinburgh)
Turnbull, K. (Harold Wood)
van der Heyden, C. J. (Zoeterwoude, Netherlands)
Wacker-Wakelin, R. J. (Birmingham)
Wade, C. D. (Paisley)
Walker, J. (Edinburgh)
West, Miss M. D. (Theale)
Wood, Miss E. A. (Edinburgh)
Wyatt, J. (Bromley)