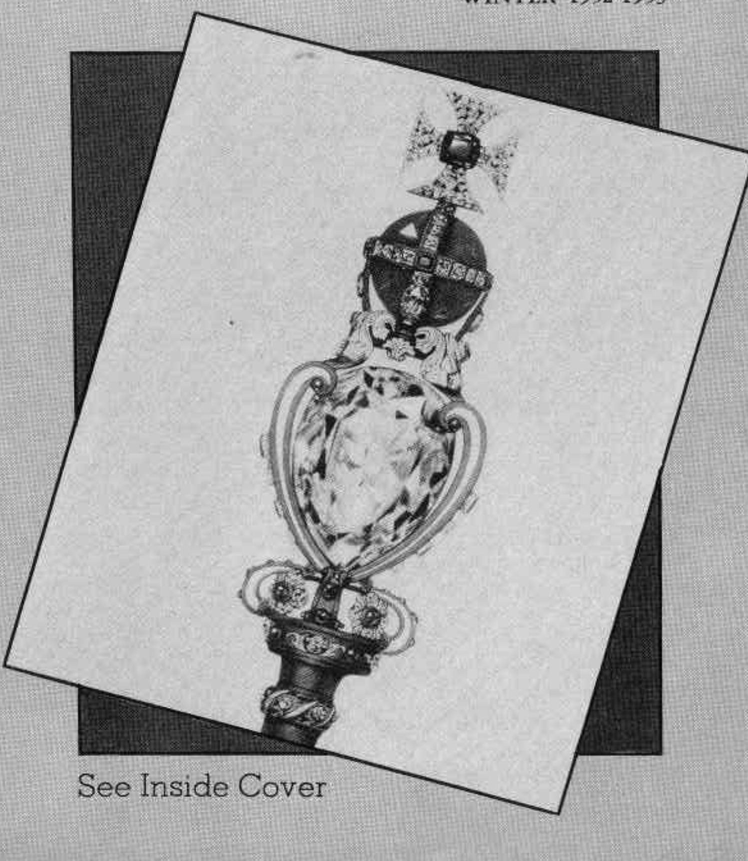
Gems and Gemology

WINTER 1952-1953



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Gems & Gemology

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Head of the English Sceptre with Cross with its magnificent 530 carat Cullinan I cut from the Star of Africa, world's largest diamond. Full length of Sceptre is shown on page 257.

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Simple Immersion Techniques to Determine the Refractive Index of Faceted Gemstones

by

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Although the direct reading forms of refractometer provide by far the most convenient and accurate means of measuring the refractive indices of faceted gemstones, gemologists have become increasingly aware of the value and occasional indispensability of immersion methods which have for so many years been standard practice among mineralogists. Descriptions of these methods are thus to be found, not only in mineralogical text books, but also in recent works on gemology such as those by Herbert Smith, Webster, Anderson, Liddicoat, and Walton.

In most of the recommended techniques having any pretense to accuracy, the microscope is considered an essential accessory, and—if unequivocal results are to be obtained—considerable practice and skill are required. One advantage of the methods described below is that no microscope — nor indeed expensive apparatus of any kind — is needed. Another advantage is the ease with which the effects can be observed and correctly interpreted. Lastly, a photographic record can be made where desired, without the use of a camera or other special equipment.

Actually, three procedures will be described: two visual and one photographic, but all are essentially the same, for the first, all that is required is a flat-bottomed glass immersion cell and a few standard liquids. Although the latter are given in works of reference, a list of some of the most useful is given below for the convenience of readers, together with the approximate refractive index of each. The exact index will depend upon the purity of the samples and also upon the temperature at which they are used; thus, only two place of decimals are given except in those cases where an intermediate figure seems to give a truer average value.

Carbon tetrachloride	1.46
Toluene	1.50
Chlorobenzene	1.525
Ethylene dibromide	1.54
Bromobenzene	1.56
Bromoform	1.59
Iodobenzene	1.62
Bromonaphthalene	1.66
Iodonaphthalene	1.705
Methylene iodide	1.745

Since these liquids are miscible in all proportions, intermediate values can readily be obtained if so desired. Indeed, suitable mixtures of, say, methylene iodide and toluene can be made up so as to cover nearly the whole range; but the advantage of using pure unmixed liquids where possible is that (except for slight variations with temperature) their refractive index can be relied upon to remain constant, which is not the case in mixtures of fluids having different degrees of volatility.

The liquids should be contained in glass-stoppered bottles. Two ounces (50 grams) of each should be sufficient and will last for years if not very frequently used. One or two glass funnels and a packet of filter papers will be needed for returning liquids to their bottles and insure their cleanliness. A few scraps of copper in the bottles of those fluids which contain iodine will prevent their becoming darkened by the presence of free iodine. Though several of the above liquids are, strictly speaking, "poisonous," none will cause harm if handled with normal care, and none has a really objectionable odor.

Now to a description of the proposed method in its simplest form. The stone, or stones, to be tested are cleaned and placed table facet down in a glass cell of suitable capacity (e.g. two inch diameter and three-fourths inch deep) and covered with just enough liquid to submerge the largest stone. The cell is then placed on a sheet of white paper and placed or held directly under the rays of an ordinary hanging electric lamp. Strip or fluorescent lighting will not yield the desired effect which ideally requires a point source of light, or a parallel beam. A pocket torch in a darkened room would answer quite well in an emergency—but should be held some distance above the cell. The higher the light the better, provided it gives enough illumination, and one light only should be used if the experiment is to be really successful.

Looking down on the stones under these conditions it will now be seen that, for specimens with refractive index higher than that of the chosen liquid, there is a shadow or dark outline round the girdle, whereas the edges of the facets appear as white lines. With stones of lower index than the fluid the reverse is found—a bright rim to the girdle and dark lines for the junctions of the facets.

The greater the discrepancy between the refractivity of the stone and the liquid, the more pronounced will these effects be. On the other hand, in cases where the stone and liquid are nearly a match, the stone will show no definite outlines and will in fact practically disappear. Flashes of spectrum colors round the girdle of the stone provide another indication that for certain colors contained in the incident white light a match between liquid and specimen has been achieved. Readers accustomed to immersing corundums and synthetic spinels in methylene iodide in order to examine their inclusions, will be familiar with the almost complete "disappearance" of the stone under these conditions. A still better example for demonstration perhaps is colorless quartz in ethylene dibromide, in which liquid it is practically invisible.

Returning to the non-matching stones: the great advantage of observing the bright or dark effects at the girdle and facet edges instead of merely the "degree of relief" is, of course, that this tells one whether to try the stone in a liquid of higher or in one of lower refractivity than that in which it is at present immersed in order to obtain a perfect or near-perfect match and thereby to know what its refractive index is. The breadth of the border and the distinctness with which the facet edges are seen give the practised observer a strong indication as to *how much* higher or lower is the refractive index of the stone than that of the liquid, in much the same way as the speed with which a stone rises or falls in a heavy liquid will enable one to guess how much lower or higher is its density.

Used in this very simple way the effects seen are not very striking: they need "looking for." But, by taking a little trouble to rig up a viewing apparatus, far more spectacular

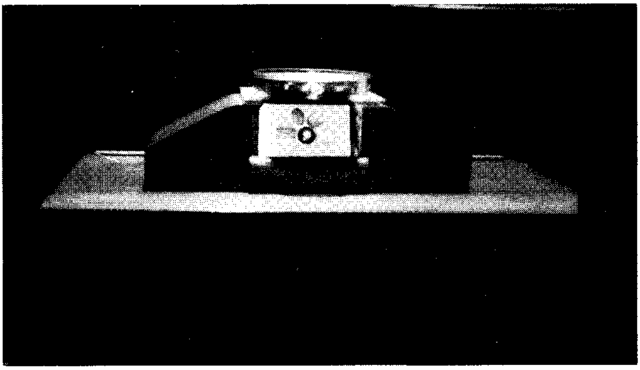

Figure 1

• **Recessed block of wood with mirror at 45° for showing varying contrast effects with immersed stones.**

and indeed quite beautiful results can be obtained. All that is needed is two cubes of wood or cardboard about three inches high and a wedge-shaped block of which the base and back are of the same dimensions as the cubes, having a third side sloping at 45° to these. On this sloping side is fixed a small mirror of the type used by ladies in their handbags, which can be procured from any "five and dime" store. The sloping block is placed between the two cubes with the mirror facing the observer, and a finely-ground glass screen is placed across the gap between the cubes, forming a bridge, with the ground side uppermost. The glass cell containing the liquid and the stone, or stones, is then placed centrally on the ground glass screen immediately over the mirror. If the whole set-up is placed immediately under the single overhead light (the higher the better), and the observer looks into the mirror he will see reflected the projection of the stones on the ground glass screen — making a very pretty and striking effect. As before, stones with a higher index than that of the immersion medium will show a dark border and bright edges to the facets while the reverse effect will be noticed with stones of low refractivity —but the phenomena are far more striking and emphatic than when viewed from above. *Figure 1* shows a modified one-piece wooden form of the apparatus described above, while *Figures 2, 3, and 4* will indicate the sort of effects visible in the mirror. These will be discussed more fully later.

If there is any reader who would like to try the method but lacks the time or the energy to make the suggested arrangements, he can rig the thing up on a temporary basis with the aid of a few books and any small mirror propped up between them at an angle of 45° by a lump of plasticine, or by leaning against another book recessed behind the others. Sheets of ground glass can be obtained very cheaply in any photographic supply store, but even here a sheet of tracing paper placed on a sheet of ordinary glass would serve as a temporary substitute.

On the other hand, those who are ingenious and enjoy making things will take pleasure in constructing a nicely-finished piece of apparatus, cut from a single block of some attractive wood about the size of a building brick, only rather taller. The wooden model shown in *Figure 1* was adapted from a simple form of dissecting microscope stand, and works admirably. A more elaborate form might incorporate a circular revolving tray accommodating half a dozen cells, each containing a different liquid, which could be swung in turn as required into position above the mirror.

It is a very easy matter to make a photographic record of these attractive immersion contrast effects simply by placing a piece of fine-grain film under the cell containing the immersed stones in a dark room and exposing

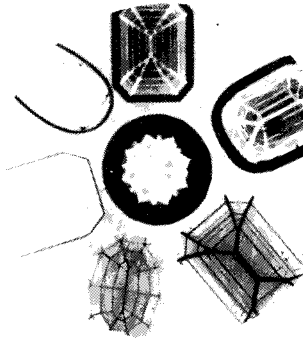

Figure 2

• **Orthoclase, quartz, beryl, topaz, spinel, chrysoberyl, and (center) zircon, immersed in cell of bromobenzene.**

for a second or two to light from an overhead lamp. If no photographic darkroom is available, this can be done in any room at night, or (in a room not entirely darkened) by using ordinary printing-out paper instead of film, and exposing for a longer time to the overhead light before development. In both cases a *negative* record will, of course, be obtained. Prints can be easily taken from the film, which will give a true picture of what is seen (or would have been seen) in the mirror arrangement. The paper negative must be used as it stands, merely remembering that the effects will be the reverse way round — light for dark and dark for light. Though, as stated, it is "very easy" to take these photographs, it is admittedly *not* easy to make the stones stay in the exact positions you wish them to be in, in order to form some sort of orderly pattern for reproduction. They have an infuriating habit of sliding across the base of the cell however carefully one inserts the film underneath it. Thus it is that the illustrations are not as perfect as I could wish. *Figures 2 and 3* show the same series of stones as seen when immersed in two different fluids. The stones are arranged clockwise in order of ascending refractivity, and are orthoclase (step-cut), quartz (oval), beryl (step-cut), topaz (oval), spinel (step-cut), chrysoberyl, and (in the center) a white zircon.

In *Figure 2* the immersion liquid is bromobenzene (1.56) and it will be noticed that there is a change-over from pale border and dark facet edges in the quartz to dark border and pale facet edges in the beryl in consequence. In *Figure 3* the liquid is bromonaphthalene (1.66) and the change-over will be seen between topaz and spinel in this instance. Notice also the increasing width of the pale or dark borders as the index becomes further and further away from that of the liquid. Notice, too, the diminished facet pattern in the heavily bordered zircon in *Figure 2*. Incidentally, by measuring the width of the zircon black border in the two cases and plotting them graphically against the refractive index of the two liquids, one can obtain a fair approximation of the value at which the border would have *zero* measurement, and thus gain a good idea of the re-

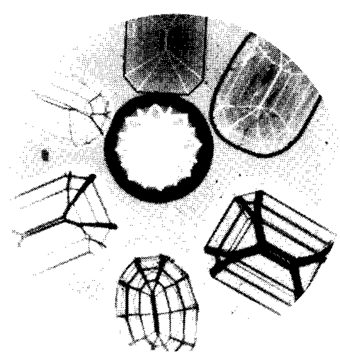

Figure 3

• **Immersion contact photograph of same stones as those used in *Figure 2*, but immersed in bromonaphthalene.**

fractive index of the stone without troubling about further immersions.

Actually, it was as a photographic technique that the general idea of the methods

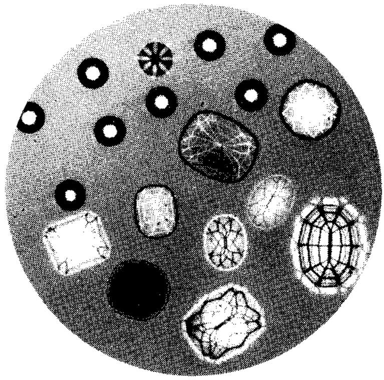

Figure 4

• Synthetic sapphirized rutile, seven zircons, sapphire, chrysoberyl, spinel, sinhalite, phenakite, spodumene, hambergite, tourmaline and quartz, immersed in cell of bromonapthalene.

outlined above was initially conceived.[1] It arose more or less accidentally from a desire to illustrate in an original fashion a short article written in collaboration with my colleague Robert Webster on curved bands in synthetic spinel.[2] I have since learned that Mr. E. J. Burbage, F.G.A., used contact photography of gemstones to obtain decorative effects many years ago, but his results were never published, as he had no scientific end in view.

Although for actual testing, the visual methods suggested would, of course, be more rapid and convenient, the photographic process has certain advantages. For one thing, it provides a permanent record—achieved without the use of any camera or special skill, of the exact size and shape of the stone, and, i. a suitable liquid, the disposition of the facets and even the presence and nature of any notable inclusions or flaws. One can not claim too much for highly refractive stones, such as diamond, no nearly matching immersion liquid can be found, and no record of the exact disposition of the facets can thus be hoped for when an immersion contact photograph, say in methylene iodide, is taken.

The contact immersion photograph reproduced in *Figure 4* was prepared more or less as a *jeu d'esprit* — for its decorative effect rather than with any serious scientific intent—but it does bring out one or two points rather well. The very different appearance of the sapphirized rutile among the seven zircons indicates how clearly a "stranger" can be spotted by this immersion method from a parcel of stones which are reputedly the same. The sinhalite and the phenakite, which can be picked out as the nearest above (dark rim) and the nearest below (pale rim) the immersion liquid, have a very different appearance because the sinhalite, being brown, absorbs strongly the blue and violet rays to which the slow film is mainly sensitive, and thus comes out dark in the photo. A panchromatic emulsion would put this right, but is more troublesome to handle.

For purposes of rigid control, monochromatic light, parallel rays, and other refinements could be pressed into service, but my present intention has been merely to introduce the general idea of the method, believing that it may prove a source of pleasure and occasional practical value to other gemologists.

1. B. W. Anderson, "Immersion Contact Photography," *Journal of Gemmology*, April, 1952.
2. B. W. Anderson and Robert Webster, "Curved Bands in Synthetic Spinel," *Journal of Gemmology,"* October, 1951.

More News of Synthetic Red Spinel

by

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The particular importance of the synthesis of minerals may be considered in the fact that an indefatigable human spirit of research succeeded in imitating nature's minerals by equivalent products of the laboratory. Being children of the 20th century and in view of continual new discoveries and inventions we may, therefore, scarcely be surprised at the news that a new synthetic stone has been produced—however unpleasant it may be for the jewelry trade. Yet, when a few months ago I was submitted some specimens of the first ruby red synthetic spinel cut from boule-crystals, I was greatly astonished.

Two years ago when I published a review[1] of the reasons why synthetic red spinel was not a commercial proposition, I was convinced that for the reasons explained therein a red spinel could never be produced by the flame fusion process of Verneuil. Half a year later G. R. Crowningshield and R. J. Holmes[2] described the most intriguing occurrence of a relatively large artificial spinel octahedron and a cluster of smaller crystals attached to a palladium disc. These papers and subsequent suggestions, passed on in private correspondence by B. W. Anderson, may be considered as the cause that promoted these latest successful experiments of making synthetic red spinel, so that in early summer 1952 the ruby red synthetic spinel as a product of the Verneuil oven has become a fact with which jewelers and gemologists will have to reckon in the future.

Still unannounced to the general trade is this new synthetic red spinel. It is so strikingly unusual that it would cause immeasurable confusion should it appear suddenly, and in quantity, on the gem market. Because synthetic red spinel has not been available in gem quality heretofore, it could be especially confusing to the uninformed jeweler. I believe, therefore, that it would be justifiable to give a report of my investigations on the first few stones which have appeared.

APPEARANCE

Six specimens of synthetic red spinel were submitted to me and hereafter I shall sometimes refer to all of them generally, or mention them singly in each case where they differ from each other.

The largest two specimens, No. 1 and No. 2, show a somewhat metallic purple-red color, which is particularly marred in specimen No. 2 by numerous cracks. Specimens No. 3, No. 4, and No. 5 are considerably better and display a good purplish red color. The finest of all is specimen No. 6 which excels in a most beautiful ruby red hue and, thanks to its brilliant cut, is very vivid and fiery. On the whole, all these synthetic red spinels resemble genuine rubies of poor to fine color rather than genuine red spinel. The synthetic counterpart so far entirely lacks the faint yellowish tint which gives genuine red spinel its brick red hue.

CHEMICAL COMPOSITION AND GROWING PROCESS

In my paper I explained in detail the conditions necessary for producing ruby red synthetic spinel and, alas, these have not altered. Thus, for obtaining ruby red color, it is imperative to prepare an equimolecular mixture of MgO and Al_2O_3 (ratio $MgO:Al_2O_3 = 1:1$) containing a certain well-balanced percentage of Cr_2O_3 as pigment. Purity of the raw material is of first importance, as it is essential for the crystal to be homogeneous.

Modern progress has made it possible to obtain raw material of the highest conceivable degree of purity, and the most precise proportion of mixture, to favor the synthesis of synthetic red spinel. Other factors of no less importance are the degree and constancy of the temperature of crystallization and constancy in the supply of material during the growth of the crystal. All these conditions must be realized within very close limits if the crystallizing process of the synthetic red spinel is to succeed.

Practical results have now confirmed the correctness of the theoretical considerations and their verdict in favor of synthetic red spinel. An important difficulty, however, existed in that the orthodox technique of Verneuil did not appear to lend itself to producing good quality single crystals, based on empiric knowledge that slight changes in the technique exercised great influence on the resulting product. A suitable adaptation of the process was investigated and applied.

CRYSTALLOGRAPHY AND X-RAY INVESTIGATION

The first boule crystals of ruby red synthetic spinel are of the well-known shape of a rounded, blunt-edged boule characteristic of synthetic stones grown by the Verneuil process. They are still not of the best quality as the boules are partly cracked and thus allow a few portions of their body only to be cut into flawless gems. Yet, each boule seen represented a single crystal whose structural lattice corresponded most precisely with the atomic lattice of natural ruby red spinel.

In order to establish comparison and knowledge on structural relationship between the earth-grown spinel and the man-made product, X-ray powder photographs of a natural ruby red spinel and a synthetic ruby red spinel were taken by W. Epprecht of the X-ray department of the Federal Laboratory of Research in Zurich. From the powder of each stone a Debye-Scherrer Diagram was made in a chamber with radius of 57.2 mm. with Cu-K-radiation. The two powder patterns (compared in *Figures 1 and 2*) proved to be identical, i.e., with respect to the position and number of lines as well as intensity of lines. For the purpose of exact characterization, the diagram of the synthetic spinel was precisely measured. The intensities, spacings, and indices of the interference lines are listed in *Table 1* and opposed to values found in competent literature.[3,4,5] This information reveals distinctly that the synthetic product is a definite spinel (coincidence of

Figure 1

• **Ruby red Synthetic Spinel**

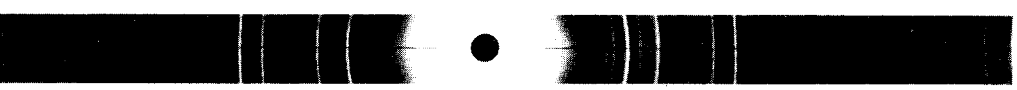

Figure 2

• **Ruby red Natural Spinel. Debye-Scherrer Diagrams, Cu-K-radiation; chamber radius 57-2 mm.**

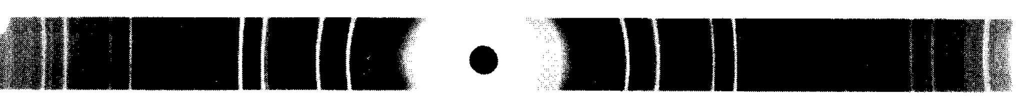

Figure 3

• **Gas bubbles. 75X**

sequence of lines and degree of intensities of the diagrams of both spinels with those found in literature on spinel). However, there are slight differences in the position of the lines between our two spinels and the values published in literature which may be due to the different lattice constants. With the object of exactly computing the lattice constants of the two spinels, two further powder photographs were made after NaCl was mixed with the spinel powder as indicator substance. The dimensions of the unit cell were found to measure:

Synthetic spinel: $a_w = 8.084$ Å ± 0.001 Å

Natural spinel: $a_w = 8.086$ Å ± 0.001 Å

Although the last decimal cannot be taken as absolutely certain (limit of deviation ± 0.001 Å), the difference in dimension of the unit cell of the two spinels is definite, since the difference of the lattice constants can be proved to be 0.002 Å, thanks to the indicator of rock salt, though the absolute size of the unit cell cannot be precisely defined. This difference of cell dimensions, however, lies within the limit of variation in natural spinels. In the literature, mention is made of the following values for natural Mg-spinels: 8.03 Å or 8.05 Å or even 8.059 Å [3,4,5]. The small difference of 0.002 Å, observed in connection with the present investigation, does not manifest any substantial difference between natural red and synthetic red spinel, nor does it offer any means of distinction between the two.

These X-ray powder tests, therefore, give definite substantiation that powder diagrams do not reveal any appreciable difference between the earth-born and the man-made red spinel, but that the synthetic product is a real spinel crystal with precisely the same crystal lattice as the natural stone.

PHYSICAL PROPERTIES

The results of the X-ray investigation led to the conviction that the physical properties of the synthetic red spinel most closely correspond to the genuine gem. Indeed, this expectation was fulfilled in almost every respect.

a. Specific gravities were determined by hydrostatic weighing in a semiautomatic Mettler Balance (in the U.S.A. called "Fisher Balance") using ethylene dibromide. The computations were corrected to water of 4°C. and the accuracy of each weighing was checked with a quartz of exactly known specific gravity. The results were at close proximity to the density of genuine red spinel and varied slightly within the limit of $S \frac{20°30'}{4°} = 3.579 - 3.598$. Details are shown in *Table II*.

b. Refractive indices were measured on an Abbe-Pulfrich total reflectometer, using a monochromatic light source (sodium light). Similarly to the specific gravity, they also showed slight variations from stone to stone, but kept within a min. of $n_D = 1.7191$ and a max. of $n_D = 1\text{-}7198$, thus coinciding very closely with those of natural red spinel. The findings of the single specimens are listed and compared with the variations of the specific gravity in *Table II*. It is conspicuous that variations of R.I. correspond to those of specific gravity (with the exception of No. 3) which probably must be ascribed to an inconstancy of distribution of pigment (proportional amount of Cr_2O_3) and it may be noted that the stones No. 5 and No. 6, with the highest data, display the most beautiful red hue.

c. The absorption spectrum shows quite good correspondence with the spectrum of the genuine gem; no distinct absorption lines are visible but broad absorption extends from 5950 Å to 4900 Å.

d. The U-V-fluorescence is dull red in short waves of 2500 Å and displays a brilliant glow of red under long waves of 3650 Å, more brilliant than the natural red gem and almost as brilliant as synthetic ruby. The fluorescence spectrum reveals a most remarkable pattern which reminds one very much of the fluorescence spectrum of ruby. While the genuine red spinel—quite unlike the ruby—produces a series of five lines of which the two strongest are at 6870 Å and 6750 Å, synthetic red spinel shows one particularly brilliant red and broad band extending from 6850 Å to 6900 Å accompanied by a very narrow and faint satellite red line at 6780 Å.

This difference from the fluoresence spectrum of genuine red spinel offers sufficient distinction to enable experienced gemologists to recognize the synthetic red spinel by this means.

MICROSCOPIC EXAMINATION

With the exception of the fluorescence spectrum synthetic ruby red spinel can, therefore, hardly be distinguished from the genuine gem, were it not for its most characteristic internal features which are of the highest diagnostic value. Of course, this new member among synthetic stones cannot deny its man-promoted origin and betrays itself, as it is to be expected, by the typical birthmarks of all synthetic stones.

While specimens No. 3, No. 4, and No. 5 reveal but tiny tension cracks and stone No. 6 is completely clean and flawless, specimens No. 1 and No. 2 yield the most instructive information in that, with respect to microscopic examination, both these specimens contain all the features which characterize synthetic red spinel.

The gas bubbles are neither of similar appearance nor shape as in ordinary synthetic spinels of the ratio $MgO: Al_2O_3 = 1.:3.5$ but resemble much rather those observed in synthetic corundum. The vesicles are either spherical or of some distorted, irregular form, elongated, bruised and occur even as so-called "tadpoles" *(Figures 3, 4, 5, and 6)*. Their size varies from ordinary dimensions to ultramicroscopic size, the former being rather evenly dispersed through the stone, while the latter accumulate into dense clouds *(Figure 7)*. In the stones that lie before me, the clouds are in broad parallel bands lying across the long axis of the boule *(Figure 8)*. Great was my surprise though to discover yet another interesting feature—not at all, or very rarely, present in ordinary synthetic spinel—which consists of the appearance of very distinct curved striae. These striae are either narrow *(Figure 9)* or broad *(Figure 10)*. Near the bottom of the boule they are more strongly curved, while towards the head of the crystal the radius of the curvature becomes longer. This occurrence of curved bands combined with gas bubbles may be most misleading to the uninitiated gemologist *(Figures 11 and 12)*, as he might take the stone for a synthetic red corundum at the first mere sight through the microscope. However, lack of dichroism and characteristic extinction will readily assist him to form the right judgment. Specimens No. 3-No. 6 do not contain any gas bubbles at all but still display the curved bands very markedly.

From a genetic point of view, the occurrence of gas bubbles similar to those in synthetic corundum and of curved bands, as well and as clearly designed as in synthetic red corundum, seems to reveal that conditions of growth are similar in both synthetic species. The strong obstruction of synthetic red spinel against formation has already been explained in detail[1], while on the other hand it is well known that synthetic red corundum "does not like to grow." It may, therefore, be considered a fact that growth lines (curved striae) prove difficult growth and the distinctness of their appearance is reciprocal to facility of growth, because the single layers resulting from the dripping molten drops of raw material intermix more or less readily.

Thus we may assume that readiness of growth increases from synthetic red spinel (very strongly marked striae) via synthetic red corundum (narrow, well-defined striations) over synthetic blue corundum (broad swashed bands) via synthetic yellow, pale-colored corundum (very faint bands) to colorless corundum and ordinary synthetic spinel of all colors (except red) where there are no, or very rarely, any bands. It is also most interesting to obtain another confirmation of the obvious fact that shape and appearance of the gas vesicle is to a certain extent influenced by the chemical composition of the host mineral's crystal structure.

EXTINCTION

It appears most instructive to observe that the extinction of synthetic red spinels seems to depend upon their internal perfection, because specimen No. 6, which is absolutely flawless, shows complete extinction. Within the stones No. 3, No. 4, and No. 5 anomalous, cloudy extinction is bound to the few cracks and their vicinity. In specimens No. 1 and No. 2, however, the extinction is most characteristic of anomalous double refraction by tension and is distinctly feathery in No. 2, while in No. 1 the pattern consists of broad bands which parallel the dense clouds of gas bubbles as well as the curved growth layers *(Figure 13)*.

CONCLUSION

May I express the hope that the reader will be warned by the foregoing account and know how to recognize a synthetic ruby red spinel should he ever come across one, if they should appear on the market in quantities in the future.

The production of synthetic red spinel is no necessity and it is to be hoped that the producers of synthetic stones will look upon this new achievement as the result of scientific study and technical development and leave it at that, being satisfied with the thought that new knowledge and experience on the genesis, genetic conditions, and other properties of genuine and synthetic stones could be gathered from it. It is definitely wrong to reproduce genuine gems by the synthesis, as is the case with all synthetic spinels. It would be much wiser and better to intentionally produce new colors and new stones, which would claim individual merit as being fully synthetic stones reaching an appreciated position of their own, excluding all danger of confusion with genuine gems. In this way the realm of the precious gems would not only be much more clearly separated from the sphere of synthetic stones, but the synthetic stone could be looked upon as a decorative product with its own special purpose.

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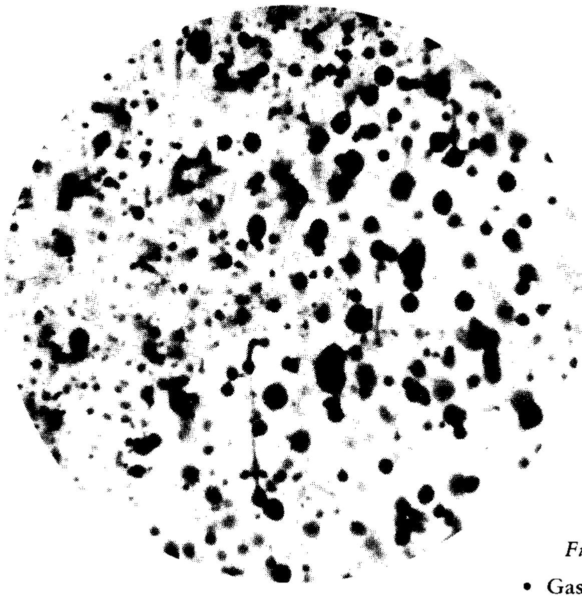


Figure 4

• Gas bubbles. 75X

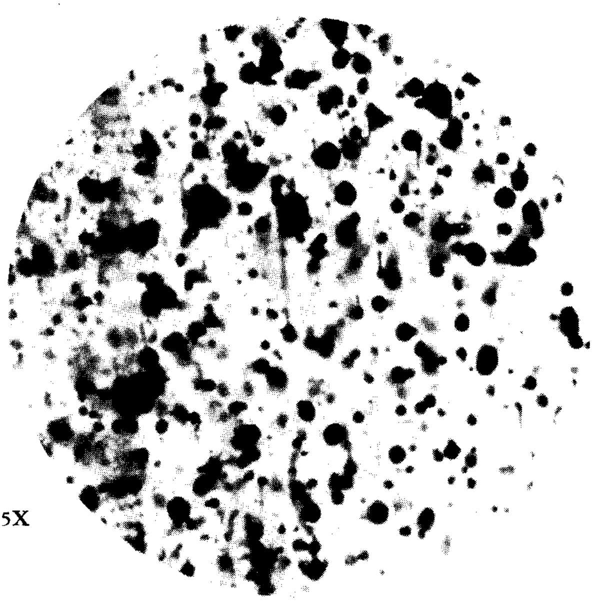


Figure 5

• Gas bubbles. 75X

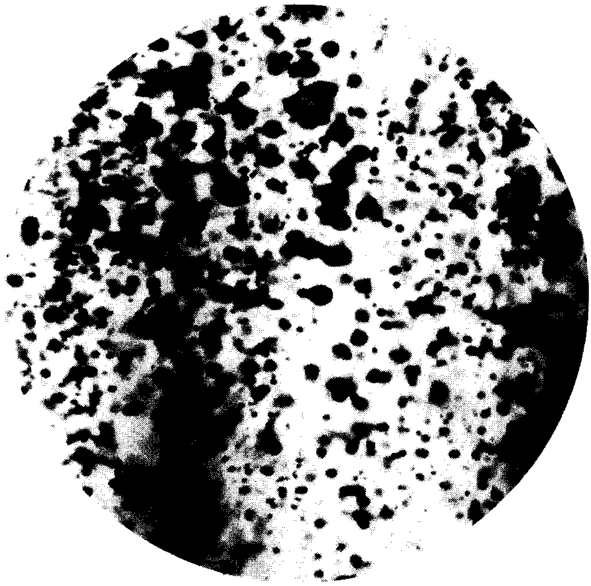


Figure 6

• Gas bubbles. 75X

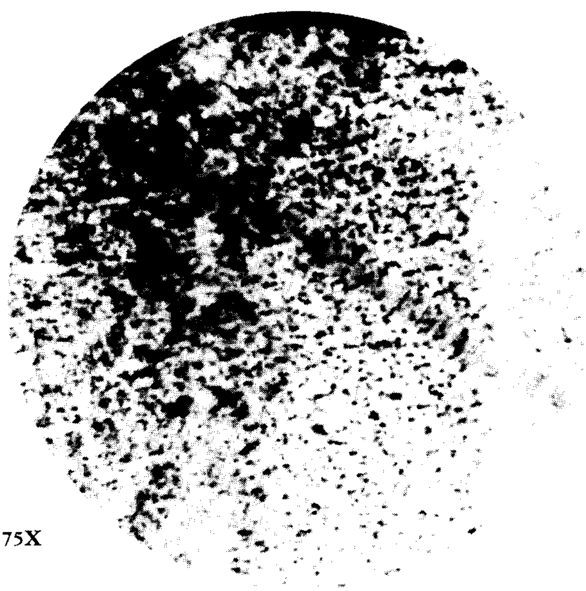


Figure 7

• Dense cloud of Gas Vesicles. 75X

Figure 8

• Dense cloud of Gas Vesicles. 75X

Figure 9

• Curved Striae (growth layers). 75X

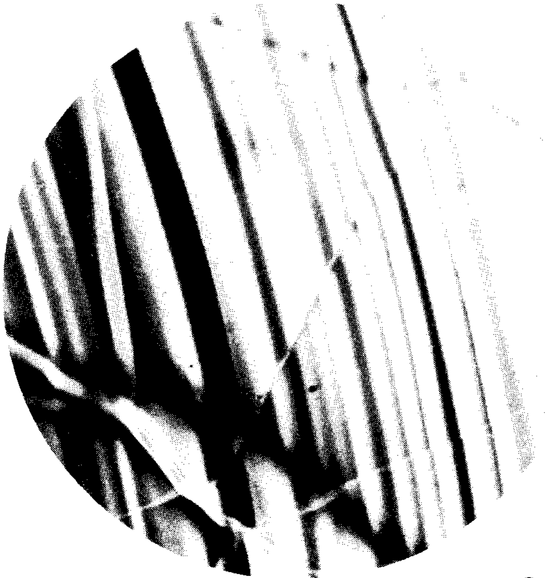


Figure 10

• Curved Bands (growth layers). 75X

Figure 11

• Gas Bubbles and Curved Striae. 75X

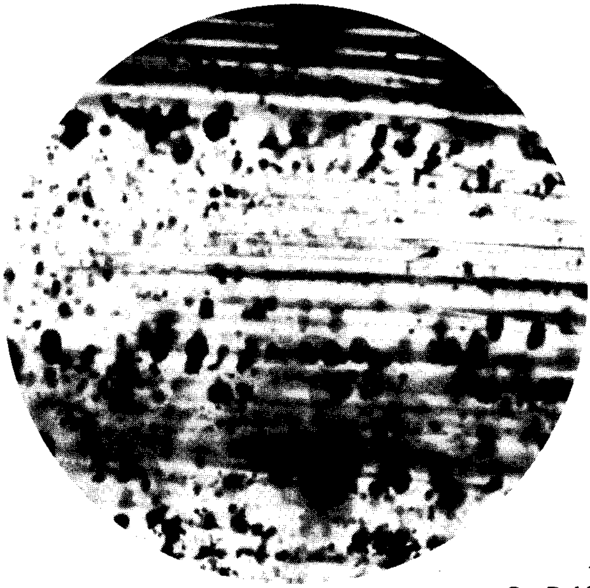


Figure 12

• Gas Bubbles and Curved Striae. 75X

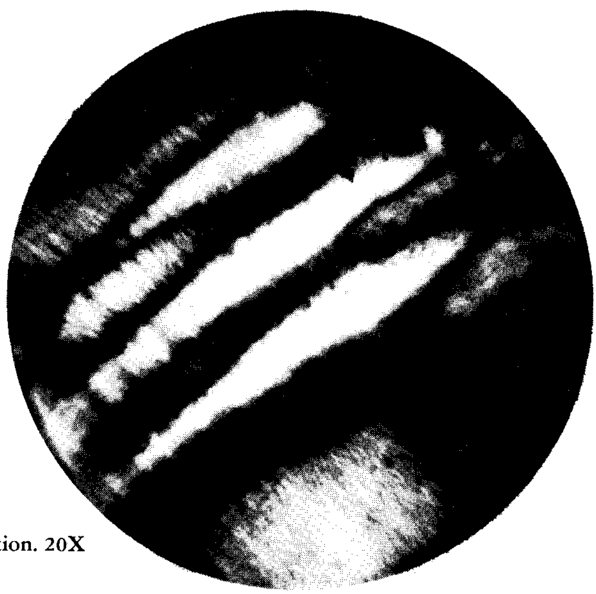


Figure 13

• Anomalous, banded extinction. 20X

TABLE I

POWDER DIAGRAMS OF SPINEL

Synthetic Spinel			Values according to competent literature	
Intensity	**Spacing**	**Indices**	**Intensity**	**Spacing**
mw	-	β - 111	-	-
m	4.64	α - 111	m	4.60
w	-	β - 220	-	-
m	2.846	α - 220	m	2.83
m	-	β - 311	-	-
vst	2.426	α - 311	st	2.42
w	-	β - 400	-	-
mst	2.013	α - 400	st	2.00
w	-	β - 511,333	-	-
vw	1.645	α - 422	w	1.638
w	-	β - 440	-	-
mst	1.551	α - 511,333	st	1.545
st	1.425	α - 440	st	1.420
vw	1.363	α - 531	w	1.360
ew	-	β - 444	-	-
ew	1.275	α - 620	w	1.271
m	1.231	α - 533	wm	1.226
ew	1.220	α - 622	w	1.211
m	1.164	α - 444	m	1.162
vw	1.130	α - 711,511	w	1.127
vw	-	β - 800	-	-
w	1.079	α - 642	m	1.075
m	1.052	α - 731,553	mst	1.048
vw	-	β - 751,555	-	-
mw	1.009	α - 800	m	1.006
vw	-	β - 840	-	-
vw	0.953	α - 822,660	w	0.947
ew	-	β - 931	-	-
m	0.933	α - 751,555	m	0.929
w	-	β - 844	-	-
wm	0.904	α - 840	w	0.899
vw	-	β - 951,773	-	-
ew	0.862	α - 664	vw	0.862
m	0.848	α_1 - 931	w	0.843
mw	0.848	α_2 - 931	-	-
mst	0.826	α_1 - 844	m	0.821
m	0.826	α_2 - 844	-	-

st - strong
m - medium
w - weak
vw - very weak
ew - extremely weak

TABLE II

Details of the Physical Properties of Synthetic Red Spinel

Specimen	Cut	Color	Weight	Sp.g.	R.I.	Extinction	Internal Features
No.1	Square	Purple red	2.00ct.	3.585	1.7196	Strongly anomalous. Texture banded.	Banded clouds of tiny single bubbles, curved striae.
No.2	Emerald	Light purple red	1.60ct.	3.585	1.7196	Strongly anomalous. Texture feathery.	Large cracks, dense cloud of minute bubbles, curved striae.
No.3	Baguette	Purplish red	.72ct.	3.593	1.7191	Faintly anomalous. Texture feathery.	Two long cracks, curved striae.
No.4	Baguette	Purplish red	.56ct.	3.579	1.7191	Complete, only faintly cloudy in vicinity of fissures.	Two thin small fissures, curved striae.
No.5	Baguette	Purplish red	.76ct.	3.595	1.7198	Complete, very faintly feathery, brightening in vicinity of fissures.	Several thin fissures, curved striae.
No.6	Brilliant	Ruby red	.37ct.	3.593	1.7198	Complete	Flawless, curved striae.

• The House of Jewels is in the Tower of London.

Amid Ancient Pageantry A Modern Queen is Crowned

By KAY SWINDLER

Early in this year, in the United States of America, a man elected by popular choice to lead his country through what may well be turbulent days asked, unceremoniously, for the guidance and help of a Supreme Power in discharging his obligations to the citizens of this land, and those other lands over the world bound together by a universal brotherhood of free men.

For many reasons, and with mingled feelings, the eyes and ears of the world will again on June 2, 1953, be focused on a charming, poised young matron who will on that day be solemnly crowned in traditional pageantry as Elizabeth II of England.

To serious-minded peoples everywhere this ritual will mean more than a repetition of medieval rites associated with the bestowing of power on an earthly monarch. Reaching far back into the distant ages for its pattern and inspiration, this magnificent ceremony had its beginning in the belief that God's selection of an earthly representative, ordained to lead His people along the paths of right, had absolute and binding obligation. So Dwight D. Eisenhower, 33rd president of the United States of America—and the fair young queen of England—acknowledge, each in his or her own way, the serious nature of the office entrusted to them, and embark upon their magnitudinous responsibilities with a humble request for Divine aid.

The ceremony of the English coronation is, and always has been, a deeply religious ritual. It is in reality the supreme expression of religious fealty. The act of crowning itself is administered by the highest official of the Church of England and the entire ceremony is filled with prayer and religious significance, some of it extending back to the original ceremonies used in crowning ancient kings of Israel.

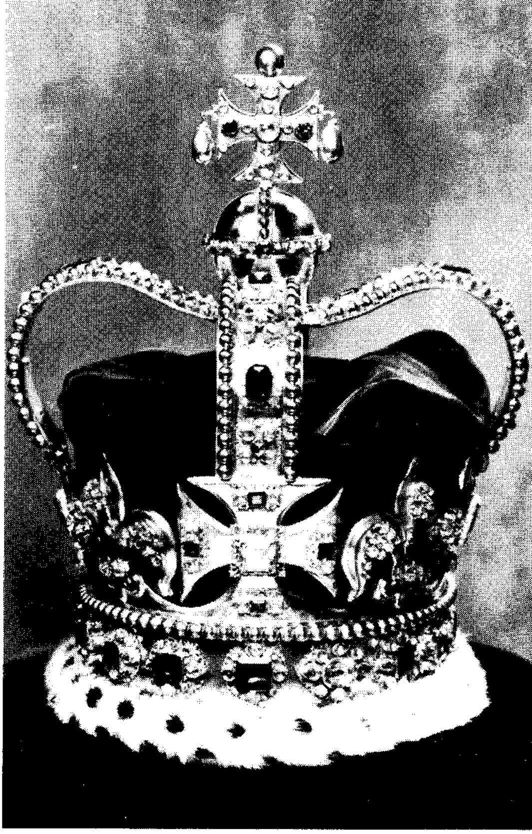
True, its outward manifestations employ some of the most fabulous items of material worth existing in the world, but these too become symbolic of a blended past and present—from which human errors and a constant reaching toward idealistic goals have brought a greater understanding of man's relation to man, and a realization of his obligation to the world and his Creator.

Our readers will be more interested, perhaps, in the magnificent jewels whose worldly value it is impossible to compute—and which play such an important role in the ceremony itself—as they appear briefly in the coronation of the young queen.

Unfortunately, it is not possible to show these famous gems and hallmarks of British sovereignty in all the magnificent beauty of their natural color and brilliance. Since the writer was privileged to view replicas of the English regalia at its only showing in this country, she is more cognizant than before of the inadequacy of words to describe its superb and colorful beauty—and the great loss of that beauty through black and white reproductions. We shall, however, try to give our readers a word picture of the more important items as best we can.

Although crown jewels have played a part in the history of a united England and the ordaining of its sovereign heads since, at least, Athelstan (ruled 924-40), the British regalia as it exists today—with the possible exception of the Ampulla—is less than 300 years old.

Histories of the famous gems which emblazon the regal pieces of the House of Windsor, however, extend back through the ages into an unknown beginning, their story of conquest—hope—achievement—glory—and bloodshed mutely buried in the internal depths of intense color and dazzling brilliance. We shall give a brief glimpse into the pasts of a few of the best-known of these romantic gems later in this article.



• St. Edward's Crown.

Destroyed during the Commonwealth, the most important of the crown jewels of England were replaced by Sir Robert Vyner for the coronation of Charles II in 1661. Before the regalia was broken up and sold by members of the House of Commons, a complete inventory was made and each article itemized. Total value recorded (1649) is given as 2,647 pounds, 18 shillings, 4 pence. The Royal Treasury in 1662 paid Sir Robert

21,978 pounds, 9 shillings, 11 pence for creating two crowns, two sceptres, the orb, St. Edward's staff, and "the Armilla; the Ampull."

Due to the effort made at that time to duplicate, as nearly as possible, the royal treasures which had been destroyed, old drawings showing the early Spurs, St. Edward's Staff, and the Sceptre with Dove reveal only slight differences between them and those which will be used at the June coronation of Elizabeth II. From existing cuts of the historic symbols of early English sovereignty, Sir Robert also patterned the crown, used since 1661 (with the exception of in the coronation of Queen Victoria), after the one used by the last of the Saxon kings, Edward the Confessor, and it is still known as "St. Edward's Crown."

ST. EDWARD'S CROWN

Although St. Edward's Crown is the greatest in symbolism of all the crowns of Great Britain, it offers the least in artistic beauty as it was created when art was at an extremely low ebb in England. Besides having little to offer in the way of artistic merit, the crown is exceptionally cumbersome and heavy, having been made when wigs were generally worn, and weighs (according to various authorities) somewhere between five and seven pounds. The stones mounted in the crown are of little material value as they are of poor quality, and badly flawed. Nothing has been added to any inherent beauty the stones might possess since our modern methods of revealing brilliance through scientific cutting and polishing were unknown to the Royal Court Jewelers in those days.

However, to Englishmen everywhere, the significance of this crown is far more important than is the mere worth of the materials used. It is the symbol of centuries of national greatness—the crown of the realm. *It is the Crown of England!*

St. Edward's Crown is fashioned of a heavy rim or circlet of gold decorated by diamonds. Around the rim, arranged alternately, are four crosses patee and four fleur-de-lis—designs traditional with the crown jewels of England—each adorned with diamonds, emeralds, rubies, and sapphires.

Two complete arches, edged with silver pearls, connect the crosses and are further decorated with clusters of diamonds and other precious stones. These arches are the signs of heredity and independent monarchy and the depression where they cross at the top indicates a royal—rather than imperial—crown.

At the intersection of the arches is mounted an orb, or globe, of gold which is circled by a fillet of more gemstones. A final cross tops the golden orb and at its top is a large spheroidal pearl with pear-shaped pearls hanging from the side arms of the cross.

Patterned after the crown of St. Edward the Confessor, a good ruler and holy man of the 11th century, this crown has played an important role in the life of each British monarch (with the exception of Victoria) since 1661—but only for the brief moment when it is placed on the royal head as he or she is proclaimed king or queen of England by the Archbishop of Canterbury. On all state occasions thereafter the Imperial State Crown is worn.

IMPERIAL CROWN OF STATE

Although little more than a century old, there is perhaps no crown in all the world today which exceeds in beauty or richness of historic gems, England's Imperial Crown of State. This includes those crowns which still exist, most of them only as relics of countries once headed by a ruling monarch.

Fashioned in its present form in 1838 for the young Queen Victoria, and used as the instrument of coronation, it is the crown which has again been selected by Elizabeth II for her coronation rites on June 2. The present Crown of State weighs only 39 oz. 5 dwt. in comparison to the several pounds of the ponderous Crown of England.

The Imperial Crown of State is the crown which is worn at the opening of Parliament and other important state occasions. It is also the crown which rests on the bier of the sovereign after death. It is regarded, more or less, as the personal property of the ruling monarch and may be changed to satisfy his tastes, or the fickle whims of fashion. Latest news from London reveals that the crown has been taken from The Tower and changes are now being made by the crown jewelers. The same jewels will be replaced in the refashioned crown with only such minor changes made as tightening the band and bending the arches inward so that it may appear less lofty and heavy-looking.

In the British State Crown are seen the imperial arches which are not depressed at their joint meeting as are those of the royal St. Edward's Crown. Although the crown is comparatively young in years, many of its gems are famous for their long and violent histories. In addition to the several historic gems, which we shall later describe, the following lesser stones are used in the beautiful designs of the crown: four rubies, 11 emeralds, 16 sapphires, 277 pearls, and 2,783 diamonds which represent every kind of cutting.

In the center front of the gem-encrusted silver circlet with its light, airy filigree construction is the second largest stone cut from the famous Cullinan diamond—weighing 317 metric carats. Directly above the pearl-bordered rim, in the center front, is the historic Black Prince's "Ruby" mounted in a cross patee of brilliant diamonds. Emeralds are used in the centers of the other three crosses of the crown. Rubies center the traditional fleur-de-lis topping the rim at alternate positions with the crosses. The arches themselves are thickly covered with diamonds and pearls while the large egg-shaped pearls at the intersection of the arches were once the earrings of the first Queen Elizabeth according to Tower tradition.

The orb is solidly overlaid with diamonds as is the cross above in the center of which is a sapphire of magnificent color, said to have once been mounted in the ring of Edward the Confessor. In the center back of the rim is mounted the great Stuart Sapphire which once held the spot of prominence now given to the Star of Africa diamond.

The Crown's very lightness of weight played into the scheme of the unscrupulous Colonel Blood who in 1671 made a bold attempt to steal the Crown Jewels from their seeming place of safety in the Tower. Because of this lightness and delicacy of workmanship, he was able to crush the fragile Crown with a mallet and conceal it in a special bag carried under his purloined clerical robes.

THE STUART SAPPHIRE

Little is known of the early history of the Stuart Sapphire although it is known definitely to have been among the royal gems which accompanied James II, last of the Stuart kings, in his hasty retreat to France. It is possible the stone was once owned by Charles II but only conjecture gives it an earlier place in the troubled past of the Stuart family. When the Stuart cause was conceded lost by the deposed defendants of Mary, tragic Queen of Scots, it was left by Cardinal York, son of the Old Pretender, to George III and has since maintained a prominent place in the Imperial Crown of State.

THE BLACK PRINCE'S RUBY

More often discussed—and more frequently questioned—than any of the famous royal gems is the famous "ruby" of Edward, the Black Prince, hero of Crecy and Poitiers. Discovery that the stone was really a spinel, rather than the more valuable ruby, was made when an inventory was taken by the Commonwealth at the time the Crown Jewels of England were broken up and sold. Its adventurous history, ancient age, and long association with affairs of the British kingdom, however, endeared the stone no less in the hearts of Englishmen and it still retains its very prominent position in the center cross of the Crown of State.

First recorded history of the ruby places it among the treasures of the Moorish King of Granada who, in 1367, was murdered in cold blood by the King of Castile—known as Don Pedro the Cruel—to obtain the stone, along with other valuable booty. In that same year the dashing Black Prince—then Duke of Aquitaine—was given the stone by the treacherous Spanish king in recognition of military services rendered by the English forces. A description of this battle is given by Sir Conan Doyle in his *White Company*.

It was while fighting the battles of the ignoble Don Pedro that the Black Prince—so named because of his black armour—contracted the fatal disease resulting in his death, and the ruby passed on to his son who became Richard II.

It is said that the ruby was worn on the helmet of Henry V at the great Battle of Agincourt. Dressed in magnificent armour and helmet of gleaming gilt topped by a crown heavily encrusted with rubies, sapphires, and pearls, the great ruby blazed forth as the most splendid of all this rich ostentation. In a duel of mortal combat part of the king's crown was shorn away by a crushing blow from the battle axe of the great Duc d'Alencon, but the glorious ruby remained untouched by the somber drama.

Severe historians give no credence to further adventures accorded the stone by more imaginative writers and, perhaps, it merely indulged in a few hundred years of well-deserved quiet resting among the Royal Regalia, meditating on past experiences and spurious glories. Commenting on the dramatized account of its adventures with Richard III at the Field of Bosworth, Sir George Younghusband comments, "According to the well-known story, when the tide of battle turned against him, Richard, who had worn his crown throughout the day, though probably behind a safe barbed wire of knights, was seized with panic, and to ensure a less conspicuous retreat, took off his crown and hid it in a hawthorn bush. There some unlucky underling, doubtless in quest of loot, found it in good and appropriate season, so that the victorious army was through its appointed leaders enabled to crown there and then, amidst the dead and dying, Henry VII, King of England. Let us hope that the great ruby was in the crown on this historic occasion."

Whether it was present on this important date or not it was, at any rate, still a part of the royal jewels when Parliament—furious with the caprices of kings and weary of crowns—disposed of the lot in 1649. Along with other royal gems, the ruby of the Black Prince is described in the record of the sale in this manner: "To one large ballas ruby wrapped in paper, value £4." What an ignominious end for such a proud and haughty gem! The name of the purchaser remains unknown but Younghusband again comments, "Perchance even it passed by favor to a fair lady beloved of a Roundhead." True or not, it was somehow preserved and reset, still intact, in the crown designed for the Restoration.

At the time of the great Tower theft of the Crown Jewels, in smashing the Crown of State the ruby was dislodged from its setting. However, it was later recovered from the pocket of one of the fleeing accomplices of the nefarious Colonel Blood.

The last recorded adventure of the ruby finds it hidden for safety's sake from the aerial bombardments of World War II while three bombs fell on or near the Tower precincts.

Apparently no change has been made in the stone through the long years of its history. Irregular in shape and nearly two inches long, it once had a hole drilled through one end for hanging as a pendant, no doubt, or attaching to the hats of its royal owners. This hole has since been filled in with a small ruby. The stone is only roughly polished, as was customary in the Middle Ages, and this could easily indicate that it was at one time among the treasures of ancient Oriental princes where it may have had an even more bloody history than that in its recorded past.

Today, unchanged, it remains as one of the greatest national treasures of England and will again appear in all its proud glory

• Great Britain's Imperial Crown of State.

on the day Elizabeth II is crowned Queen of England.

ST. EDWARD'S SAPPHIRE

In contrast to the violence and intrigue typifying the adventures of the Black Prince's Ruby, the legendary history of St. Edward's Sapphire places it in a reverse setting with a past full of holiness, mysticism, kindly actions and deeds of generosity.

The stone which today graces the center of the top cross patee of the Imperial State Crown is said once to have been mounted in the Coronation Ring of Edward the Confessor, holy Saxon monarch who was crowned in 1042. Edward—called the Saint-King, having been canonized in 1161—is described as a fair and gentle man credited with having healing powers in his slender and almost transparent fingers.

One of the quaint legends which is associated with this ancient gem is delightfully told by Caxton, first English printer. Approached one day by a fair old man asking alms in front of a church in Essex called Havering, the good King Edward, having no money on his person, gave the frail old man his ring, in which was mounted the beautiful sapphire. Years passed and two English pilgrims, seeking religious relics in the Holy Land, lost their way at nightfall. Not knowing what to do or how to protect themselves from savage beasts native to the region, they suddenly saw in the distance a company of men clothed in white, followed by a saintly man with snowy hair. The two pilgrims hurriedly approached the group and when they introduced themselves to the leader he inquired of their good king and asked them to deliver a message and gift to their monarch on their return to England. Then stating, "I am John the Evangelist . . ." the old man and his company "departed from them suddenly." When the gift was received by King Edward he discovered his own ring with the beautiful sapphire, presented years before to the seeker of alms.

The story of the history of St. Edward's Sapphire further relates—and is to some degree authenticated by old drawings—that in 1102 the coffin of Edward was opened and the ring removed from his well-preserved finger. It was accordingly deposited as a holy relic and is said to have been responsible for miraculous cures of various diseases.

If the present stone is indeed the one removed from the tomb of Edward the Confessor, it has been refashioned for it is now a rose-cut gem described as flawless and of good color. It is regarded as one of the oldest and most valuable gems in the British Regalia.

EARRINGS OF ELIZABETH I

Although it is only tradition which identifies the pearls suspended from the intersection of the arches of the Crown of State as having once belonged to Elizabeth I, the story of how they happened to be placed there is authoritative.

King Edward VII in assuming the duties of kingship after the death of his mother, Queen Victoria, ordered an inventory of contents in the royal palaces. Among the jewels were four large pearls which had always been regarded by the royal family as earrings of the Tudor queen who had an inordinate fondness for these gems. They were placed in the royal crown at the request of Edward VII.

THE SCEPTRE WITH CROSS

Perhaps the most ancient of all the emblems of royalty is the sceptre—two of which play an important role in the coming coronation. Certainly there exists no more beautiful example of this ancient kingly symbol than the Sceptre with Cross — signifying power and justice—which the sovereign of England holds in the right hand during the act of crowning.

Although the English Sceptre with Cross was also created in 1661 by Sir Robert Vyner, several changes have been made since that time, most notable of them the addition of the great 530 carat Star of Africa—largest of the several stones cut from the famous Cullinan diamond which weighed 3106 carats in its original form.

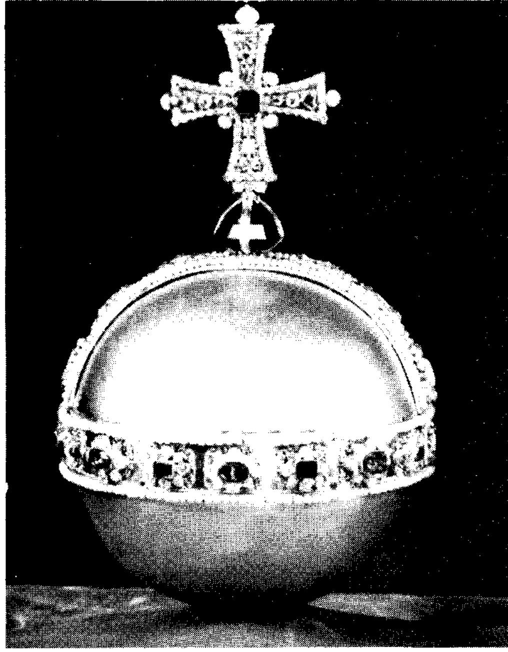
This golden sceptre measures about three feet and its lower tip is richly ornamented with clusters of gems, and sprays of enamel and gold. It is really the top of the sceptre, however, which lends a magnificence unsurpassed o this royal emblem of power. Although amethysts are no longer regarded as rare, the large amethyst orb was placed in the sceptre during a period when these stones were costly and much in demand. Even now its deep purple brilliance lends a striking contrast to the flashing fires of the great Star of Africa diamond suspended beneath it. Cross arches and bands of gems encircling the large purple sphere are studded with diamonds and rubies, mounted in gold. The emerald centered in the cross patee above the orb is thickly surrounded by diamonds.

Although the Sceptre with Cross is used only at a coronation and at the funeral of a monarch, the Star of Africa—known in this country as Cullinan I—is detachable and may be worn as a pendant on great occasions of state.

The 3106 carat rough Cullinan diamond crystal — largest diamond ever recovered — was presented to King Edward VII in 1907 by the Transvaal government. After it had been cut into the four magnificent stones which are now a part of the British crown jewels—and 101 lesser stones—it was the king himself who suggested that the most gorgeous of all cut diamonds should be placed in the royal sceptre.

THE SCEPTRE WITH DOVE

The second sceptre used in the crowning of British monarchs is sometimes referred to as the "Rod with Dove" and was also created by Sir Robert Vyner and closely patterned after the one used in the ceremonies of ancient British coronations. It exceeds in length approximately one half foot the jeweled sceptre and signifies equity and mercy, being held in the left hand of the king during the coronation ceremony. The dove, which tops the elaborately enameled and bejeweled staff of the sceptre, typifies the Holy Ghost who is traditionally believed to guide the action of kings. The dove is fashioned of white enamel with feet, eyes,



• The Orb.

and beak of gold while the orb beneath is studded with diamonds.

JEWELED SWORD OF STATE

Regarded as the most beautiful and valuable sword in the world, England's Jeweled Sword of State was made for George IV. Diamonds, sapphires, rubies, and emeralds are richly woven into designs portraying the rose of England, the thistle of Scotland, and the shamrock of Ireland. During the ceremony it is girt about the new monarch who then places it on the altar in homage to the Church. It is later redeemed and carried naked before the king during the remainder of the ceremony.

THE ORB

The orb represents the earth, a part of which is to be ruled by the new monarch, and is carried in the left hand as he or she leaves the Abbey after the coronation ceremony. It is representative of independent sovereignty under the cross of Christianity. If of Roman origin, as believed, the cross was no doubt added to the design after the Romans had rejected their pagan deities.

Actually there are two royal orbs among the crown jewels of England, the second smaller and less ornate one having been made for the crowning of Mary II who ruled jointly with William. The larger one, which will be used for the coronation of Elizabeth II, measures six inches in diameter. As in the jeweled sceptre, a very fine amethyst supports the diamond encrusted cross centering a blue sapphire. Pearls, emeralds, diamonds, rubies, and sapphires are blended into a colorful band and arch girding the golden sphere.

THE AMPULLA AND SPOON

While these two implements of coronation are the least ornate of any used, they have the greatest religious significance of any in the ceremony. Actually placing the crown on the royal head is regarded as the act which makes the Sovereign king of England but the act of anointing is, from a religious point of view, the most significant in the entire ritual. Not until the sacred oil has been applied "in the name of the Father, the Son, and the Holy Ghost" may the monarch be vested with his royal ornaments of power. The anointing ceremony takes place immediately after the king has taken the Oath.

This royal unction in the crowning of kings extends far back into history and was used by the prophet Nathan and Zadoc the Priest in anointing Saul, the first king of the Jews.

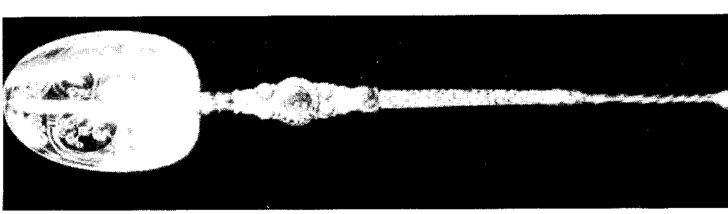
The Ampulla, in the form of an eagle standing about nine inches high with a wing stretch of seven inches and weighing 10 ounces of gold, is the container for sanctified oil with which British monarchs are anointed. The eagle is so constructed that its hollow center may be filled by removing the head. The oil is then poured through the beak of the bird into the golden spoon which has a ridge down the center, dividing it into two parts. Into this spoon the Archbishop of Canterbury dips two fingers, and with them anoints the king with the sign of the Cross.

Although devoid of precious stones—with the exception of four pearls in the handle of the spoon—these vessels of the ritual of holy unction are perhaps the oldest among the royal treasures of England. The handle of the spoon appears to be of Byzantine design, beautifully chased, and is about seven and one half inches long. It is not believed to have been a part of the regalia prior to the Restoration but, more likely, a sacred vessel overlooked within the Abbey when Oliver Cromwell took over the reins of English government.

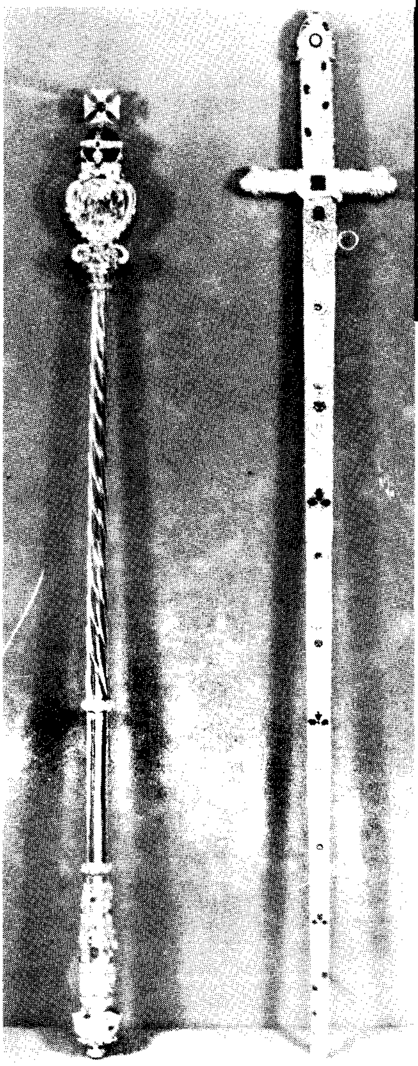
The Ampulla, or container of the holy oil, is regarded as of great age and was probably also saved from destruction by being housed in the Abbey rather than the Tower during England's Civil War. It, too, has a legendary history which goes back to the time of Thomas á Becket. Praying one night in a church at Sens, France, the banished á Becket—or so the story goes—received a visitation from the Blessed Virgin who presented him with the golden eagle and a small vial of celestial oil. At the same time she instructed him to conceal them until a true champion of the Church should be chosen to rule over England. This legend is depicted in the medieval stained glass windows of the Cathedral of St. Etienne at Sens.

The legend further relates how the eagle

• The Spoon.



• The Ampulla.



• Sceptre with Cross and Jeweled Sword of State.

and its sacred anointing oil lay hidden for almost 200 years until its hiding place was revealed to a holy man during a dream. Here the Black Prince again enters the legendary history surrounding the royal regalia as it is said the oil was presented to him as next in royal lineage. Since he did not live to be king of England, and his son was only 10 when crowned and did not know of its existence, the oil was first used in the crowning of Henry IV who made much ado over the fact that he was the first king of England anointed from the holy vessel delivered to St. Thomas by Our Lady.

When on January 20, 1953, an invisible crown of responsibility, humility, and courage settled firmly on the proud head of Dwight D. Eisenhower, millions silently voiced a fervent prayer of "God Help the President." Likewise, on June 2 of this same eventful year, as the heavy crown of the ancient kingdom of Britain is reverently placed on the comely head of Elizabeth II and the lofty corridors of the Abbey swell with rejoicing, millions will join the fanfare of ancient homage in a solemn supplication to the Supreme Ruler—"God Save the Queen."

Gemological Digests

DEATH TAKES PIONEER OF DIAMOND INDUSTRY

Alpheus Fuller Williams, honorary member of the Educational Advisory Board of the Gemological Institute of America and one of the well-known authorities of the diamond industry, died at the age of 78 at his home on The Cape, South Africa, early last month.

Although he spent more than half a century in South Africa, he was born in Oakland, California, and studied at Cornell and the University of California before joining his father, then manager of the De Beers Consolidated Mines, Ltd., in Kimberley.

A graduate engineer, Alpheus Williams first served the De Beers Company in that capacity, being promoted to the position of Asst. General Manager during the following year. Six years later when his father, Gardner Williams, retired from his managerial position, the son followed in his footsteps.

During the 26 years of his valuable and loyal service as manager of De Beers, some of the greatest and most important developments in the diamond industry—as well as in the political history of South Africa—took place. These experiences, coupled with the knowledge gained from long and intimate associations with others during these years, are recorded for posterity in his great book, *Some Dreams Come True,* which was published in 1949. His first book,—a work of monumental scope in two volumes — *The Genesis of the Diamond,* published in 1932, established his great geological reputation.

No worthy cause was without the support of Alpheus Williams and much credit is given him in his chosen country for his untiring support of civic and industrial improvements, as well as for his eagerness to be of help to others. During the siege of Kimberley some 3,000 women and children

• Alpheus F. Williams.

deep in the mining galleries of the Kimberley and De Beers Mines. When war again came to the world, Alpheus Williams was made Director of Ambulance and was later responsible for the training of hundreds of men and women who afterwards joined the South African Army during World War II. were safely housed by him and his father

After his retirement as manager of De Beers Consolidated Mines, Ltd., in 1931, he organized a structural steel business which he operated in Johannesburg with his four sons. He had many hobbies, some covering such diversified fields as bird fancier, photography, and scientific research. He owned one of the finest collections of colored diamonds in the world.[1] The collection was originally owned by his father but Alpheus Williams started to add to it in 1899 and during his lifetime it was supplemented with many additional stones of scientific importance.

[1] Color plates of a portion of the Williams collection of colored diamonds were a part of the Summer 1947 issue of **Gems and Gemology.**

Gemological Digests

SECOND LARGEST SYNTHETIC STAR RUBY CREATED BY LINDE AIR PRODUCTS COMPANY

Late in 1952 what is believed to be the second largest synthetic star ruby ever produced was created in the laboratories of the Linde Air Products Company. The stone, which weighs 82.93 carats, is believed by scientists of the company to be one of the finest they have produced to date but they admit they have no explanation as to how or why these large sized gems occur, stating, "They just happen under certain ideal, unpredictable conditions."

Like other Linde-made stars, this new gemstone which has been named "Columbus" by newspaper, TV and radio personalities who have examined it, is physically, optically, and chemically identical to earth-mined star stones.

Linde in 1947 created the world's largest known synthetic star ruby which weighs 109.25 carats and is now exhibited in the American Museum of Natural History, New York City. The largest natural star ruby—the famed De Long Star—which weighs 100 carats is also the property of the American Museum.

Book Review

GEM CUTTING *by J. Daniel Willems, 2nd edition. $4.50. Charles A. Bennett Co., Inc., Publishers. 218 pp. including 85 figures consisting of photographs and drawings; eight tables of data pertinent to the subject; nine excellent plates showing lapidary equipment and its operation; and 33 cuts detailing the procedure of fashioning from a piece of rough material to a finished gemstone. Reviewed by James Small.*

Dr. Willems is well-qualified to write this book for the hobbyist cutter, as he has experienced the progression of his hobby from a rock collector to cabochon cutter to faceting gemstones, and has also designed faceting equipment. This book progresses in the same way with the presentation simple enough for the newly interested hobbyist to acquire a good basis for the progressive work covered in the remainder of the book.

Gem Cutting was first published four years ago. Its enthusiastic reception, plus the steadily growing field of hobbyists, have made it necessary to bring out this second edition. In this new edition, there is some clarification of the text, as well as improvement in some of the drawings. In addition, 50 new photographic plates, which clearly show the fashioning process necessary to shape a piece of rough material into a finished gemstone, have been added to the new edition.