Vol. 12 No. 6 April, 1971

THE JOURNAL OF GEMMOLOGY

and

PROCEEDINGS OF THE
GEMMOLOGICAL
ASSOCIATION
OF GREAT BRITAIN

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OF GREAT BRITAIN
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MORE NOTES FROM THE LABORATORY

By B. W. ANDERSON

1. *Detection of Opal Doublets*

One of the more awkward tasks which we are asked to undertake in the Laboratory is to determine whether a given opal is homogeneous or an opal-topped doublet. Usually the stone concerned is mounted in a setting which prevents one from seeing the rim or girdle where the junction layer of a doublet would presumably be visible.

Though the edge of the stone is obscured, its base is often visible. Should this be recognisable as black onyx, then the gem can safely be classed as an opal-on-onyx doublet. On the other hand, if the base consists of grey non-precious opal the question "doublet or not?" remains open.

The first lesson in tackling such cases is *not to give up hope:* determined efforts will usually yield an answer. First, one should scrutinise very carefully with a lens, or better, a low-power microscope, the border of the stone where it meets the setting, viewing it both from above and from below. Surprisingly often there will be some point at which a glimpse of the edge of the specimen can be obtained with the further chance of seeing the tell-tale discontinuity where the thin opal top surface is cemented to the "potch" base.

If this fails, it is a good plan to try and punch a strong beam of light through the specimen. Where the stone is moderately translucent and shows no trace of bubbles, grinding marks, or other

signs of a junction plane, the stone is almost certainly a true opal. In a doublet, on the other hand, flattened bubbles often appear as little bright circular "windows", and straight lines where the surface of the base was ground flat may also be detected. If no appreciable light is transmitted, it is usually rewarding to view the stone from above under a low-power microscope and a good overhead light.

From the nature of things the "precious" top of an opal doublet is both transparent (or nearly so) and thin. It is thus almost always possible to see through it to the plane where it is cemented to the less attractive opal base. When the focus of the microscope is slowly lowered through the surface layer, a careful observer can almost always become aware of a dividing plane if such exists, either by a series of small bubbles all at the same level, or by worm-like irregularities where the cementing has not been an all-over success.

It must be confessed that the above suggested tests yield positive proof only in the case of doublets. Complete proof of homogeneity really does require a good view of the region where the "precious" opal merges into the non-iridescent "potch". Sure signs that all is well are where small "tongues" of iridescent material invade the dull grey of the base. Even in an unmounted stone it is wise to make a very careful inspection of the edge before coming to a final decision.

2. *Pearls from the Giant Clam*

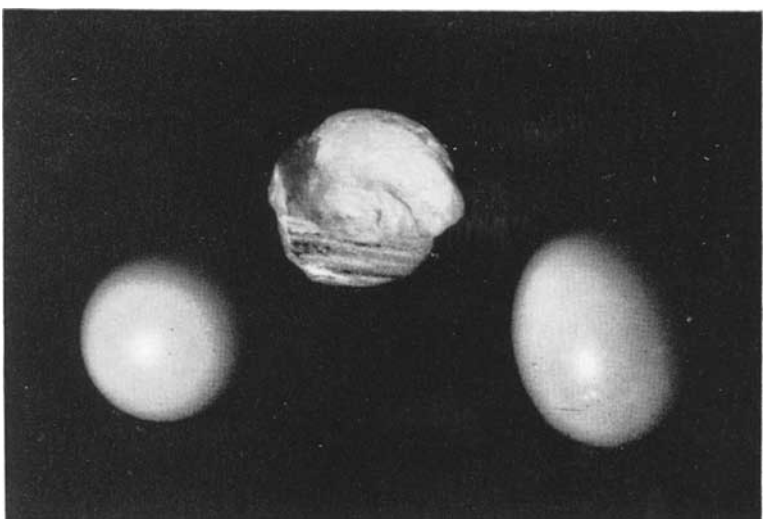
Every now and then the Laboratory is asked to identify "pearls" which though natural molluscan growths are non-nacreous and therefore outside the usual pearl and cultured pearl category.

The commonest of these, and the only type commercially acceptable are, of course, the so-called "pink pearls" from the giant conch (*strombus gigas*), a univalve whose decorative shell is lined with a porcellanous coating of delicate pink. Conch pearls have a beautiful flame-like surface pattern which makes them easily distinguishable (under a pocket lens) from coral or indeed any other substance. Their high density of 2·83–2·86 is also characteristic.

Non-nacreous black "pearls", resembling shining boot-buttons, also occasionally come our way, and though these are generally classed for convenience as "clam" pearls their exact source of origin is confessedly obscure. Their density is rather lower than that of nacreous pearls, and their attraction and commercial value are

virtually nil. We recently had an opportunity to test the more interesting and attractive white pearls found in the giant clam *tridacna gigas*. This enormous bivalve must surely be the most formidable of all shell-fish, the shells being as much as three feet in diameter and weighing up to 500 pounds. The valves are characterized by strongly crenellated edges which enable them to interlock very tightly when closed. The monster shells are found in the Pacific and Indian Oceans, in particular near reefs off the Northern coasts of Australia.

The parcel we examined contained a proportion of well-shaped "pearls" showing a beautiful optical pattern, or sheen, by reflected light, but there were also some very inferior concretions having the appearance of blobs of candle-grease, for the most part drop-shaped, with a lack-lustre finish and no reflection pattern. Typical features of these concretions were raised ridges, looped or festooned, again reminding one of the running of partly melted candle-grease. Both the "pearls" and the other concretions clearly consisted of essentially the same material and were nearly pure aragonite, as revealed by their high density of 2·86–2·89 (pure aragonite being 2·93). It seemed reasonable to presume that the "pearls" were formed in sacs within the ample body of the mollusc, while the unshapely concretions were formed under less favourable



conditions between the body and the shell. The illustration shows two typical tridacna pearls and the broken surface of another.

3. *A Diamond "portrait stone"*

Many years ago I was fortunate enough to acquire (*seriatim*) four "portrait-stone" diamonds. In addition to being most attractive objects—displaying as they do the sheer optical purity and beauty of diamond—these proved admirable for optical study. By a happy chance the four included a normal "Cape" diamond, a Type II stone, and two which were intermediate in their transparency to ultra-violet light, as can be seen in a photograph reproduced in "Gem Testing". These stones were very similar in size, being about 1 cm. in diameter and 1–1½ cts. in weight. It was quite a pleasant shock therefore to have sent to us for test a relatively "giant" portrait stone diamond nearly an inch in diameter and weighing some 10½ carats. The stone was clean and flawless and showed a blue fluorescence under ultra-violet light. The interference pattern between crossed polaroids gave the effect of hexagonal zoning which was very striking. Presumably the stone was cut from a large cleavage flake too thin for it to be fashioned into brilliants or even baguettes.

4. *Blue Zoisite and the Chelsea Colour Filter*

It is generally admitted that the blue zoisite from Tanzania can resemble fine sapphire very closely, especially when heat-treatment has largely suppressed the purple ray that in nature gives this variety an amethystine cast. In consequence one is often asked by dealers "how can I tell it from sapphire"? and since the use of a refractometer is not considered practical politics for over-the-counter or other casual transactions, the answer is not easily given.

Recently, however, it occurred to me that the Chelsea Colour Filter might prove helpful, and preliminary trials seem to confirm this. Those blue zoisites which I have viewed through the filter show a distinctly reddish appearance quite unlike sapphires of comparable colour. Admittedly mauve Ceylon sapphires containing traces of chromium will give a red showing through the filter; but again this is unlike the effect seen in the zoisite.

SYNTHESIS OF FLUORITE

By F. DUYK

FLUORITE (F_2 Ca) is considered as belonging either to the cubic system, or to the pseudo-cubic system (Mallard). Besides, belonging to this group, are minerals such as sellaite (F_2 Mg), which is quadratic and considered as the least refringent of all minerals, ittrocerite, which is also calcic, and fluocerine (F_3 Ce_4) admitted as being hexagonal.

Coming next are the double fluorides—anhydrides and hydrated—such as criolite, phachnolite, and thomsenolite, which are already considerably more distant from the group examined here.

There still exists however a curious variety called chlorophane, which has the property of emitting green light under thermic influence.

My purpose is to point out the tendency of the group to show lattice intricacies. Firstly, the optical and physical properties are as follows:

Synthetic red fluorite

R.I. = 1·43

Polarization = slight anomalous birefringence (in zones)

U.V. = inert

Density = 3·18

H. = 4.

Spectroscopy = nothing

Colour Filter = light red

Micro exam. = straight planes of growth, cristallites, non-communicating channels on level planes, gaseous cavities.

I am indebted to Dr. F. Pough's kindness and competence for the following information regarding the manufacture of synthetic Fluorite: "The Harshaw Division Kewance Oil Co. is the manufacturer. The method used is the Stockbarger one—this method is an improvement of the Bridgman process."

I found a detailed description of this process in a very good essay on the growth of arsenical gallium crystals, by K. Ozolis and E. Kokorisch, published in the *Bulletin of the Soviet Academy of Science* in 1964.

Cr, Nd, Sm, Er, Ho and U are used as colouring agents.

Cr gives light purple	Neodym gives purple
Samarium gives green	Erbium gives reddish
Holmium gives yellow	U.02 gives red purple
U.F4 gives green	Ca.UO 4 gives brown yellow.

When one is faced with the problem of practical identification of fluorite synthesis, one's attention must not be particularly attracted by the lattice constructions, because the synthetic fluorite displays the same straight-line construction as the natural product. Neither must the refractive index and the density be considered as essential, natural fluorite having the same R.I. and density. Even if an abnormal birefringence is obvious or can be detected in synthetic fluorite, one must keep in mind that the natural fluorite also shows abnormal birefringence sometimes, which is broadly to be attributed to an unusual habit of twinning by penetration developed by a rotation around a three-fold axis of symetry.

The examination under crossed polaroids may also offer a certain analogy with synthetic spinel, but as natural fluorite may possess abnormal birefringence, which spinels never display, even this test is not conclusive.

Finally, what is the method to be followed? One must remember that the extreme complexity of the lattice brings about tensions in the crystal, easily observed under crossed polaroids, and this has an unexpected result: unusual cavities, unusual in their shape, are displayed by synthetic fluorite.

Being used to rely on photographs for the detection of what I may find unusual in crystals (an old habit) I photographed these gaseous inclusions and here are the results obtained.

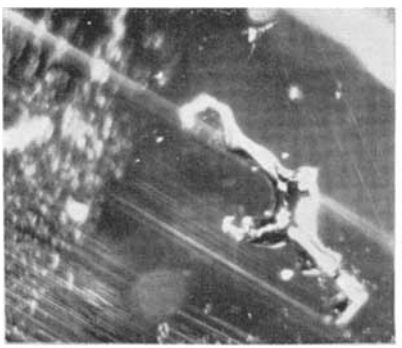


FIG. 1. *Gaseous inclusions.*

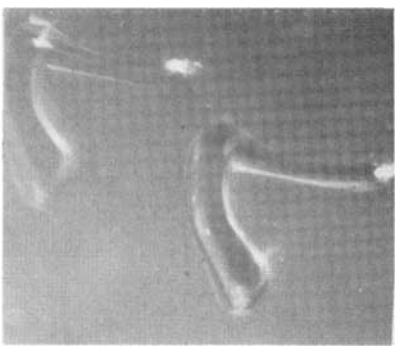


FIG. 2. *Abnormal double refraction.*

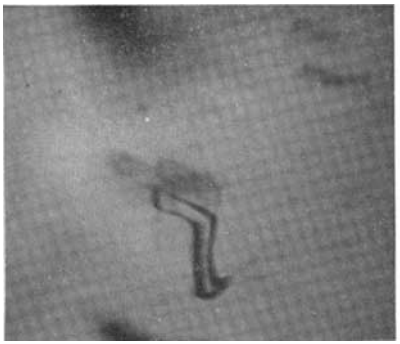


FIG. 3. *Abnormal triple refraction.*

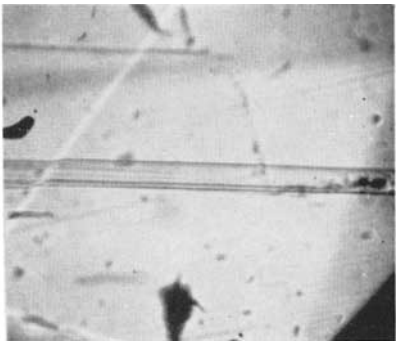


FIG. 4. *Hollow canal.*

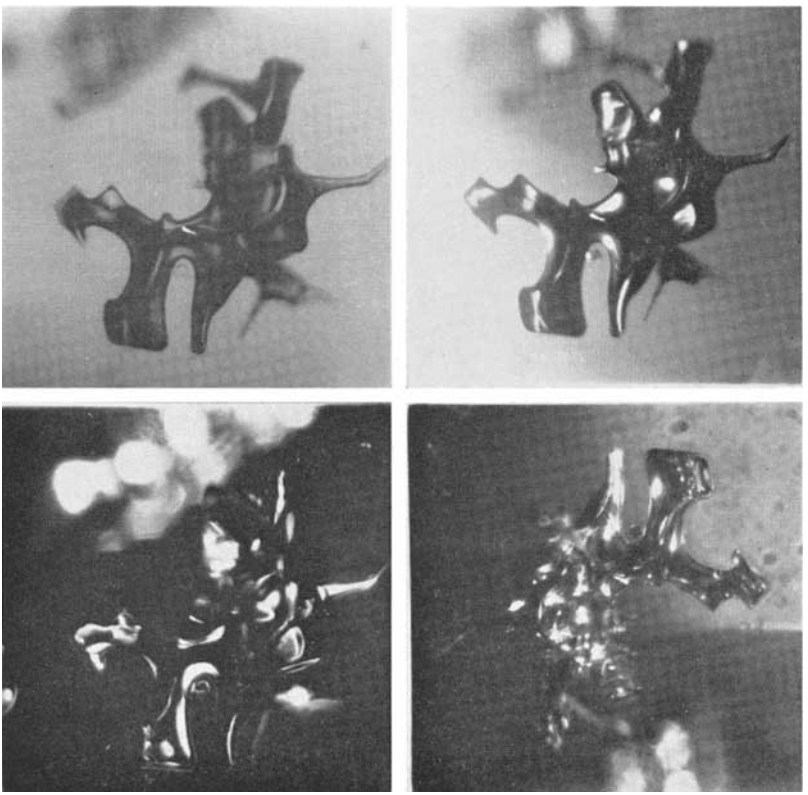


FIG. 5. *Four aspects of a gaseous inclusion.*

INCLUSIONS IN TOPAZ

By MARJATTA VIRKKUNEN, M. Phil., F.G.A. and WIKTOR DE SZEJKO, F.G.A.

THE following minerals have been observed as inclusions in topazes: fluorite (CaF_2), ilmenite ($FeTiO_3$), hematite (Fe_2O_3) goethite ($FeO{\cdot}OH$) and quartz (SiO_2). In connexion with quartz chlorite flakes also have been found sometimes. Advanced research methods have recently made it possible to identify such inclusions which reveal no typical property, shape or colour by the usual methods of determination. The inclusions may be so small that it is cumbersome to detach them from the host stone, even in such a case when the stone is sacrificed to the science.

The research material comprised a number of cut topazes acquired from Leningrad and derived from the Ural mountains. The physical constants of these topazes agree with those given in the gemmological literature for Russian topaz. The following constants were determined: S.G. 3·53 and R.I. 1·609 and 1·619. The R.I. values indicate a richness in fluorine for the chemical composition of topaz.

The stones were nearly colourless, part of them were pale sherry-coloured, the others bluish. They contain clusters of peculiar dark furry-like inclusions. These inclusions are mostly straight but they may change their direction, seemingly due to some crystallographic direction in stone (Figure 1). A closer scrutiny of these inclusions reveals that their centre is hollow, and they are filled with gaseous material and some dark substance. "Hairs" of different lengths surround these hollows in a certain plane and at the outermost tip of such a hair there might be a small colourless bright crystal (Figure 2).

The inclusions were investigated at the Geological Survey of Finland. Such individual stones, where the inclusions were at the polished surface, were investigated by electron microprobe analyses. It was found then that the topaz contained both hematite (Fe_2O_3) and cassiterite, stannic oxide (SnO_2). In all probability the dark filling in the longish central hollows is hematite and the hairs are cassiterite. The small bright crystals did not yield any information, only indications that the stone might also contain some iron-aluminium-silicate. As they seem to be cubic octahedra when looked at with a microscope with great magnification there is the possibility that they are spinel octahedra $(Mg, Fe)Al_2O_4$.

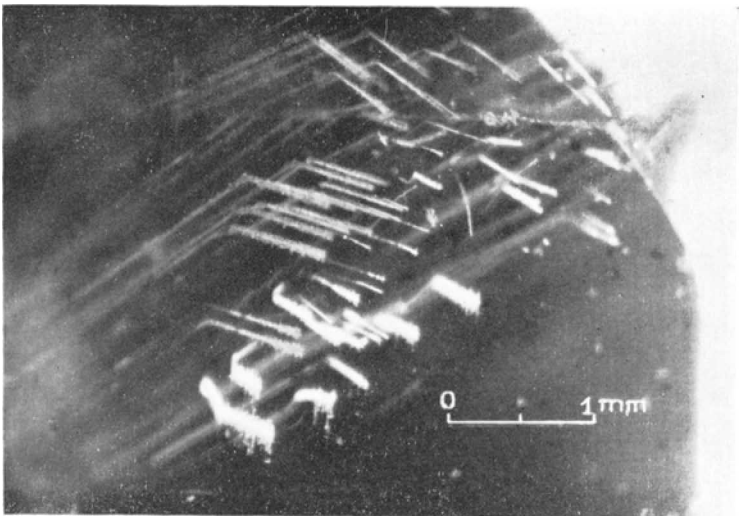


FIG. 1. *Photo: Lotta Orkomies.*

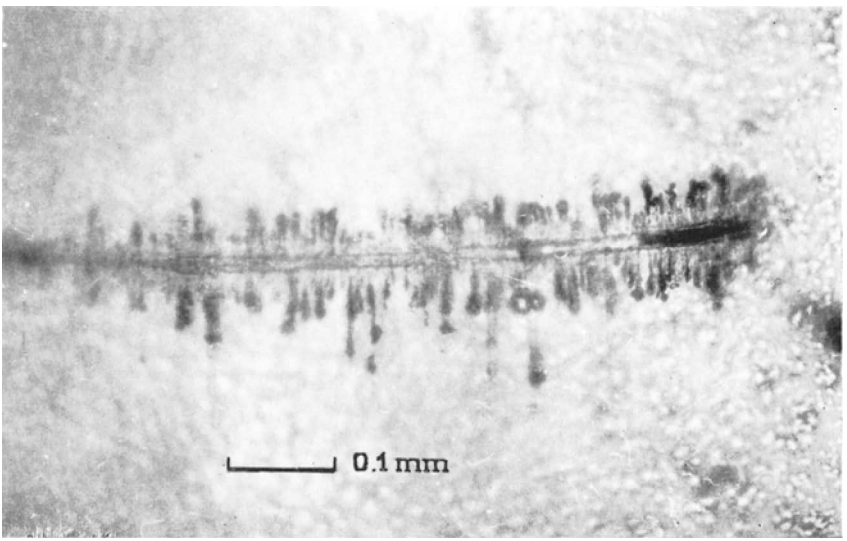


FIG. 2. *Photo: E. Halme.*

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A VISIT TO THE TOPKAPI MUSEUM AND TREASURY, ISTANBUL, TURKEY. 1970

By IRENE MOSEY

THE old Palace of the Sultans of the Ottoman Empire stands on a promontory in the city of Istanbul. It is built high above the Bosphorus with a view across to Asia just over one mile away. Istanbul has been on the trade route between East and West throughout the centuries so that some of the choicest silks, jewels, gold, silver and porcelain reached the city.

The Palace is really a series of pavilions built by successive Sultans around inner courtyards, cooled by many fountains and surrounded by high walls. Here the Sultans lived in the hey-day of the Ottoman Empire.

Originally in the 15th Century, the Treasury was housed in seven towers guarded by 250 Janissaries. The first four towers contained precious jewels, gold coins were consigned to the fifth, whilst the sixth was filled with silver coins. The seventh was reserved for government documents. Sultan Murat III moved the Treasury to seven large rooms in the Palace; and a record taken in the 18th Century showed that it contained 199,371 jewels.

Over the years each Sultan added more to the Treasury and when the last Sultan was deposed in 1919, by Kemal Ataturk, the Palace was turned into a museum, so that the treasures have remained intact.

A visitor nowadays goes first to the Royal Porcelain section housed in the old kitchens containing over 12,000 items of Chinese porcelain, the earliest dated 960 A.D. According to Eastern superstition, these porcelains changed colour and cracked when poisonous substances were applied to them.

In order to obtain an interview, each emissary brought a "small gift for the Sultan" and if the gift was not considered worthy, the unfortunate man was kept waiting and waiting . . . so the gifts included gold cups studded with turquoise and rubies, a chess set carved from agate, gold and silver boxes and ewers. One unusual gift is the seated figure of an Indian maharajah, the body and shoulders comprising a baroque pearl nearly 2″ across with the baggy trousers carved from a large piece of turquoise, the turban

set with small diamonds and another smaller baroque pearl shaped like an egret feather. There is a canopy over the figure in red and white enamels supported by four slender columns set with small diamonds and emeralds.

An impressive gift from India is a gold, jewel-studded musical box which stands on a 3ft. high table with legs shaped like groups of three palm trees. On top of the box is a golden elephant over 12″ long with flexible trunk and tail. Another item is a beautiful clear quartz cup and cover about 5″ high with a baroque pearl knob nearly 1″ diameter.

There are cases of jewel-studded swords, pistols inlaid with gold and mother-of-pearl, rifles with gold inlaid stocks and barrels, large hunting bows and arrows with the quivers embroidered with pearls. Two magnificent daggers nearly 18″ long are displayed with mirrors underneath to enable the reverse sides to be seen. One has four large emeralds of excellent colour over 1″ in diameter set in the handle, with the end emerald hinged to reveal a watch inside the hilt. The scabbard is curved and set with over 60 diamonds and several small baskets of fruit and flowers have been enamelled on the top and reverse sides. The other dagger has a hilt composed of one emerald big enough to be clasped in the hand; the cross hilt is set with diamonds; there are enamelled flowers along the 12″ long scabbard and a long gold chain enables it to be hung from the belt.

A perfect emerald crystal with six equal sides and about 1″ deep has been hollowed out and fitted with a domed lid of gold set with rubies and diamonds to make a beautiful box. There are many caskets. One is made from pieces of faceted quartz which comprise the four sides and the lid, all in gold surrounds, and measuring about 10″ × 5″ × 4″ deep. Other boxes are made of gold and covered with roughly shaped cabochon rubies, moonstones, and peridots in box-settings—over 450 stones were counted on one casket. There are bottles and stoppers in cut-glass inlaid with roughly polished rubies and sapphires, a tankard about 6″ high with a gold rim and base, and many drinking goblets of glass, gold and porcelain elaborately decorated with enamels and set with gemstones.

Other cases display exotic items like fly-whisks made of peacock feathers, Koran cases embellished with jewels, prayer rugs studded

with pearl embroidery and walking sticks with handles of gold, ivory and jade. One showcase is entirely devoted to rows and rows of amber mouthpieces for the narghile or water-pipe, each one having a different decoration of circles of diamonds or pearls or turquoise round the stem. It was believed that amber had the property of not transferring disease as the mouthpiece was passed round whilst the narghile stood on the floor in the middle.

A rather gruesome exhibit is the fore-arm of St. John the Baptist encased in gold and also a portion of his skull, but as similar relics appear all over Europe one wonders how many hands he possessed.

A happier note is struck by the gold cradle set with rubies in large diamond patterns together with gold extension bars for rocking—a much used article considering the size of the Sultan's harem.

An adjoining suite of rooms shows the robes of the various Sultans in silks, embroidered brocades and edged with ermine and sable; the earliest is the cloak of Sultan Mehmet the Second (1432-1481). One of the cases contains the robe stained with the Sultan's blood as he was assassinated, a gruesome piece of history which always seems to attract the tourist! Above the robes are shown the turbans with ornaments of diamonds and pearls topped with white egret feathers.

A collection of the Ottoman Sultans' seals includes one dated 1589 made of white agate with a gold handle; another is carved on a yellow sapphire, yet another on an emerald, but most of them are made of gold with the impression of the monogram.

All the various decorations, medals and orders presented to the Sultans are on view ranging from those given by the Russian Tzars, the Kings of Ethiopia, France and Prussia to the jewelled Star and Order of the Garter presented by Queen Victoria.

An impressive throne is like a low couch with a footstool made with gold inlay and entirely covered in lozenge shapes of alternate light and darker green enamels each containing a spray of flowers studded with rubies with centres of pearls. It was made in India as a gift from the Persian Shah to Sultan Mahmet the First in 1747 and later added to the Treasury.

Over the thrones hung long pendants, each Sultan having one of a different style. They are made of gold encasing large gemstones—one has three slices of emerald over 2″ diameter, each with six perfect sides set in gold surrounds in a triangular form, so that light passes through them. From the lowest point of the triangle hang 12″ long tassels of pearls—about 30 tassels, each having about seventy pearls. Another pendant has a perfect crystal of emerald—a huge stone the size of a clenched fist surmounted in gold with a domed top inlaid with diamonds, again with the many pearl tassels. Yet another has a single section of emerald over 2″ diameter with six large drop pearls from which is suspended another large emerald pierced down the centre, with ten smaller drop pearls making a ring to hold the pearl tassels. The sheer size and colour of the emeralds in these showcases almost take the breath away.

Three of the largest uncut emeralds weigh 3260 grams (7 lbs. 2 oz.), 1310 grams (2 lbs. 14 oz.) and 590 grams (1 lb. 4 oz.), an unbelievable treasure. Other emeralds of egg-size to pebble-size are tumbled casually in the corner of the showcase!

An enormous pear-shaped diamond of 86 carats belonging to Sultan Mehmet the Fourth (1642-1693) is now set in a double surround of 49 brilliant-cut diamonds.

One of the most beautiful items on display is a short prayer in Arabic lettering completely made in different sized diamonds, the piece is about 8″ long and over 1″ wide and dated about 1839.

The centre piece of the Treasury is a gold throne about 6′ long like a high settee, for the Sultans always reclined, never sat on the throne as in the West. It is covered at the sides and front in beaten gold and studded with 955 topazes, roughly cabochon and in box-settings. Above this throne hangs yet another pendant, this time in gold weighing 96 kg. with 12,564 diamonds which belonged to Sultan Abdulmecit.

Across the courtyard from this "Aladdin's Cave" is the part of the Palace most sacred to all Moslems. Here are the Relics of Islam captured from Egypt in 1517 by Sultan Selim I and placed in this Imperial Chamber. The window through which the Relics are viewed is protected by a solid silver gate about three feet high done in the most intricate scrollwork.

Inside the Chamber is a large silver canopy adorned with gilding, similar to a tent in shape, which was used as the Imperial Throne. It has a vaulted roof decorated with mirrors and is supported on four columns. Inside is a silver table decorated with gold leaf on which stands a large golden casket which contains the Cloak of Mohammed and the Holy Standard. There are also two of the Prophet's swords for which Sultan Ahmet I had made scabbards of solid gold studded with rubies, turquoise and other gemstones.

In a small box is the prophet's seal, an oval-shaped agate the normal size of a ring stone, and the inscription in Arabic on the seal reads "Prophet, the Apostle of God". Other sacred relics are a small piece of the Prophet's tooth, which was broken during action in the religious battle of Ohod, and a piece of hair from his beard kept in a silver casket ornamented with the most delicate filigree design. A blackened piece of parchment is a letter written by Mohammed to Mukavkas, the King of the Copts, in 627 in an attempt to convert the King to Islam. An unusual relic is the footprint of the Prophet's right foot on a porphyry stone. It was found by a regimental commander of the Imperial Regular Forces named Ahmet Bey somewhere in Tripoli, Libya, in 1874 and it was presented to the Sultan who gave him 114,000 kurus as a reward. Later it was enclosed in a gold frame with an engraved lid.

It does seem remarkable that all these treasures have remained intact throughout the centuries of Turkish history to the present day. It would appear that each Sultan upon taking office had to verify that the treasure agreed with the inventory up to that date and had not been dissipated by his predecessor. It became a matter of pride to add to this collection and it was only by the foresight of Kemal Ataturk in converting the whole of the Palace into a museum that we can today view the treasures in their original setting.

Many things have been omitted, but I can say that apart from the delights of the rest of Turkey a gemmologist will find endless pleasure in a visit to this unusual museum.

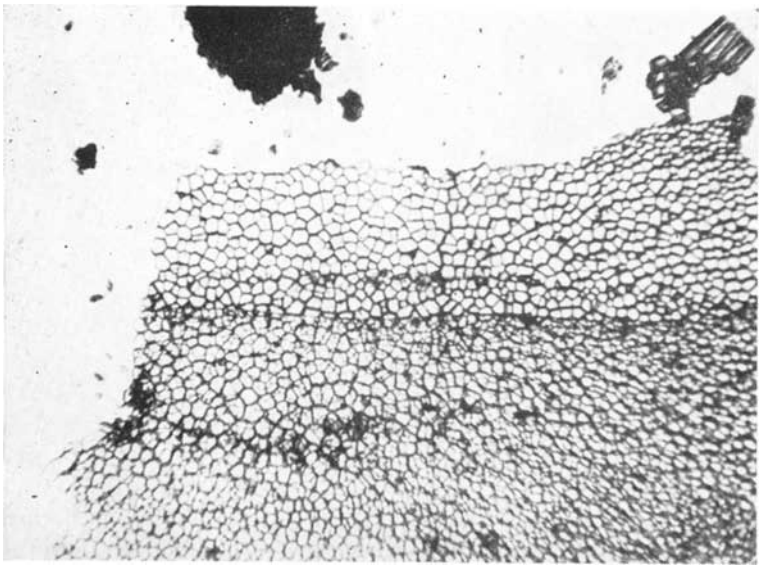
THE CONSTITUENTS OF PEARLS

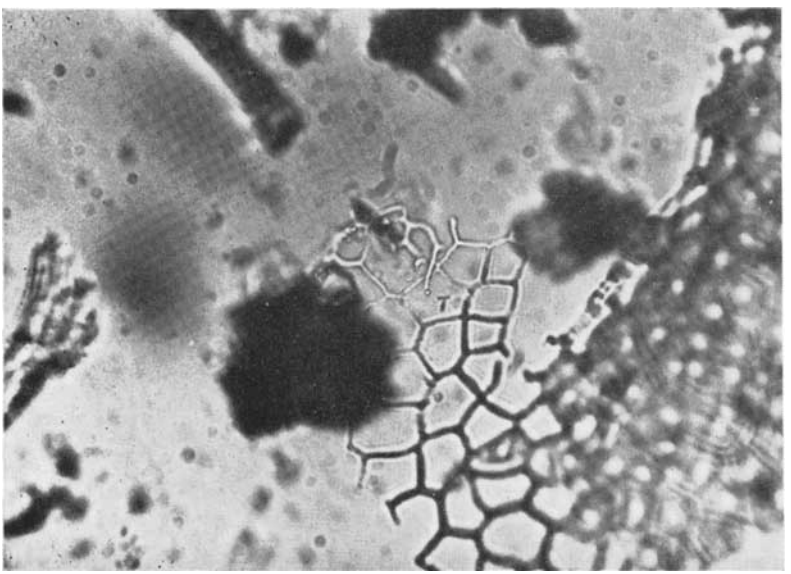
By E. H. RUTLAND, Ph.D.

THERE is a tide in the affairs of gems, as in those of men. Capriciously, their supply waxes and wanes in long-term cycles, now scarce, now relatively plentiful. Natural pearls which mainly come from tidal waters are, appropriately enough, no exception. So far as the Persian Gulf is concerned, the tide is right out and only the Far East and the Americas are now the main sources. Additional supplies seem to be coming from freshwater fisheries and the culture of pearls evokes ever more ingenuity.

There is a tide, too, in publications about natural pearls. It must be some years since the technical press produced an article about them and it must be admitted that all essentials have been said and are enshrined in the textbooks. I was therefore more than pleased to meet a serious student of pearls at a recent conference who produced a large number of photomicrographs illustrating aspects of pearl structure of which I had had only a vague notion. He is Mr. E. Bibend, a jeweller of Koblenz, who kindly allowed me to use the pictures here reproduced and supplied the relevant data.

As is well known, pearl oysters and mussels build up pearls much in the same way as they build their shells, by depositing calcium carbonate, either as aragonite or as calcite, until it forms tiny crystals. Concurrently these are cemented together with a horny protein, conchiolin. Both constituents are secreted by the animals' epithelial cells. In the shell-building process some parts of the oysters' skin or mantle, containing these cells, specialize in the deposition of, first, the horny periostracum, composed of conchiolin; then a rigid layer of prismatic crystals, which are finally topped off with a smooth nacreous layer. Conchiolin and calcium carbonate either as prisms or as nacreous platelets can, however, be secreted by any part of the mantle. In the formation of pearls, as distinct from the shell, the nacreous platelets in many species predominate and sometimes wholly supersede the prismatic layers. Growth is seasonal and a new sequence of layers is superimposed on previous layers each year. The rate of growth depends on the species, the vigour of the animal, on the environment and





FIGS. 1 and 2. *Conchiolin framework enclosing prisms of aragonite.*

on the benignity of the season. The first year's growth is also usually greater than that of subsequent years.

Sections through pearls, illustrating the concentric and radial structure resulting from the processes outlined above, can be seen in many textbooks. Mr. Bibend's achievement is that he succeeded in dissolving the conchiolin binding between the prisms thus exposing the individual crystallites; and conversely dissolving the calcium carbonate, leaving the conchiolin honeycomb unaffected. He then produced clear photographs showing the result.

Vertical views of the conchiolin network with the prisms removed are shown in figures 1 and 2, while in figure 3 both the prisms and the conchiolin in a yearly layer have been dissolved almost to the base. The outlines of the crystals are by no means regular, though some vagely hexagonal and triangular shapes occur. The whole mass is closely wedged together, no doubt for greater rigidity. In the interstices between crystals Mr. Bibend also found some rods or veins of conchiolin, presumably serving to bind the crystals together still further. These were in lateral arrangement and are illustrated in figure 4. Figure 5 is an oblique view of a husk of conchiolin from which the prismatic crystallites have been dissolved. The rounded tops of the crystals and their lateral striations are clearly reproduced in the conchiolin matrix.

The next picture, figure 6, shows the platy layer between two seasons' growth partly dissolved away, revealing the tops of some of the prisms underneath. These are shown more clearly in figure 7, where the whole platy layer has been removed as well as most of the conchiolin in the interstices. Though the crystal heads are rounded, their combined surface must still be so rough as to necessitate a smooth platy top-dressing.

The remaining pictures show prismatic crystals singly and in groups. To allow for a radial structure, the crystals are thinner at the bottom end. The lines of light along their lengths indicate that their faces are continuous, but the lateral striations make it clear that deposition is not continuous. Growth probably proceeds in daily doses. The layering is particularly conspicuous on the part-crystal shown at the side of figure 8. Figure 10 shows how two successive years' growth fits together. The demarcation line of plates and conchiolin can clearly be seen between the two crystal layers.

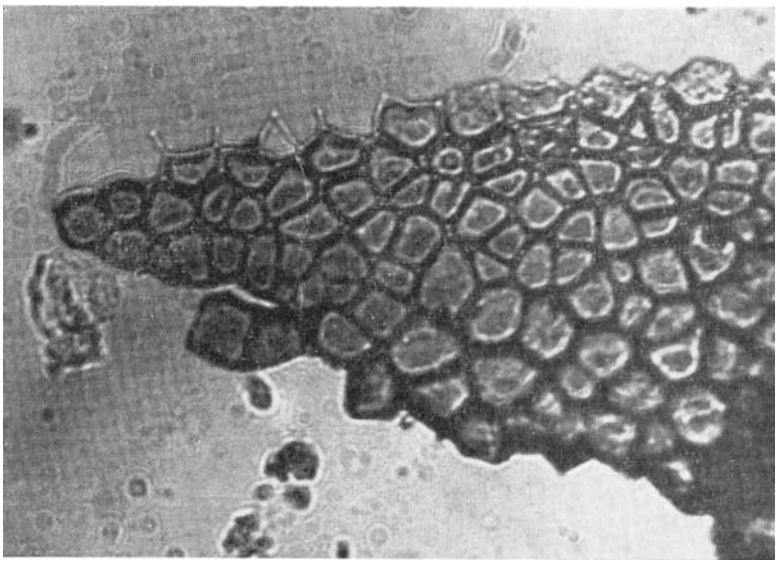


FIG. 3. *Prisms of aragonite dissolved down to base showing conchiolin binding between prisms.*

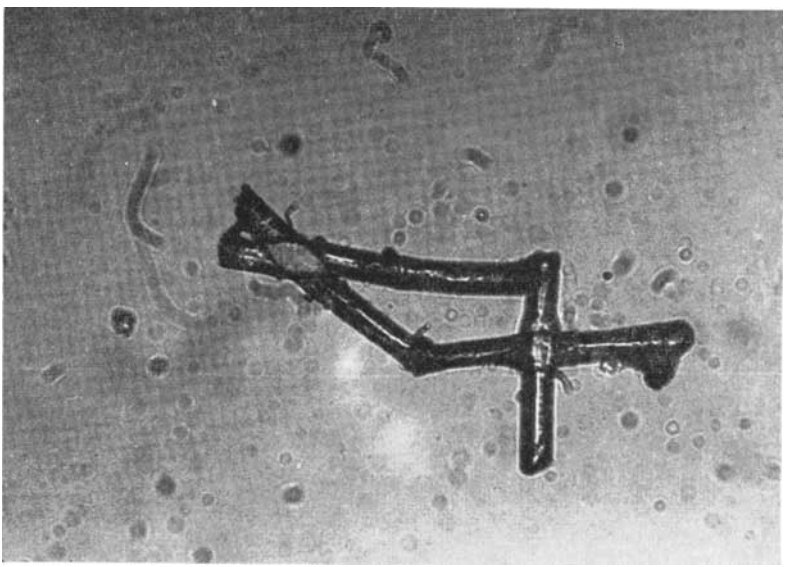


FIG. 4. *"Veins" found in the conchiolin interstices between aragonite prisms.*

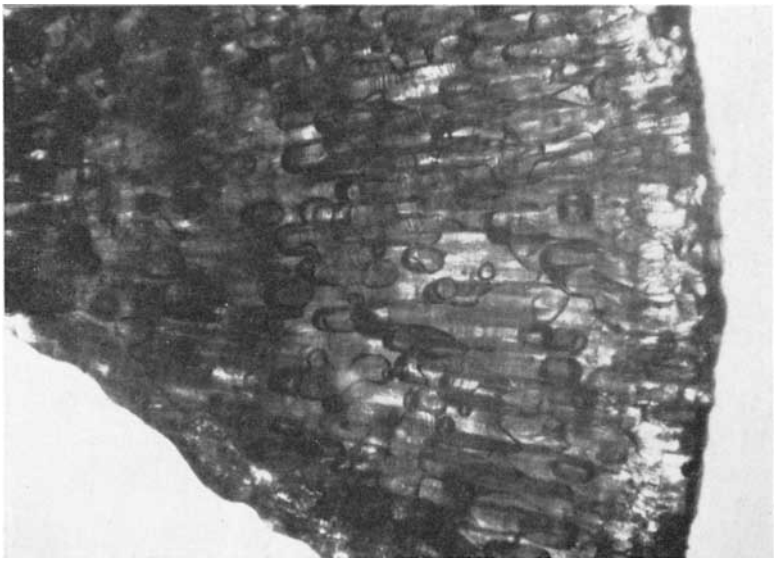


FIG. 5. *Husk of conchiolin from which crystals have been removed.*

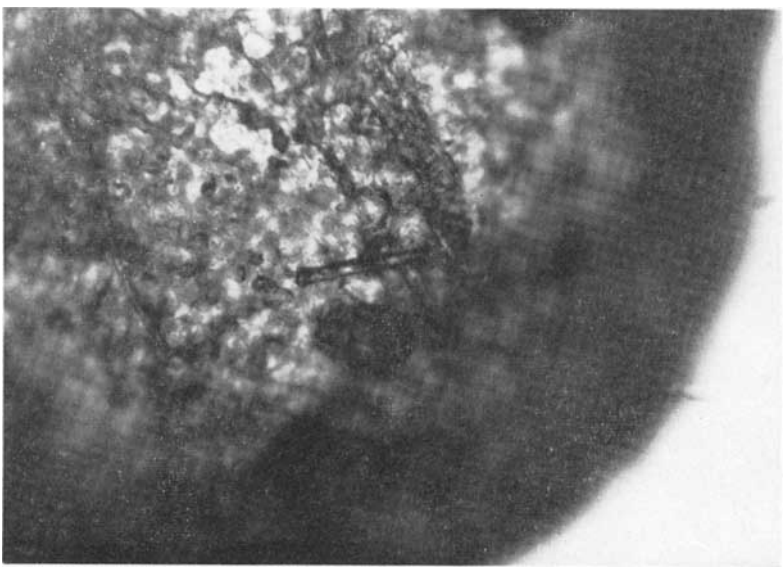


FIG. 6. *View through one of the conchiolin layers of a natural pearl showing tops of aragonite prisms and platelets beneath.*

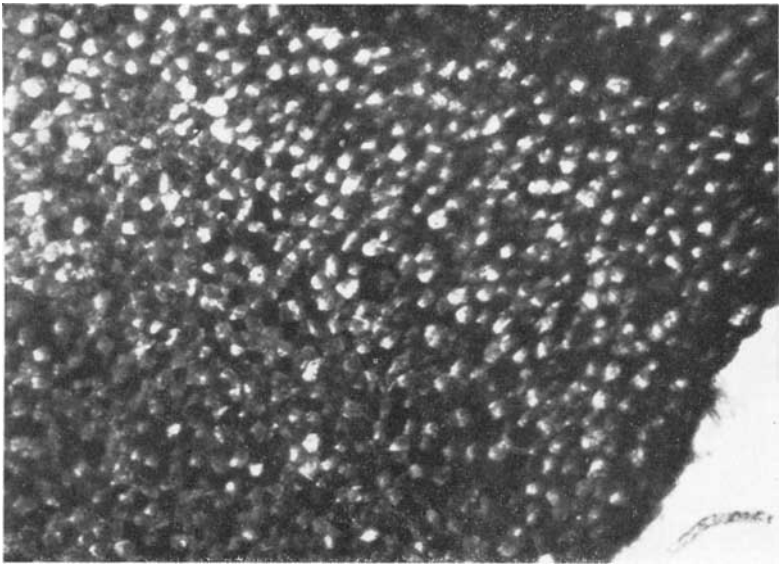


FIG. 7. *Prisms of aragonite forming one layer of a pearl.*

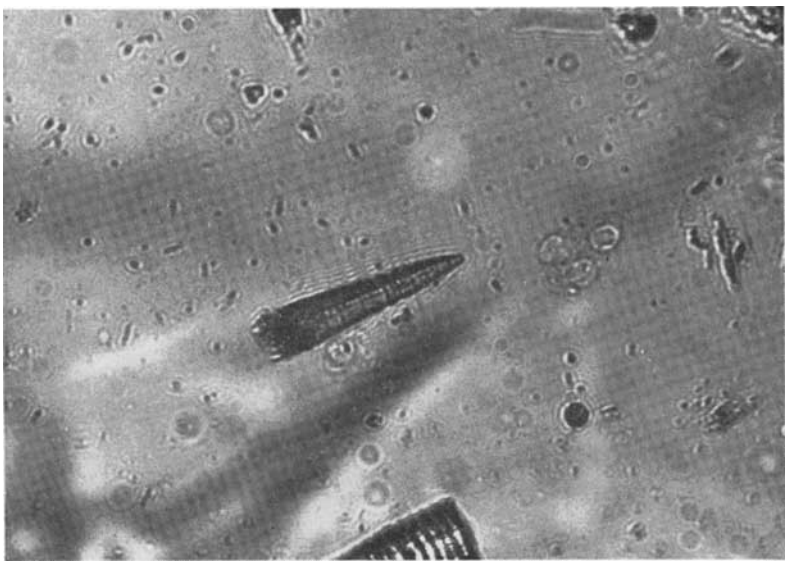


FIG. 8. *Crystals from fresh-water pearl.*

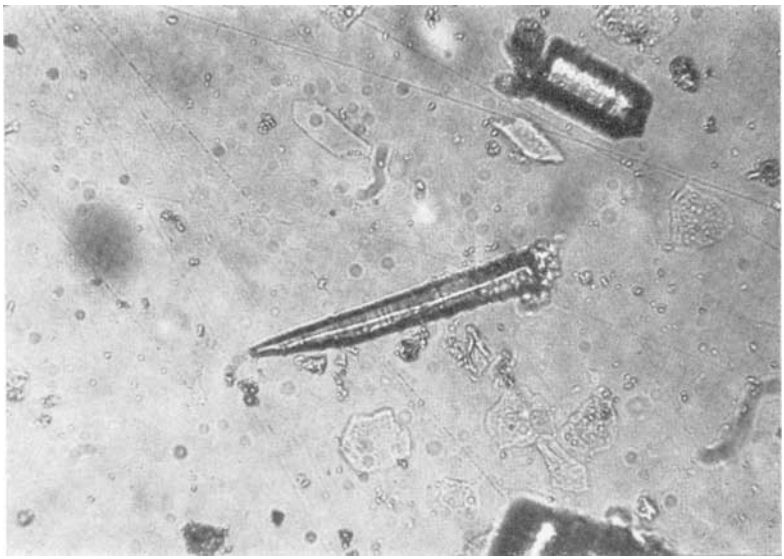


FIG. 9. *Well developed aragonite crystal lamellae of conchiolin.*

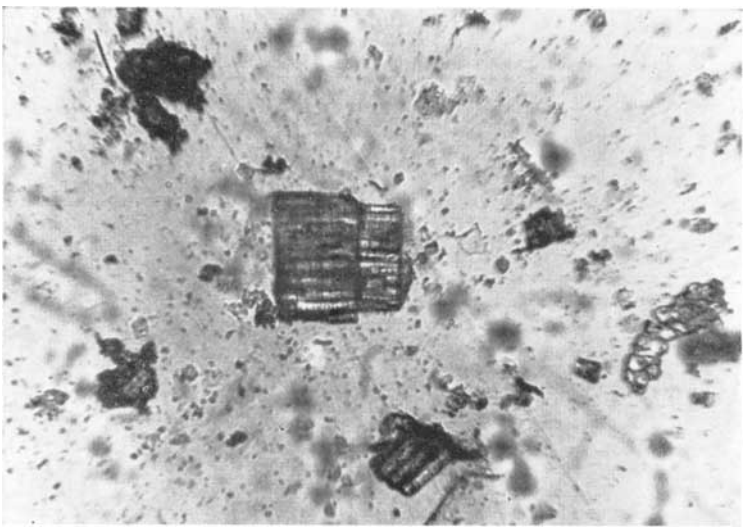


FIG. 10. *Group of crystals showing two successive years' growth fitting together.*

A SIMPLER METHOD FOR PHOTOMICROGRAPHY

By S. B. NIKON COOPER, B.D., F.G.A.

HAVE you ever wanted to get a record—say—of that inclusion, possibly quartz, in andalusite? It is so small that you can spend minutes searching for it again if you lose it.

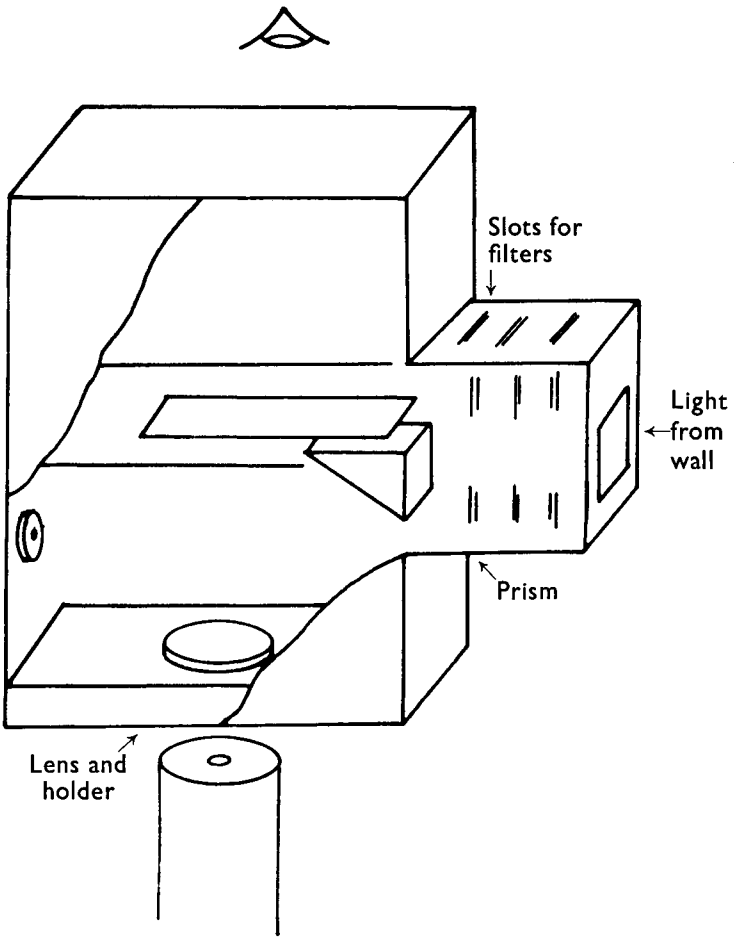
The answer of course is simple: take a photomicrograph. And there is your record, in colour, for all to see.

There is only one snag with this. In most systems of photomicrography up to now, you have had to make a guess at the exposure time (and this can, and does, vary from 1/50th of a second to a matter of minutes or more). Either that, or a "trial and error" run has to be devised—and that is expensive.

But now the problem of finding the exact exposure time has been neatly and efficiently solved. Below are printed the details, as a tribute to the inventive genius of the late W. R. ("Bob") Hinton, of Farnham, Surrey. His method was simplicity itself, and can be economically made by any handyman.

His ingenious solution was to couple the image (of unknown light intensity) that you see through your microscope, with another —say—of the wall next to where you are working, so that they are seen side by side. The brightness of this latter image can be measured by an ordinary light-meter. It is then a simple procedure of adding neutral filters until the two images match up in intensity. You know the set exposure time for the one (the "wall"); deduct the number of stops corresponding to the number of neutral filters used, and you then have an exact exposure time for the image seen through the optical system of the microscope.

Reduced to bare essentials this consists of a box frame, painted matt-black inside, incorporating a simple lens, placed at its focal distance below a ground-glass plate. These are in direct line with the microscope draw-tube. Adjacent to this is mounted a prism section. In front of the prism is a convenient light-tight holder for the neutral filters (these can be obtained from Messrs. Ilford's, and can be fitted into transparency mounts). If three filters of 50%, 25% and 6¼% transmission are used—corresponding to relative strengths of 1, 2 and 4—any combination of filters up



The "Hinton" photometer camera.

to "7" strength may be selected. The whole can be mounted directly onto a microscope draw-tube, or if preferred, secured by a ball-joint mounting at the side.

Procedure:

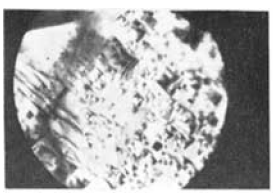
1. Assemble photometer-camera over microscope (leave the eye-piece in).

2. Focus microscope to give a sharp image on the ground-glass plate.
3. Match brightness of light received through the prism to the point of interest of the image on the ground-glass plate. Do this by using the various neutral filters.
4. Measure the brightness of the area seen by the prism (the "wall") by a light meter.
5. Note the indicated exposure for the widest aperture (lowest "f" number) of your camera.
6. Correct the exposure by deducting the same number of stops to equal the number of neutral filters used in the photometer. (E.g.: if the indicated exposure was 1/50th second, and you have used filters to value of "5", your exposure time is now 5 stops on—so, not 1/50th second, but 1 second.)
7. Set the camera focus to infinity, and the stop to the lowest "f" number.
8. Remove photometer, and assemble the camera over the microscope.
9. Take the photograph using the exposure as at (6) above.

The film should be balanced for tungsten light. If "daylight" type, use the appropriate filter (and do not forget to add *one more* stop to your exposure time).

It works. It is cheap and relatively simple to assemble, and it can open up a whole new world of possibilities to your study of gemmology . . . and it may make you keen to use your microscope on every new stone that comes your way.

Typical examples of photomicrographs obtained using the "Hinton" photometer system are shown.



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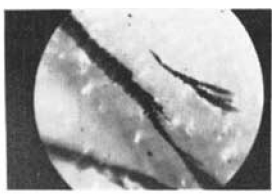
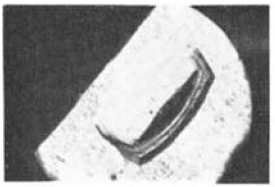


2.

FIG. 1. *Growth marks on cube face of diamond crystal* (1/5 *s.* × 300).

FIG. 2. *Rutile feather in pale amethyst* (1 *s.* × 150).



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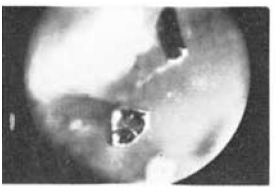

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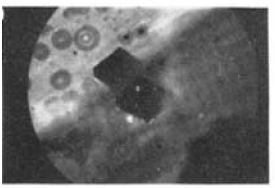

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FIG. 3. *Growth mark on prism face, beryl crystal* (1/10 *s.* × 100).

FIG. 4. *Crystals attached to prism face, smoky quartz crystal* ($\frac{1}{2}$ *s.* × 150).

FIG. 5. *Crystal inclusions in fire opal* (4 *s.* × 150).

FIG. 6. *Partly re-sorbed tetragonal crystals in spinel* (4 *s.* × 150).

FIG. 7. *Magnetite inclusion in apatite* (2 *s.* × 150).

FIG. 8. 2 *generations diamond* (4 *s.* × 150).

Gemmological Abstracts

BANK (H.). *Ueber die Lichtbrechungsindizes, die Doppelbrechung und die Dichte des Mischglieder der Skapolith-Reihe.* About the refractive indices, the double refraction and the density of stones in the scapolite series. Zeitsch. d. deutsch. Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 116-121.
Graphs, bibl. E.S.

BANK (H.), BERDESINSK (W.), OTTEMANN (J.). *Orangeroter Spessartin aus Brasilien.* Orange-red spessartite from Brazil. Zeitschr. d. deutsch. Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 123-127.

Garnets of various colours have always been found in Brazil. A new type of garnet was found in the Golcanda district (well-known for tourmalines). The stones vary in colour from dark orange-red to dark red. Refractive indices were 1·803-1·805; S.G. 4·14 ± 0·02. They were found to have 21·08% manganese, 9·53% iron and 0·17% calcium. There was no magnesium, titanium, chromium or vanadium. The authors concluded that the stones in question were spessartites showing a small percentage of almandine. Map, bibl.
E.S.

BANK (H.), OTTEMANN (J.), BERDESINSKI (W.). *Edel-Olivin aus Norwegen.* Precious olivine from Norway. Zeitschr. d. deutsch Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 128-133.

The olivine found in Norway is a forsterite, i.e. an olivine with a small amount of iron and a large content of magnesium. This was shown by x-ray examination and S.G. comparisons.
E.S.

BANK (H.). *Zur Einteilung der Gemmologie.* Classification of gemmology. Zeitschr. d. deutsch. Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 166-173.

The author suggests a decimal classification for gemmology. The whole subject could be sub-divided into general and specific gemmology, the first being sub-divided into characteristics and properties of gems, testing methods and working methods, the

second being sub-divided into natural gems (sub-divided into minerals, sulphides, oxides, etc.) and imitations (synthetics, imitations, and cultured pearls). For instance: 1 = general gemmology; 1·1 = characteristics and properties; 1·14 = physical characteristics; 1·141 = mechanical characteristics; 1·1411 = hardness. To give an example for the second group: 2 = specific gemmology; 2·1 = natural stones; 2·11 = minerals; 2·118 = silicates; 2·116 = beryl; 2·11862 = aquamarine.

E.S.

BANK (H.). *Was ist "YAG"?* What is "YAG"? Zeitschr. d. deutsch. Gemmol. 1970, 19, 3/4, pp. 176-179.

YAG is a synthetic product which has the chemical composition of an yttrium aluminate and can be used as a diamond substitute. The R.I. is lower than that of diamond and the S.G. quite a bit higher (diamond = 3·52, strontium titanate = 5·13, yttrium aluminate = 4·55). It is singly refractive and the R.I. is difficult to determine, but with the help of a heavy solution (Clerici) should be easily distinguishable from diamond.

E.S.

CASSEDANNE (J.). *Le gite de sphene-gemme de Capelinha.* Gem quality sphene from Capelinha. Bul. Ass. Francaise de Gem., 1970, 25, pp. 13-15.

The locality is Campo do Boa in the municipality of Capelinha, 134 km. from Diamantina and 157 km. from Teofilo Otoni, in the state of Minas Gerais. The sphene crystals rarely exceed a decimetre in length and are yellowish-green with a resinous lustre, with some faces (100, 102, 010) striated and corroded. They are frequently fissured, which explains the rarity of cut stones from this source. Hardness varies from 5 to 5½, density 3·52. Single crystals are rare, most occurring as two types of macles, contact and cruciform penetration. Associated minerals are hyaline quartz, magnetite and tourmaline.

M.O'D.

JOENS (H.). *Nordsee-Bernstein.* Amber from the Baltic. Zeitschr. d. deutsch. Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 143-146.

Short historical survey of amber found in the Baltic. Occasionally a carved figure is washed ashore, presumably carved during the

stone age. Today's centre is St. Peter-Ording, where the amber is cleaned and polished. This natural amber has a transparent "bark", which is not found in imitations or in the pressed amber. The latter is produced by heating small pieces to 140-200°C under a pressure of 400-500 atm.

E.S.

MASSO (M.). *Quelques commentaires sur un rubis synthétique.* Some notes on synthetic ruby. Bul. Ass. Française de Gem., 1970, 25, pp. 11.

Seven synthetic rubies were examined giving the following results: optic axis parallel to the length of the stone, strong dichroism, S.G. 4·015–3·996, R.I. 1·760 and 1·768, red fluorescence, absorption spectrum similar to that of normal synthetic ruby with noticeable absorption of the yellow and green. No curved lines were seen but there were masses of both round and oval gas bubbles. Wavy markings resembling those seen in Kashan synthetic ruby were present. Some stones had lines crossing at almost 90°. The origin of the stones is unknown.

M.O'D.

NOEL (A. G.). *Treating opal matrix.* Lapidary Journ., 1970, 24, 7, 914.

A short account about the sugar-acid process for treating suitably porous Australian opal matrix.

S.P.

RÖSCH (S.). *Die Farben des blauen Zoisits von Tansania des "Tansanits".* The colours of the blue zoisite of Tanzania, the so-called tanzanite. Zeitschr. d. deutsch. Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 103-115.

At first sight the zoisite crystal seems disappointing; instead of the blue colour it is khaki-brown. The author explains the absorption spectra of these stones and the way it has to be cut in order to produce the desired blue colour. The colour is then also improved by a heating process. The green zoisite is briefly mentioned. 2 tables, 8 graphs, bibl.

E.S.

RUTLAND (E. H.). *Farbgebende Spurenelemente in Edelsteinen.* Colouring trace elements in gemstones. Zeitschr. d. deutsch. Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 139-142.

The author discusses the role played by trace elements in colouring minerals, in particular gemstones, especially if they are present in very small quantities. In each case the influenced stones are enumerated and a short description of their absorption spectra given. The most common trace element seems to be iron, then chromium. The author deals with manganese, copper, vanadium, titanium, uranium and rare earths.

E.S.

SANTOS MUNZURI (A.). *Consideraciones sobre los granates grossularia.* Gemologia, Bol. Ass. Espanola Gem. (Bul. Spanish Gemm. Ass.), 1969, 1, 3/4.

After a general discussion of the garnets and a note on the Mackowsky diagram showing the inter-relationship of the garnets, the author turns to the consideration of grossular garnet. Ceylon is the principal producer of the hessonite variety of grossular and nearly all cut stones now come from there. They are characterized by inclusions of diopside and zircon, which show their strong birefringence if the stone is examined under crossed polars. Other localities mentioned are Italy, Siberia and Mexico, where euhedral opaque crystals of green or red are found in the Jace Lake area. Fine examples of this material have been sent to China for fashioning into figurines.

Grossular from Pakistan had the following constants (Anderson) S.G. 3·64, R.I. 1·738, with a spectrum showing two lines in the red at 6970, accompanied by a line at 6300, with bands at 6050 and 5050Å. The stones show inclusions of actinolite similar to those displayed by Siberian and South African emeralds. In 1967 grossular from Zambia appeared in England, with constants of S.G. 3·55, R.I. 1·732. These are average values obtained by the author after an examination of 150 cut and rough stones. Canadian grossular has been found in colourless rhombdodecahedra form. They are found in Quebec asbestos mines and display characteristic inclusions of crossed canals.

9 colour photographs.

M.O'D.

WALDECK (H.), BAIER (E.). *Manganverteilung in Zuchtperlen.* Distribution of manganese in cultured pearls. Zeitschr. d. deutsch. Gemmol. Gesellschaft, 1970, 19, 3/4, pp. 99-102.

Using neutron activation it was shown that cultured pearls with and without a nucleus contain more manganese than natural pearls. The higher manganese content seems to be due to the higher manganese content of the implanted marine material. 3 tables, bibl.

E.S.

BOOK REVIEWS

BRUTON (E.). *Diamonds.* N.A.G. Press, London, 1970, 372 pp. 330 illus., coloured frontispiece. Price £5.

It has been suggested that a small boy's idea of paradise would be to be given the Crystal Palace and (conveniently to hand) Brighton beach to throw at it. On a more modest and adult scale it must rejoice a practised writer to become aware of a gap in the literature on a given subject and to know himself very well equipped to fill it.

The actual *doing* of the job is quite another matter. Long before even the thousandth stone was cast our small boy would probably be permanently cured of his propensity. An author is made of sterner stuff and has a living to make, but there are usually times during the creation of a major work when the sheer hard slog involved makes the project seem hardly worth the candle.

The gap in the literature of diamond which Mr. Bruton saw and has now filled so admirably must have become glaringly apparent to him when he came to conduct the Diamond Course at the Sir John Cass College in London. Though there have been many books written on diamond in the last 50 years there existed none which gave anything approaching a complete account of the mineral as a gemstone.

Eric Bruton's new book has the quality and dimensions of a future classic, and one can safely predict that it will pass through many editions, improving as it goes, and be translated into other languages.

The volume is ample in size—372 large octavo pages—and more than adequately illustrated with some 330 excellent photographs and drawings. At the end of each chapter a list of references is given, which is an unusual and welcome feature.

The opening chapter "Diamonds in History" might more aptly be titled "Introducing Diamond", as the sketchy and speculative record of diamond in history only occupies a few paragraphs, the remainder consisting of brief notes on various aspects of diamond which are to be dealt with more fully in succeeding chapters. The statement on page 16 that a half-carat stone weighs "about a twenty-eighth part of an ounce" is a slip which needs correction.

In the second chapter "Where Diamonds are Found" the book gets into its stride. The story of the discovery of the first authenticated diamond pebble in South Africa has perhaps been too often told for it to retain its very real human and romantic interest, but it was good to see so full and accurate an account of it given here. The chain of trust as this $21\frac{1}{2}$ carat crystal was handed on from finder to eventual purchaser was an early example of the way this strange trade was to run in the future. Even the final allocation of rewards for the stone was notably fair. It is a pity that several of the other romantic stories of diamond discovery (such as that of the giant Cullinan crystal) could not be recounted in similar exact detail.

The next few chapters deal with the growth of the big mining companies and with the various methods of mining and recovery used in the main diamond-bearing pipes and alluvial fields. Having visited most of the major mines of South Africa Mr. Bruton is able to give a first-hand account of the highly specialised mining and recovery techniques which are needed to make an economic success where the precious mineral is present in so exceedingly low a concentration.

There follows a chapter on prospecting for diamonds, showing the gradual replacement of the old hit and miss methods ("diamond is where you find it") by more methodical and scientifically planned exploration based on geological knowledge and past experience. A good account is given of Dr. Gavin Lamont's recent successful prospecting in the Kalahari Desert, which entailed systematic sampling of minerals in the surface sand for tell-tale traces of garnets, ilmenite, etc. fished up ages before from lower strata by ants when building their towering nests. One would expect here a

description of the ingenious and pertinacious prospecting methods used by Russian scientists which led to the discovery of the vast "Mir" pipe and other rich deposits in the permafrost regions of northern Siberia, already referred to in a previous chapter. Mr. Bruton pleads insufficient information, but quite a lot of detail was in fact made available five years ago by N. Polutoff in an excellent article in "Gems and Gemology".

Next come chapters on "How the Market Operates", "Sorting Crystals", "The History of Diamond Cutting" and "History of Cuts". This last chapter, with its rather strange-sounding title, is valuable in having many clear diagrams of the various styles of cutting from the earliest roses and table cuts to the modern brilliant with its elaborately worked out scheme of angles and proportions based on Tolkowsky's design which was published in 1919. In this chapter the mis-spelling "facetted" for faceted is very prominent (though not consistently used) and needs carefully weeding out for the next edition.

The next chapter, on "Diamond Manufacture", is particularly well done, and gives in splendidly illustrated detail the whole process of converting a rough diamond into a perfect polished gem. There ensue three chapters on the grading of polished diamonds according to the "three C's" (colour, clarity and cut) which will be of prime value for students in the Diamond Courses. In the table reproduced as Fig. 12. 6. there is an unfortunate error in the colour-scale nomenclature as used in this country. Mr. Bruton gives the order as . . . . Silver Cape, Cape, Light Cape, Dark Cape . . . . and the same error is repeated two pages later. The correct and logical succession is . . . . Silver Cape, Light Cape, Cape, Dark Cape . . . .

The remaining chapters are on "Valuing Diamonds", "Origin and Geological Distribution", "Diamond Crystals", "The Physical Properties of Diamonds" (the first part of which would fit more appropriately into the chapter on crystals), "Synthetic Diamonds: Artificial Coloration", concluding with "Identification of Diamond". A most useful summary of the properties of diamond as compared with its most plausible substitutes is given as a tail-piece to this last chapter. There are appendices giving statistics of the largest uncut and cut diamonds and of world production, photographs showing how to fold a diamond paper, and an excellent index.

A general feature in the production of this book which assists both casual and serious readers to find their way is the subdivision

of each chapter into quite short plainly headed paragraphs. The danger here (not always avoided) is that these headings may not always accurately reflect the contents of the paragraph.

In dealing with a book so full of accurate and detailed information, the reviewer who picks on the inevitable small errors and inconsistencies to be found in the text must seem ungrateful and ungenerous. These can more usefully be brought to the author's attention to assist him in the production of a new edition.

B.W.A.

BUTKOVIČ (Š.). *História Slovenského Drahého Opálu z Dubníka.* History of the Opal Mines at Dubnik. Bratislava, 1970. 268 p. Price Kcs. 30·00.

An excellent treatise in the Czech language about the Dubnik (Cervenica) opal mines. Now in Czechoslovakia, but formerly in Hungary, the mines are situated north of Kŏsice, in the eastern part of Slovakia, in the Libánka and Simonka mountains. Dubnik is the opal centre. The Czechoslovakian stones have a whitish background with delicate hues of blue, green and red. They are better known as Hungarian opals, before the district in which they occur became part of Czechoslovakia. The author has paid attention to the development of the opinions about opal which have appeared in the specialized literature and the bibliography is one of the best yet produced. The excellence of the text is supplemented by substantial summaries (about 16 pages each) in English, German and Russian. There are various coloured plates, but only one captures the beauty of this type of opal. For example, one really needs to see the splendid specimens in the Natural History Museum of Vienna to appreciate the loveliness of the stones. Dr. Butkovič has carried out a painstaking historical study of opal and a detailed account of the occurrences around Dubnik.

S.P.

SEN (N. B.). *Glorious History of the Koh-i-Noor Diamond.* New Book Soc. of India, 1970. ($4.00/£1·25).

This book was first published in 1953 as "History of Koh-i-Noor". Although in a larger format, it is substantially the same. The dedication has been changed and an end chapter in the original (a plea for the return of the diamond to India) has been omitted, though the old plea is still present in the new book.

S.P.

ASSOCIATION NOTICES

COUNCIL MEETING

A meeting of the Council of the Association was held at Saint Dunstan's House, Carey Lane, London E.C.2. on the 26th January, 1971. Mr. Norman Harper, Chairman, presided.

The following were elected:

FELLOWSHIP

Pie De Masso, Rosa M., Barcelona, Spain

ORDINARY

Blackwell, Gordon R., Royston, Herts.
Cambray, Clifford, Banstead, Surrey
Chetty, Samuel F. C., Vasby, Sweden.
Davies, Beryl A., Rhayader, Radnorshire
Rughini, Enrico, Bordighera, Italy
Fujisaki, Yukio, Iizuki City, Japan
Gandolfi, Giovanni A., Milan, Italy
Gilpin, Marriott O. F., Grays, Essex
Hutchinson, David, Sheffield, Yorks.
Leavitt, Joseph M., Orlando, Fa., U.S.A.
LeVine, Michael, Mt. Eden, Auckland, N. Zealand
Massie, George A., Sheffield, Yorks.
Nakamura, Yukio, Kumamoto-City, Japan
Ogden, John M., London
Ono, Koji, Kobe, Hyogo-Ken, Japan
Reston, J. A., Frodsham, Ches.
Robinson, Irvine, Silver Spring, Md., U.S.A.
Romi, Ishtiaq A., Karachi, Pakistan

Further arrangements were made in connexion with the Gemmological Exhibition to be held during the last two weeks in September and first two weeks in October, 1971, being arranged by the Glasgow Museums and Art Galleries and the Scottish Branch of the Association.

The following Officers were nominated: President, Sir Lawrence Bragg, C.H., F.R.S.; Chairman, Mr. Norman Harper; Vice-Chairman, Mr. D. N. King; and Treasurer, Mr. F. E. Lawson

Clarke. It was agreed that Mr. P. Riley should continue as Deputy Chairman of the Association.

Messrs. D. J. Ewing, J. M. B. McWilliam and W. Stern who retire under the Articles of Association in rotation, were nominated for re-election to the Council. Mr. Robert Webster, who retires under the age limit set down in section 185 of the Companies Act, 1948, was also nominated for re-election.

It was agreed to hold a meeting of members on the 12th October and the Presentation of Awards on the 23rd November.

The resignation of the Secretary to take effect in March, 1973, was received and accepted with regret.

MEMBERS' MEETINGS

A meeting of the Scottish Branch of the Association was held on the 19th January, 1971, at the North British Hotel, Glasgow. A talk was given by Detective Inspector H. MacLeod, F.G.A., of the Glasgow Police, entitled "Crime and the Jeweller".

A talk and demonstration of gemstone cutting and polishing was given by Mr. A. D. Hughes to the Midlands Branch of the Association, at a meeting held on the 18th February, 1971, at the Auctioneers' Institute, Birmingham.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to Dr. C. E. S. Arps for his monograph Petrology of a part of the Western Galician Basement between the Rio Jallas and the Ria de Arosa (N.W. Spain) with emphasis on zircon investigations.

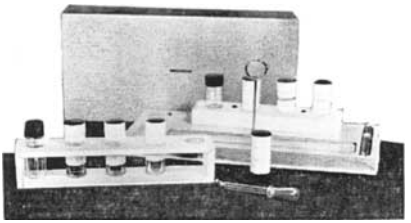
MEETINGS AND EXHIBITION

A meeting has been arranged for Tuesday, 12th October, 1971, at Goldsmiths' Hall, London, when Mr. Charles Schiffmann of the Gübelin Gemmological Laboratory, Lucerne, will be speaking to members.

The presentation of awards gained in the 1971 examinations will be held at Goldsmiths' Hall, London, on Tuesday, 23rd November, 1971.

An Exhibition of Gemstones is to be held at the Kelvin Museum and Art Gallery, Glasgow, during the last two weeks of September and first two weeks of October, 1971. This is being arranged by the Scottish Branch of the Association, in conjunction with the Glasgow Museums and Art Galleries.

GEMMOLOGY S.G. UNIT



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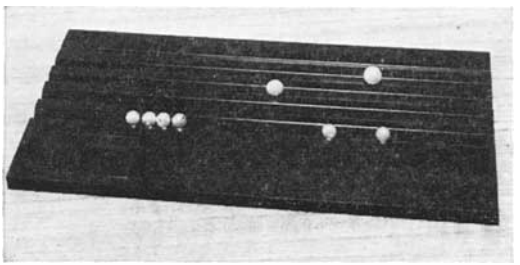

Black or white plastic sorting trays for cut stones, pearls or beads. Five different size grooves. White tray useful for colour grading of diamonds.

Measurement 20 × 10 cms.

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Distributing Agents:

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01-606 5025.

Vol. 12
No. 6
April 1971

CONTENTS

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