THE JOURNAL OF GEMMOLOGY

AND PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

Vol. IV No. 8 OCTOBER 1954

SOME UNUSUAL STRUCTURES in PEARLS and CULTURED PEARLS

by ROBERT WEBSTER, F.G.A.

MODERN techniques employing the revealing eye of the X-ray beam have opened up a new era in pearl testing, and during the past decade many peculiar structures in pearls have been observed by X-ray photography, some of which may well be of interest to readers of the *Journal of Gemmology*.

It may be an advantage to preface these notes with a short explanation of the principles of direct X-radiography. Quite soon after Röntgen made his classic discovery of X-rays it was observed that the degree of transparency of a substance to the rays was, broadly speaking, in inverse ratio to the atomic density of the substance. Therefore, a body having a structure made up of different substances may show different intensities of shadow to the rays and thus so affects a photographic film, or a fluorescent screen, as to make the structures visible.

From the foregoing it will quite easily be understood that the bony structures of the animal frame will be readily revealed by the greater density of shadow given by the bones, containing the heavier atoms of calcium (atomic weight 40) and phosphorus (atomic weight 30), as against that of the flesh which is made up of the light atoms, carbon, nitrogen, oxygen and hydrogen (with atomic weights of 12, 14, 16, and 1 respectively). This is illustrated by the radiograph of part of a human hand. Fig. 1.

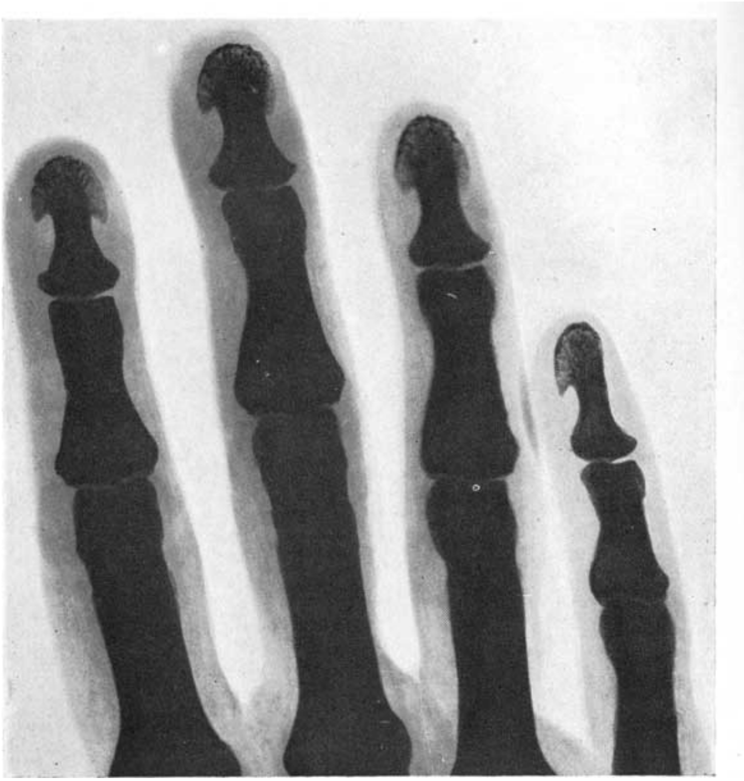


Fig. 1. X-ray picture of a human hand showing the greater opacity of the bones to the rays than is the case with the flesh.

The radiography of pearls is based upon the same principle of differential X-ray transparency, but owing to the very fine structures usually involved, special techniques are necessary. Gemmologists know that a genuine pearl consists of a mineral part, calcium carbonate ($CaCO_3$), usually in the form of pseudo-hexagonal twinned crystallites of aragonite arranged in concentric layers with their vertical axes radial to the centre, cemented with an organic substance called conchiolin. Therefore the analogy of bone and flesh again becomes evident. The conchiolin, however, need not be sufficiently concentrated to show up boldly like the picture of flesh and bone. It is much more likely to show up as fine line structures where the organic matter has been relatively more thickly deposited between the layers of the crystallites. The

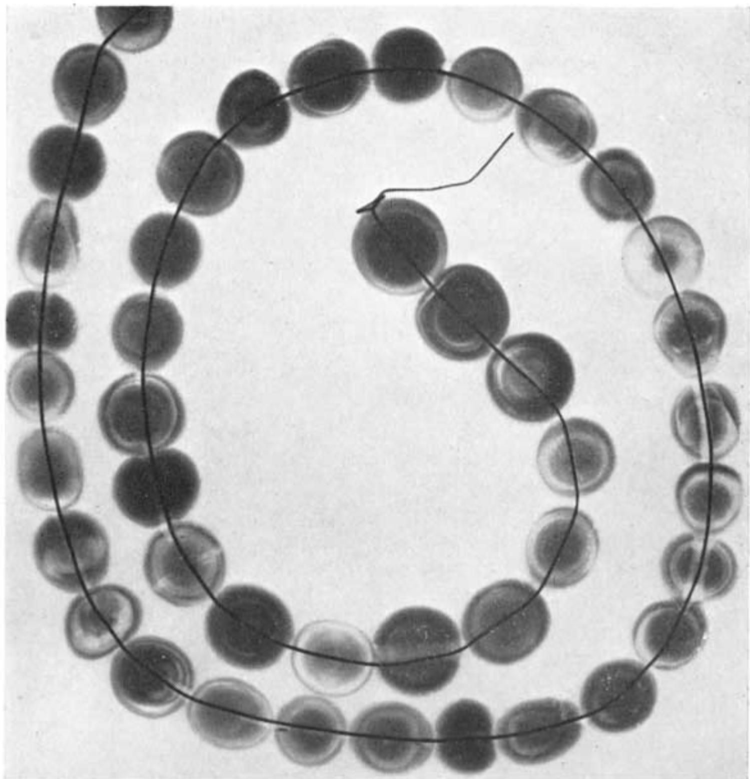


Fig. 2. Radiograph of a number of genuine pearls ; some of which show the " tree ring " effect.

X-ray picture may then show black lines as arcs or even complete circles, the latter producing a " tree-ring " effect. Most oriental pearls will show very little or nothing at all, although a conchiolin-rich centre is sometimes seen and indicates a natural pearl. Some of the structures seen in natural pearl are illustrated in Figure 2, which is a radiograph of some pearls showing much structure, an effect which is not often seen.

The finer structures seen in the X-ray photographs of genuine pearls rarely bear reproduction for illustrations. In every case of identification it is the film that is studied and even then must be examined closely in order to discern these fine structures which indicate the natural origin of the pearl. It must be mentioned at

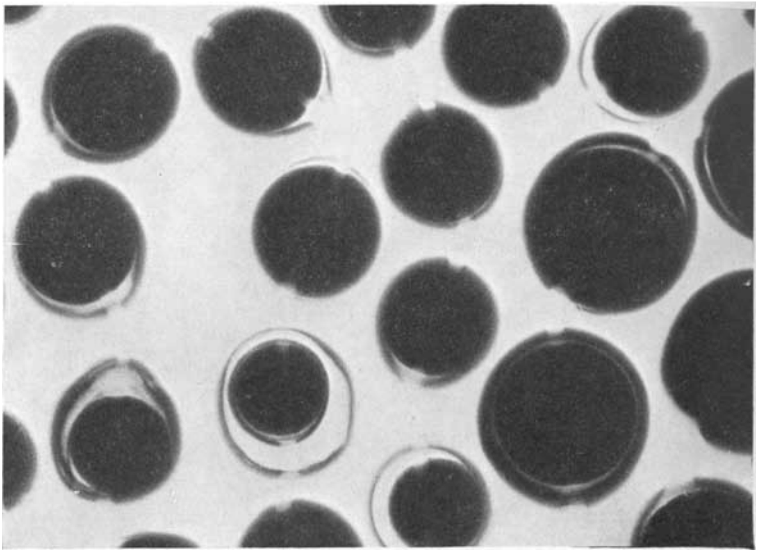


Fig. 3. Radiograph of cultured pearls showing the bead nucleus outlined by the conchiolin layer (white in this positive print but would show dark in the negative). One pearl appears to have had a cultured pearl used as nucleus.

Fig. 4. Radiograph of a drop-shaped cultured pearl showing an excess of conchiolin at one end thus producing the pear shape, the bead nucleus being spherical.

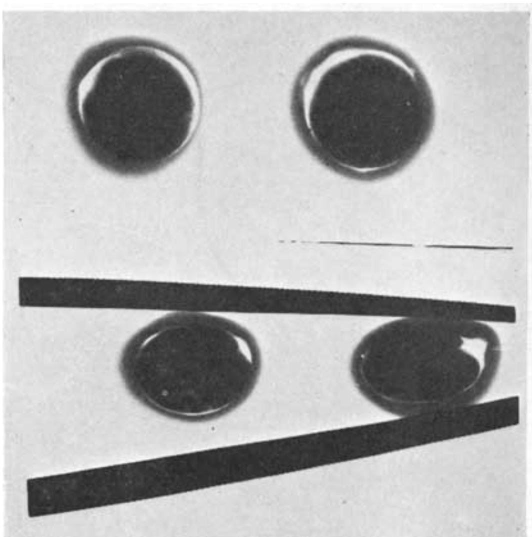


Fig. 5. Button-shaped cultured pearls with oval-shaped nuclei. Radiograph by Robert Crowningshield of New York.

this stage that all the illustrations are positive prints, and are also (except Figure 1) enlargements of the original film. Thus the white parts in the illustration will be black in the original negative—the blackening showing where the X-ray beam has been more easily able to penetrate. That is where the conchiolin patches lie.

In the case of cultured pearls with their relatively large mother-of-pearl nucleus, the bead centre often shows a slightly greater opacity to X-rays than the outer nacreous layer, and, further, shows no structure, except, when the position of the straight layers is parallel to the X-ray beam, when some differential absorption of the beam produces a weak but distinct banded appearance to the opacity of the bead nucleus.

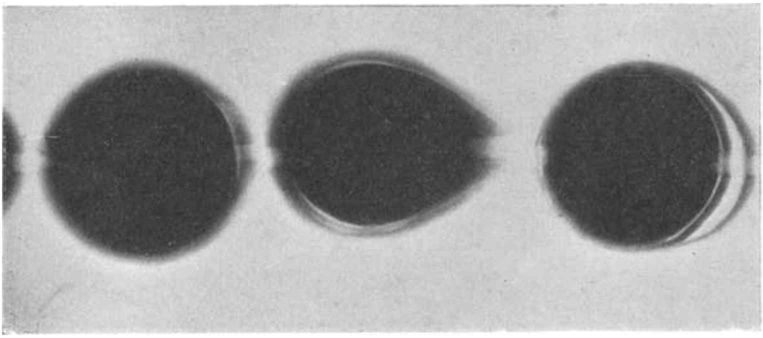


Fig. 6. A drop-shaped cultured pearl with a pear-shaped bead nucleus. The pearls on each side are normal cultured pearls with spherical beads.

What is usual in cultured pearls is to find that the bead is surrounded by a relatively thick layer of conchiolin. It is as though the oyster objected to the job of coating a large insertion and secreted conchiolin first and then completed the surface with pearly nacre. Figure 3 shows this effect well, but many cultured pearls show only a fine line encircling the bead—or sometimes the nature of the pearl may be seen only by the slight difference in the transradiability of the nucleus and the outer nacre. Often, especially with baroque pearls, the conchiolin deposit is considerable and irregularly arranged, an effect seen in some of the pearls shown in Figure 10. This is true also in the case of cultured drop-shaped pearls, which usually owe their shape to a patch of conchiolin producing the " pip " at one end (Figure 4).

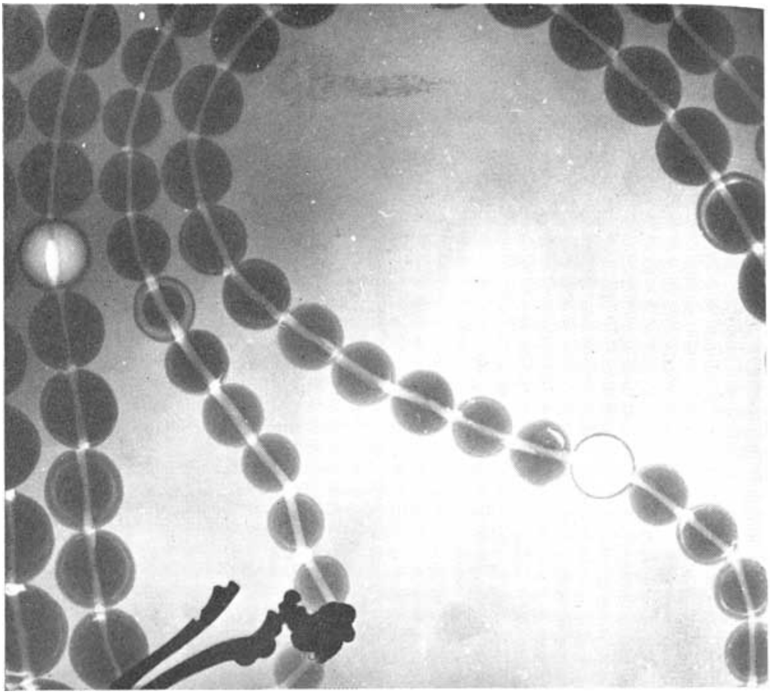


Fig. 7. The two cultured pearls with light coloured centres were found to have nuclei made of steatite (soapstone).

It is not, however, the intention here to discuss the techniques of pearl X-radiography, but merely to illustrate some of the more unusual structures met with in the course of routine testing.

In general the bead nucleus inserted into the Japanese pearl oyster (*Pinctada martensi*) is a spherical bead, but this need not be so, and some cultured pearls may show nuclei of different shapes. These are rare, for it is understood that the oyster does not take kindly to a nucleus of any shape other than spherical. It is said that nuclei of other shapes produce a greater mortality in the animals making the controlled production of pearls of other shapes than round to be less commercially practical, so that they are rarely used. That drop and button-shaped cultured pearls often occur adventitiously is well known, but these have round mother-of-pearl beads as cores and the resultant shape is due to vagaries of deposition of the conchiolin and nacre produced by the animal.

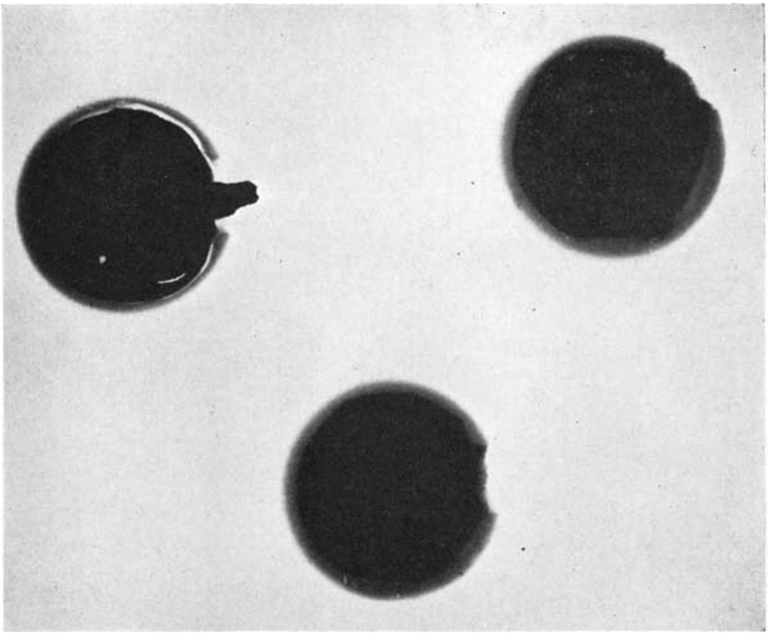


Fig. 8. Three cultured pearls which had their centres filled with cement.

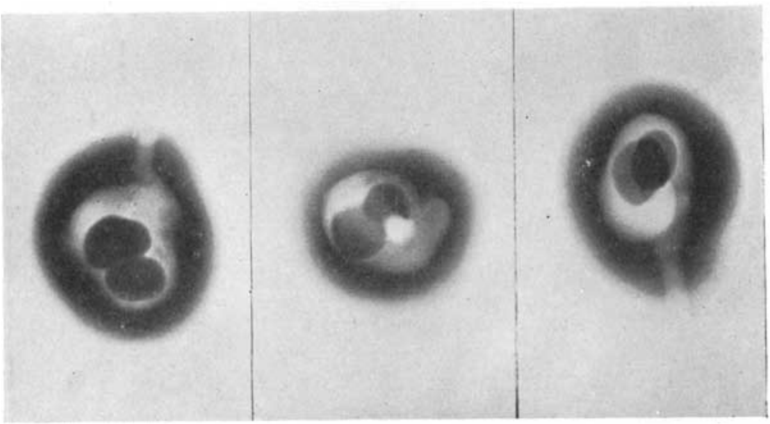


Fig. 9. A cultured pearl with " twin " nuclei. The pearl has been radiographed in three different directions.

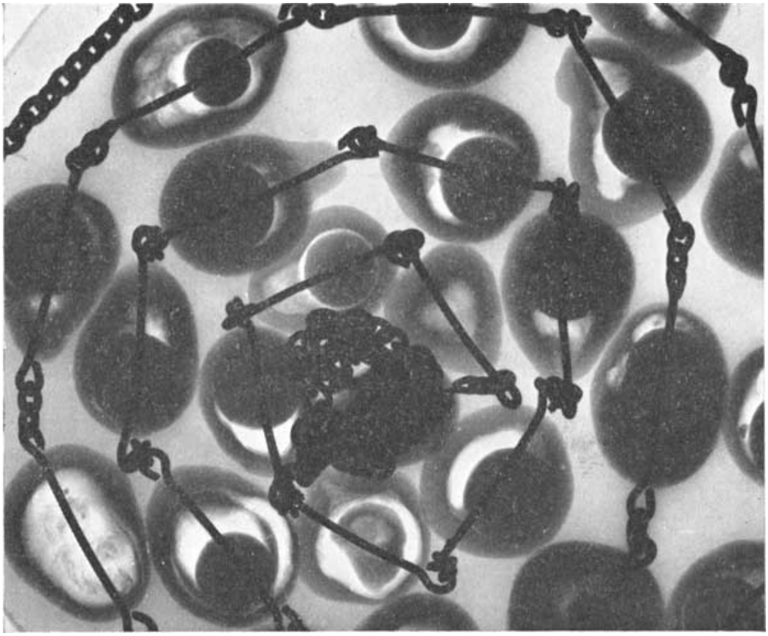


Fig. 10. Radiograph of a very baroque necklet showing some pearls without nuclei. These pearls are probably from the fresh water pearl clam (Hyriopsis schlegeli) of Japan. The nucleated pearls may probably be also from the same animal.

The writer has not happened upon an *oval* bead nucleus (used to produce button-shaped pearls) but is indebted to Mr. Robert Crowningshield of the Gem Trade Laboratory at New York for the illustration of a pair of such pearls (Figure 5). Mr. Crowningshield reports having met several pearls with such oval nuclei. Recently a case where the nucleus was pear-shaped was observed (Figure 6). Proof that this pearl was indeed a cultured pearl was made by the lauegram method. Laboratory records show that once before such a drop-shaped nucleus had been encountered, but in this case the direct picture did not show the outline at all well.

Several other cases of unusual nuclei in cultured pearls have been shown by direct X-radiography. Particularly interesting are the two pearls shown with white centres (black on the film) in the illustration of part of a cultured pearl necklet in Figure 7. As permission was given for these pearls to be removed and examined the nature of the nucleus could be determined. They were found

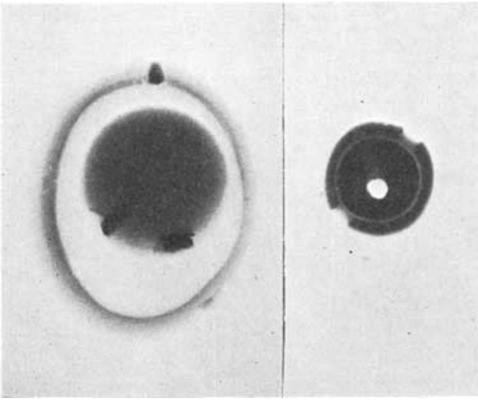


Fig. 11. *Cultured pearls in which the bead nucleus had become loose and had rotated.*

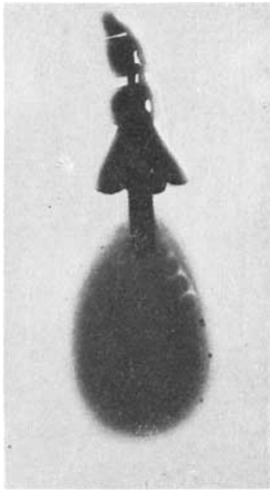


Fig. 12. *A genuine drop pearl with secondary drilling filled up with several seed pearls.*

to be banded steatite (soapstone). This effect has been seen since, a necklet subsequently tested showing a similar transparent-centred lone pearl. No opportunity was given to test this bead, which may even be one with a plastic core, it not being unreasonable to suppose that such a type of core could have been tried out experimentally.

Figure 8 shows three cultured pearls—at least they had nacreous skins—in which the inside was filled with some form of cement. Figure 9 shows three different views of a cultured pearl with irregular " twin " nuclei. The mate of this pearl was a perfectly good baroque cultured pearl with spherical nucleus.

The necklet illustrated in Figure 10 shows various types of baroque pearls including some without a nucleus. These latter pearls are thought to be some experimental non-nucleated pearls cultured from the freshwater pearl clam (*Hyriopsis schlegeli*) which lives at the south-eastern edge of the Biwa-Ko in Shiga Prefecture, Japan. The other pearls showing bead nuclei may also be from the same animal, for it is known that experiments with nucleated pearls were also carried out using the *Hyriopsis schlegeli*.

It is often noticed that the bead nucleus of a cultured pearl becomes loose and is able to rotate within the nacreous shell.

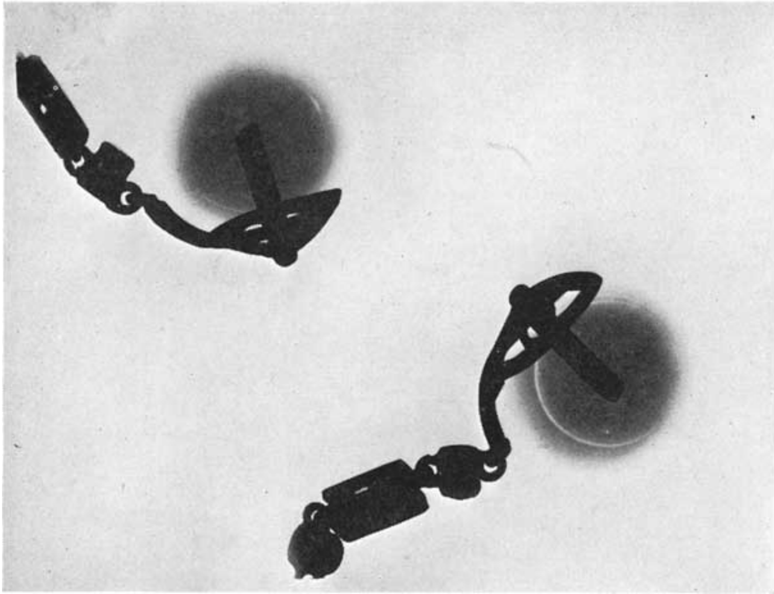


Fig. 13. *One of this pair of pearls was seen to be clearly genuine from the negative. The other seemed to be just as clearly cultured. Both pearls were found to be natural by the lauegram method.*

Figure 11 shows two examples of this effect, in one of which metal pins are evident.

Figure 12 shows a genuine drop-shaped pearl which has been " Chinese drilled," or drilled to relieve stress in a cracked pearl. In this case the secondary drilling has been filled up with four or five seed pearls.

Finally, reference must be made to the danger of direct X-radiography as a testing tool. The method requires experience in mastering the techniques necessary to produce a good negative, but considerably more in the interpretation of the negative itself. Figure 13 illustrates this point well, for on inspection of the negative it seemed clear that one of the pearls was genuine but that the other was cultured. The arcs and rings in the one pearl (much more clearly seen in the negative than in the positive reproduction) left no doubt as to its genuineness. The other pearl, however, showed only the one ring and there seemed little doubt that it was cultured. Lauegrams of the pearls, however, showed *both* to be natural pearls.

THREE GEMSTONES from BURMA

by B. W. ANDERSON, B.Sc., F.G.A., and C. J. PAYNE, B.Sc., F.G.A.

EARLY in May some unusual cut stones were submitted to the writers by Mr. A. D. C. Pain who has great interests in Burma. These stones all came from the well known stone tract at Mogok. The most impressive stone was a golden-orange sphene weighing 22·265 carats. A chip of this stone was first submitted which showed a small biaxial figure with great colour dispersion and very faintly the didymium lines in the yellow of the spectrum; very large birefringence seen through the polished facet and a vague reading on the refractometer at 1·91 all went to prove it to be a sphene. The large stone showed the didymium lines more strongly, and is the largest cut sphene ever seen in the Laboratory and very much larger than anything from the usual source in the Alps. It is unfortunately too full of vague lines and other inclusions of a powdery nature, which detract a little from the brilliance expected in a sphene. However, for sheer size it is a most remarkable stone. The density of the chip was 3·542 and the density of the large stone was identical.

Another unusual stone was a deep violet scapolite, weighing 4·083 carats. This stone had the following properties : ω 1·5487 ε 1·5398 $\omega—\varepsilon$ 0·0089 *d* 2·602. Pink and white scapolites were known from Mogok but this was an unusual colour. All Mogok scapolites are low type. Scapolite is the name for a series of silicates somewhat comparable to the plagioclase feldspars. They are tetragonal crystals of a lower class having only a horizontal plane and 4-fold axis of symmetry, their compositions vary from marialite $Na_4Cl\ Si_9\ Al_3\ O_{24}$ through dipyre and mizzonite to meionite $Ca_4\ CO_3\ Si_6\ Al_6\ O_{24}$, marialite and meionite being the end members of the series. The crystals are of course uniaxial and negative. This deep violet stone is on the borderline between marialite and dipyre, with about 80 per cent. marialite and 20 per cent. meionite. Most Burma stones that the writers have seen were of dipyre type.

The last stone was a grey blue star spinel of 18·24 cts. with a density of 3·591. Star spinels are rare and this was an unusually large specimen. The nature of the asterism is similar to that in the better known cubic mineral almandine garnet, alternating 4-ray and 6-ray stars all round the stone.

JADE STORY—EUROPEAN

by ELSIE RUFF, F.G.A.

TO begin an investigation of jade by writing of the ant seems irrelevant. Yet it is related to the subject in that it leads us to what might be called *The birth of the tool*. Maurice Maeterlinck's famous *Life of the Ant* contains a description of the Weaver ant's method of building a nest. The author sums up :

" Here, then, we have the first example, in the animal world, of the employment of a tool. We shall find no other example among the insects, nor even among the mammals, which occupy the highest positions in the hierarchy of living creatures. It is true that an ape has sometimes been seen to make use of a stick in order to rake in a banana or a nut which was not within reach of his hand ; but the action seems so precarious and uncertain, and inspired by such incoherent and fortuitous impulses, that it cannot be compared with the deliberate use of the distaff and shuttle."

Fossil amber from the Baltic area has provided abundant material for a study of ant life, in a period when the ant was already " civilized." This means, as Maeterlinck points out, that they existed in the Oligocene and the Miocene periods (20–35 million years ago and 1–20 million years ago respectively), long before the appearance of man. It was not till Pliocene times, approximately a million years ago, that we find man with crude flint implements. And many thousands of years elapsed before he used jade as his tool. There is no indication that jade was used for any other reason before this. Furthermore, it is quite evident that this jade implement was the highest achievement in Stone Age tools. It was the tool of experiment and experience. For efficiency it was second to none.

No wonder man valued early jade. Men are still proud of their tools, often to the point of veneration. In the Stone Ages a fine tool must have meant even more to individual man. For one reason, it could not be reproduced quickly. Time added to its preciousness, physical and psychological. Without it man could not live and remain *man*—evolving. Is it any wonder, therefore, that with the beginning of religious theories and superstitions specially fine jade implements were reserved for ceremonial occasions and became significant in various ways ? Sir James

Frazer (*The Golden Bough*) felt there were strong grounds for thinking that, in the evolution of thought, magic preceded religion. Certainly one can agree with him that precious stones were used as amulets long before they were worn as mere ornaments.

We find jade tools in Europe as early as 23,000 B.C. Swiss Lake Dwellers have left us ample evidence in beautifully finished artifacts. A lake community, built on piles, with a drawbridge that could be lifted at will, gives one a clear picture of early dwellers anxious about physical security. Pile dwellers are still extant, in various parts of the world, though the need for this type of protection has long since vanished. Early Swiss settlements were the dwellings of people using stone, bone and wood for their implements. Later communities added bronze. And, still later, iron.

Nor were these settlements isolated. The Lake of Neuchâtel accounted for fifty. Lake Constance for more than thirty. We may read that the settlement of Morges, in the Lake of Geneva, was exposed to view during the drought of 1921. Sutz, one of the largest settlements in the Lake of Bienne, extended to more than six acres, and its bridge, connecting with the shore, was nearly one hundred yards long and more than forty feet wide. From Lake Constance alone a thousand jade implements have been recorded, the station of Maurach having supplied nearly five hundred—not to mention chips and sawn fragments that inevitably surround the neolithic workshop.

We are entitled to believe that the period of man's use of jade in neolithic Europe was a long and well developed one. It was a period covering something like 20,000 years. Dr. Sydney H. Ball (*Roman Book on Precious Stones*) recorded that, in north-west Italy, neolithic people were using axes of both jadeite and nephrite as late as 2500 to 1500 B.C. and that Pliny's *Ceraunia* must have included just such axes.

In modern times, these jade implements first came to light during the 19th century and this led, naturally, to a great deal of speculation regarding their mineral origin. Many then believed that this jade came from the East, that is, China or perhaps Burma. It was suggested that a gradual emigration, involving generations, took place somewhere in the East, where jade was commonly used, and that some of these jade possessions accompanied the migratory people. (A similar theory was advanced regarding the migration of the Maoris to New Zealand, though in this instance not to account for the presence of jade in the country).

In Dr. Keller's *Lake Dwellings of Switzerland*, published in English during 1878, we may read, on page 451 :

" Several nephrites and jadeites, one of which is in the shape of a long chisel four inches in length, were found in the Settlement of Gerlafinger (or Gérofin) in the Lake of Bienne. According to Professor Fischer of Freiburg (Baden) the density is 3.01. It is the most important of all the specimens of nephrite yet found in our lake dwellings, in fact its beautiful greenish-blue tint, with scattered reddish-yellow spots, make it look very like the Siberian nephrite of Bantongol. Professor Fischer has a fragment which was brought direct from that country. Now, the fact that the isolated block of nephrite found at Schwernsal, in the early part of this century, is perfectly identical with the nephrite of Siberia, may possibly furnish us with some data to the route which was followed by the first inhabitants of this country."

Others who studied the question believed that sooner or later a European locality would come to light. Since two occurrences of nephrite were later discovered, this theory has proved partially correct. Yet the source of jadeite remains a mystery. In a footnote to the volume quoted above (p. 61) Professor von Fellenburg, reading a paper at Bern in 1865, said : " . . . the question yet to be decided is, whether the nephrite found in our lake dwellings may not also have been of Swiss origin, like the celts more commonly found with it, made of serpentine and siliceous schist, for the serpentine and chloritic schist which occur in New Zealand nephrite districts, are found also in Switzerland . . . and very possibly also may show segregations of nephrite."

Nor were these jade implements confined to Switzerland and northern Italy. They have been discovered all over Europe, in particular Brittany. A very interesting paper, part of which follows, appeared in the Journal of the Anthropological Institute during 1930 (Vol. 60). It was entitled " On the use of Greenstone (Jadeite, Callais, etc.) in the megalithic culture of Brittany," by C. Daryll Forde : " In Spain and Portugal the megalith builders made extensive use of various green stones as a material for polished stone axes and necklace beads. North of the Iberian peninsula these elements of material culture thin out. In parts of the peninsula of Brittany, however, green stone beads and axes are again abundant. They are found especially in a dense megalithic concentration which rivals Iberia in the magnificence of its tombs. Green stone axes, generally said to be of jadeite, have been found occasionally in the megalithic areas of France, in the Massif Central, in the Western Pyrenees and the tombs of the Marne. But they are reported in far greater number from the Breton peninsula. . . . The Breton green stone axes are often distinct both in form and size from the numerous tools of fibrolite and other substances which were in daily use among the megalithic builders. They are frequently bored with great care for suspension by a thong, and were sometimes deliberately broken when placed in the tombs. They show no sign of use as implements. These qualities justify us in regarding them as special productions for use in tomb ritual, and I shall therefore refer to them as ceremonial axes. . . . Ring discs of jadeite and other stones are associated with the ceremonial axes. . . . Damour examined specimens of Breton and other 'jadeite' axes. Of the French axes he says: 'We must regard the material of the axes as very rarely of an absolute purity. In many of the specimens it constitutes not a single species, but rather a mixture of various elements in which jadeite would appear to enter in a varying proportion. The mixed substance may belong to the minerals of the epidote group, or to the isomorphic pyroxenes of jadeite of approximately the same density' . . . The greater number of the Breton axes that have been mineralogically examined are of jadeite or its variety chloromelanite. . . . Occasionally axes of true jade (nephrite) are also claimed. . . . Green stones, generally identified as jadeite, were also used in the early cultures of Northern and Central Italy. They are frequent in the 'neolithic' caves of Liguria . . . it is clear that in Italy, as in Western Europe, the early civilized communities were expert practical mineralogists. The jadeite and the chloromelanite of the axes of North Italy are almost certainly of local raw material, for Franchi was able to show that the jadeite pebbles, long known in Piedmont, were derived from outcrops to be found, *in situ*, in the Ligurian Appennines and parts of Western Switzerland. . . ." In 1879 Dr. Heinrich Schliemann was unearthing the old walled city of Hissarlik and there thirteen nephrite implements—one white—varying in specific gravity from 2.91 to 2.99 came to light.[1] Professor Maskelyne, to whom

1. It is interesting to note that in his *Ilios, City and Country of the Trojans*, Dr. Schliemann, along with others of this period, refers always to jadeite and jade (nephrite).

Dr. Schliemann applied for these determinations, wrote that, among the thirteen Hissarlik jade implements, " . . . is the first . . . I have seen of true white jade as the material of a stone implement, and that too in association with the regular green jade."

Since Professor Maskelyne's remarks are so interesting, it seems right to quote him further, and at some length. "The presence of white jade," he goes on, "is interesting as pointing to the locality whence it came ; its association with its green brother is interesting as helping to confirm this indication. In fact, it is a very great probability that the Kuen-lun mountains produced the mineral of which these implements are made, and that they came from Khotan by the process of primeval barter, that must have nursed a trade capable of moving onwards over the 'roof of the world' perhaps, or less probably by Cashmere, Afghanistan, and Persia, into the heart of Europe. If the Pamir and the Hindoo Kush was the route, this primitive stream of commerce may have flowed along the course of the Oxus before that great artery of carrying power had become diverted by the geological upheaval of Northern Persia from its old course to the Caspian. I have always wondered why jade ceased to be a prized material and an article of commerce as soon as civilization laid hold of our race. The Assyrians and the Egyptians hardly, if the latter at all, knew jade. Yet jade implements have been dug up in Mesopotamia of primeval type, and the commerce that transported these implements in far distant times bore them as far as Brittany. The Assyrians and the Egyptians, like all other peoples, have valued green stones. Green jasper and Amazon stone, and even Plasma, were known and appreciated ; why not then jade also ? My answer would be, that they could not get it. Unlike the Chinese, who have always kept it in honour because they have it at their gate, the Mesopotamian and Egyptian artists did not know jade, or only knew it as coming accidentally to hand, perhaps as a material of a prehistoric weapon. We need to know more than we do of the prehistoric movements of the human race, to be able to say whether the region of the Pamir and of Eastern Turkestan was once more densely peopled, was in fact more habitable, than to-day is the case ; but I am strongly inclined to believe that a geological change is at the bottom of the disappearance of jade from among the valued materials of the archaic, the ancient, and the medieval ages, down to within three hundred or four hundred years of this time. If the upheaval of the regions, along which this commerce flowed, has rendered them less habitable, has planted deserts where once men dwelt with flocks, has made regions of ice where once winter was endurable — has, finally, diverted from its course a great river, that bore a commerce or at least fertilized the route of a commerce — there may be an explanation of the drying up of the stream of that commerce itself.

The Hissarlik locality for such an interesting find of so many and such beautiful jade implements has an interest also in this, that the geographical importance of the Hellespont, as the Bridge from Asia to Europe, seems to have brought to that spot the opportunity of selection and an abundance of material. I am writing to you perhaps some dreams more dreamy, you will think, than any of the dreams I wrote of in my first page. At any rate, while you are giving realistic life to the ancient tale of Troy, strive to do something, too, for this more venerable witness to the brotherhood and the intercommunication of the human race in the age rather of Kronos than of Zeus. Was it the jade-stone that Kronos swallowed?"

The author himself now writes: "Professor Fischer is amazed at hearing that among my thirteen Hissarlik jade axes there is a white one, for he had as yet only seen axes of green jade; he knows rare white jade abundantly from Turkestan (at least, yellowish, greyish, and greenish white), besides perfectly white from China; but no trace of axes was discovered by the travellers of his acquaintance who explored the jade quarries of Turkestan. (Footnote: This white jade axe . . . was found at a depth of 6½ feet below the surface, and must therefore belong to the latest prehistoric city of Hissarlik; for in the subsequent settlement, which from the pottery I hold to be an ancient Lydian one, I never found stone implements.) The Siberian jade has a bright grass-green colour; the New Zealand jade for the most part a more dark green colour. There is besides a very dark green jade in Asia, which must be native somewhere in Asia (perhaps in Turkestan), and of which Timur's[1] tombstone in Samarkand is made. Professor Fischer received fragments of the latter from the late Professor Barbot de Marny of St. Petersburg, who knocked them off with his own hand in the mosque, of course at the danger of his life. Professor Fischer says in conclusion that my thirteen Hissarlik jade axes come from the farthest eastern

1. Commonly known as Tamerlane by many European travellers. Up to the 20th century the tomb was described as of *jasper*.

point at which polished jade axes have been found, and expresses the wish that before the end of his life the fortune might be allotted to him of finding out what people brought them to Europe."

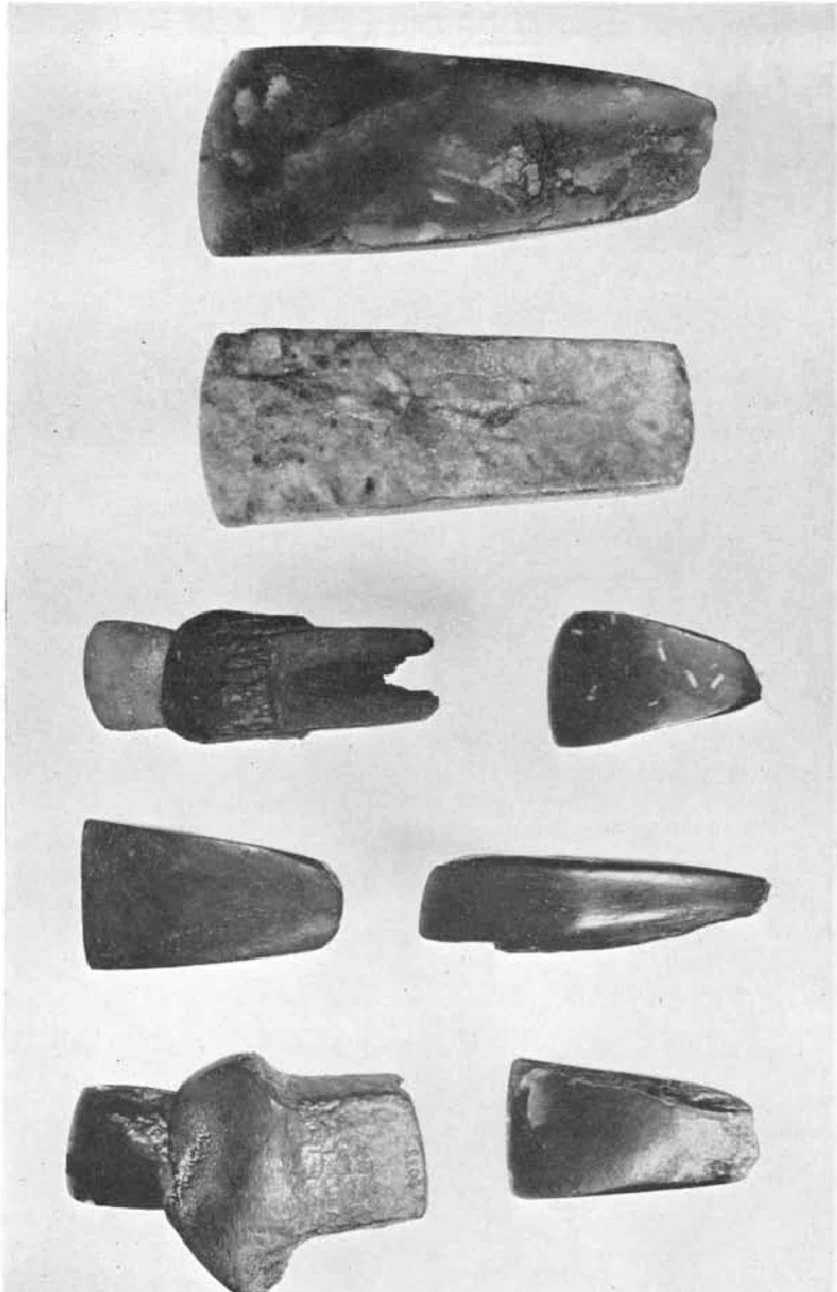
Isolated finds of raw jade have been legion. One reported piece of unworked jade in Europe goes back to 1815. Later in the century, Professor A. Damour, who gave the name to jadeite, recorded a pebble or boulder and a piece of crude jadeite from Italy.

During the discussions of the last century it was pointed out that, in the early days of the Swiss Lake Dwellers, Europe was occupied by a race of Turanian[2] aborigines and that it remained for the Aryans to introduce iron and finally to dominate the older race. We have no idea what this early European called his jade. He probably said no more than " pass me the axe." What we do know is that the jade comprised two varieties, jadeite and nephrite. In other words, our jade of to-day.

It was hardly possible, in those early days, for jade to be substituted. No other substance yielded so fine an edge—little short of good steel—or proved so tough in use. If he did not know, through fashioning, that he was dealing with a substitute, early man would be quickly aware of it in use. There could be no compromise until his need was ceremonial or amuletic or ornamental, and even then, since jade, if available, was not exactly scarce, it is very unlikely. Again, the early cutter could hardly have been deceived.

The study of jade teaches us much about man. Indeed, it is linked with him. To study jade is to study man. Jade is, as Professor Maskelyne put it, a "venerable witness." This study has helped to establish that early man travelled much more than we once gave him credit for. He migrated more, probably for a variety of reasons. In fact, the history of man is the history of his migrations. To some extent, this accounts for the fact that jade implements, *par excellence,* were in use literally all over the world. Another theory must also be considered, nevertheless. (And it may be that both are correct.) Given similar circumstances and similar needs, man arrives at similar conclusions. Human thought travels along much the same groove. (One may experiment with this for oneself, remembering that it is not always easy to be sure one acts *originally,* for memory plays tricks).

2. An obscure term thought to be of great antiquity.



Photograph by courtesy of Swiss National Museum.

Apart from our knowledge that the Swiss Lake Dweller used jade—some of the hatchets were expertly fitted with horn handles comparable with our modern carving knives—and that he used, apparently indiscriminately, the two varieties, it has been shown that jadeite was much more prolific on some lakes while nephrite was prolific on others. Nephrite implements have been most commonly found in the lakes of East Switzerland, Lake Constance for example. Jadeite prevailed in the West—Neuchâtel and so on. In France, away from lake dwellings, jadeite predominated. Out of thirteen prehistoric implements tested from this country only one was of nephrite. These facts were established towards the end of the last century. Yet it did not mean that both types of jade were not often found together. During 1892 two small pebbles of nephrite from the Lake of Neuchâtel were tested for specific gravity, giving a reading of 3.02. Two more pebbles from the same shores gave specific gravity results as 3.42 and 3.36, and of these the following chemical compositions were published :

Specific Gravity	3.42	3.36
SiO_2	52.42	50.30
Al_2O_3	26.00	25.68
FeO	2.02	2.79
CaO	9.05	11.00
MgO	3.56	4.45
Fe_2O	7.44	6.30
H_2O	0.20	0.40
	100.69	100.92

Regardless of the term in use, whether by historians or contemporary gemmologists, our quest for jade would appear to stem from the jade of neolithic man, that is, man of the advanced Stone Age. And European neolithic jade is the oldest jade we know. The discovery of jade weapons and implements in the Cave of Mentone, and other such deposits of Western Europe, started off a series of enquiries in the last century that came to be known as *The Jade Question.*

The first recorded discovery of nephrite *in situ* was made by Hermann Traube of Breslau in 1884. Here in Silicia, Germany, near Jordansmühl, he came upon material he might easily have over-looked, and which he first thought to be a hard serpentine. On chemical analysis it proved to be nephrite. In 1886 he found a further nephrite occurrence in the same country, this time at the well-known arsenical pyrites mines near Reichenstein. Later, in 1899, an American gemmologist, Dr. George F. Kunz, discovered, at Jordansmühl, one of the largest, if not the largest, boulders of nephrite yet to be quarried. It weighed 4718 pounds and is now in the American Museum of Natural History, New York City. Almost as satisfactory as the discovery of these occurrences was evidence that the deposits had been worked in prehistoric times.

It is interesting to read Max Bauer's account in his book *Edelsteinkunde*, published in Leipzig in 1896 and translated in 1904 by Dr. L. J. Spencer: "The occurrence of nephrite *in situ* in Germany, is limited to Silesia. . . . One of these (occurrences) is Jordansmühl in the Zobten mountains : here nephrite, usually of a dark green colour, forms a layer of considerable extent, and in places over a foot in thickness, between granulite and serpentine. The mineral occurs at the same place as rounded nodules, the largest of which measure 5 cm. across and in veins in the serpentine; the nephrite of which the axes found at Gnichwitz, two hours journey from Jordansmühl, are made, is very similar in character to the rough material found in the locality. The other locality in Silesia, at which nephrite is found, is Reichenstein, a famous mining centre. The material found here is compact, of a light greyish-green colour, sometimes tinged with red, and is indistinctly schistose ; it occurs in layers, the thickest of which are 7 cm. across, interlaced with a diopside-rock in the Prince adit."

Despite the enthusiasm that these occurrences developed, nothing further has come to light, and the jadeite of Europe is still a mystery. In the Journal of the Anthropological Institute of 1891, it was said that the missing factor in the jade problem was our ignorance—a statement applicable nevertheless to most studies—and that the last word had not yet been said on this subject. More than half a century has elapsed and we are no nearer a jadeite solution. Far from the last word having been said, we are still groping around to complete the first chapter of this story. And thousands of words on the subject of jade have appeared during the past five decades. Many occurrences of nephrite have been recorded in Scotland, not one of which has been established.

The favourite, involving the ancient little island of Iona, in the Hebrides, has been well publicized and definitely exploded. As far back as 1899, the following appeared in the Journal of the Anthropological Institute (Vol. XX) :

" Mr. Walhouse said that some years ago he noticed a letter in the *Times* in which the writer stated that, when visiting Iona, he had bought some pretty green pebbles from children who were offering them for sale on the beach, and some time after he had shown them to a Chinese gentleman of some learning, who pronounced them to be real jade. Mr. Walhouse said he had been to Iona himself some years before this letter in the *Times* and had bought some of these pebbles, two of which he produced. Mr. Rudler however pronounced them to be only serpentinous marble, or ophicalcite, a mixture of serpentine and limestone."

Mention has also been made of nephrite occurrences in Ireland though nothing that could give serious credence to this assertion has yet transpired. Some claims go back as far as the seventh century, when an Archbishop of Armagh is said to have had his mitre set with " three Gadde[1] stones of green mined in Tirone." That a neolithic people used jade in Ireland is by no means improbable. Lake Dwellings existed in that country and, to quote *Lake Dwellings in Switzerland* once more (page 493) : " . . . we believe the builders of the lake dwellings were a branch of the Celtic population of Switzerland, but that the earlier settlements belonged to the prehistoric period, and had already fallen into decay before the Celts took their place in the history of Europe."

Just as fossil amber has been invaluable in the study of ant life, so is it not without significance in the study of jade. Swiss Lake Dwellers traded in amber and this amber almost certainly came originally from as far away as the German coast. Assuming that the Silician nephrite occurrences were known in those days, the distance could hardly have presented great difficulty. We may learn that these early people were a " pastoral people, and possessed the most important animals, such as the dog, the cow, the sheep, the goat, and the horse. All these animals have their origin, not in Europe, but in Asia. . . ."

1. The term *Gadde* in 7th century Ireland must be discredited when applied to jade, as will be shown later.

2. Said to be the oldest existing Treatise on Stones.

Since Jordansmühl and Reichenstein have long remained just place names to the average gemmologist, the above map gives the position of these two small places — approximately 47 *kilos apart — in relation to a large centre, viz. Breslau. Jordansmühl is about* 31½ *kilos from Breslau.*

For this information we are indebted to Sir Charles Hardinge, Bart., who has made a study of the district from two sheets of an old and out-of-date German Ordnance Map.

In a fragmentary treatise *On Stones* that has come down to us, written by Theophrastus in 315 B.C.,[2] we are told that the Swiss Lake Dwellers and early peoples had solved the secret of striking fire with pyrites. The Reichenstein nephrite occurrence was discovered in the arsenical pyrites mines. If these ancient peoples obtained their pyrites from this mine, they almost certainly secured nephrite from the same source.

Gemmological Abstracts

SCHMIDT (PH.). *Jade—ein Edelstein in der Kultur der Jahrtausende. Jade—a gem in the culture of millenniums.* Zeitschr.d.Deutsch. Gesell.f.Edelsteinkunde, No. 8, 1954, pp. 11–15.

The archeologist Dr. Alberto Ruz Luhillier found in the grave of a Maya prince in the ruined city of Palenque on Tehuantepec inside a pyramid the skeleton of a middle-aged man. The head was covered with a jade diadem, and there were also jade ear-rings. The face was covered with a jade mask. Both hands held jade objects, which were also laying loosely about, especially small jade idols of the Maya sun god. During the whole history of man jade, especially nephrite because of its hardness, is of great importance. For a time it was assumed erroneously that prehistoric nephrite from Asia, specially China, was brought to Europe and the rest of the world. In 4000 and 5000 B.C. nephrite was used in Egypt for knives, saws, hammers, etc. Many of these prehistoric tools were found in other parts of the world, i.e. America, Australia and central Africa. In Europe these prehistoric articles made from nephrite were found in southern Italy, France, Austria, Switzerland and Germany. The material corresponds with European occurrences. To-day jade is found in Turkestan, Siberia, India, China and New Zealand. The Maoris use jade for ancestral masks. In Troja articles of gold, ivory, amber and nephrite were found. Although nephrite was used universally for arms and ornaments, it was valued most in China. In the seventh century B.C. " Yu " the gem of gems was described by Kvan-Yhung, the Chinese philosopher. The insignia of the Chinese emperors were jade and the emperors of the Tchou dynasty (122–249 B.C.) drank jade in water. Many jade articles were carved as symbols. Most precious stones were supposed to have some magical power in the antique, and nephrite was supposed to heal illnesses affecting the eye, stomach and especially the kidneys. It was also used as protection during child-birth. Even to-day jade is a talisman in Turkey against the " evil look," in India against lightning. It is worn as birthstone (Cancer) and as talisman by gamblers and racing motorists. Apart from its use as seals and ring stones, New Zealand nephrite (green stone) is worked into amulets for the Maoris not only locally but on a bigger scale at Idar-Oberstein. The survey is a valuable historical account with many literary references. E.S.

Bambauer (H. U.), Schmitt (K. H.). *Ein neues Lapis-Lazuli-farbiges synthetisches Produkt. A new lapis-lazuli coloured synthetic product.* Gold und Silber, No. 7/8, 1954, pp. 13–14. (See Journ. Gemmology, 1954, Vol. IV, No. 7, p. 281.)

Examination with the polarizing microscope of thin sections and powder specimens showed that the new Idar-Oberstein made material which appeared uniformly blue to the eye consisted of an aggregate of roundish grains which were optically isotropic and of a diameter of 0.07–0·6 mm. (0·003 to 0·024 inch). The nature of numerous apparently colourless roundish inclusions in the grains was not determined. The R.I. was $1{\cdot}716 \pm 0{\cdot}003$, the S.G. was $3{\cdot}58 \pm 0{\cdot}01$ (sic !) and the hardness around 8 Mohs' scale. The constants pointed to a spinel-like crystal compound. The material was soluble in pyrosulphate of potassium and the qualitative analysis had the following result :

Al_2O_3	...	79·52%
MgO	...	19·03%
CoO	...	1·53%
		100·08%

corresponding to a Mol. ratio of 0·63 MgO : 1·00 Al_2O_3, if the 1·53% CoO are added to the MgO. From these values a formula could be compounded as follows :

$$Mg_{1{\cdot}96}\ Co_{0{\cdot}09}\ Al_{6{\cdot}35}\ O_{12{\cdot}00}$$

If it was assumed that the material belonged to an isomorphous series the hypothetical end members of which were $3(MgO.Al_2O_3)$ and $4(\text{Gamma } Al_2O_3)$ (i.e. $Mg_3AL_6O_{12}$ and gamma Al_8O_{12}) ; it could be seen that the Mol. ratio $(R''', R'')_{8{\cdot}40}O_{12{\cdot}00}$ pointed to a position of the material roughly in the centre of the series, but nearer the gamma Al_2O_3. The blue colour was caused by the presence of CoO. X-ray diffraction methods were used to determine the lattice constant a_0 $8{\cdot}042 \pm 0{\cdot}002$ Å. It could be shown in a diagram that this value fell on the straight line connecting the values for the end members of the isomorphous series, namely

a_0 8·09 Å for $Mg.Al_2O_3$ and a_0 7·88 Å for gamma Al_2O_3. The name given to the new material, i.e. " lapis-lazuli coloured synthetic spinel " is thus correctly chosen. W.S.

SALLER (X.). *Neuigkeiten vom Zuchtperlenmarket. News from the market in cultured pearls.* Zeitschr.d.Deutsch.Gesell.f.Edelstein-kunde, No. 8, 1954, pp. 4–6.

Newly imported pearls from Japan are most difficult to determine. Two grey baroque pearls were examined ; they were 10·5 × 9·5 mm. and weighed 8·93 cts. That they were cultured could perhaps be suspected from a small truncated conical protrusion, the top of which curved inwards in the manner of a crater and the surrounding of which was slightly pale. Also under the microscope, one could not find any definite indications. Cultured pearls usually adopt the shape of the piece which is inserted into the mollusc and covered by it. If this foreign body is round, the pearl will also be round, if irregular the pearl will be irregular or baroque. If the bead, however, is round and the pearl yet grows irregular, the reason remains obscure even if one cuts open the pearl. The two examined baroque pearls were abnormal. The reproduced X-ray radiography showed that they were cultured, The inserted round bead took up one-third only of the total volume and one-third only of the skin was attached to the nucleus. Two X-ray diffraction patterns taken at right angles to each other revealed the true nature without any doubt. When one pearl was opened it was found that the space between the skin and the bead was only partly filled with conchiolin. E.S.

SCHIEBEL (W.). *Farbskala für den Edelsteinhandel. Colour scale for the gem trade.* Zeitschr.d.Deutsch.Gesell.f.Edelsteinkun de No. 8, 1954, pp. 10–11.

The precise determination of the colour of a precious stone is most difficult, as there is no possibility of comparison in nature or technical and commercial literature. A suitable scale is wanted. In order to obtain a colour scale for himself the author obtained a series of synthetic stones of various shades. He points out that in other industries colour scales are existent, for instance in the paint and sugar industries. He suggests a scale made of glass specimens, each colour numbered, and distributed to all jewellers, workshops, factories, wholesalers and others. E.S.

ALTMANN (J. D.). *Spotlight on Australian Opals.* Lapidary Journ., Pt. 1, Vol. 8 (3), pp. 266–273.

A short account of the Australian opal fields and mining and business methods. There is a useful summary of definitions of opal and mining expressions. S.P.

RUTLAND (E. H.). *Vest-pocket polariscope.* Gemmologist, Vol. XXIII, No. 275, pp. 103–4. June, 1954.

Describes a small polariscope employing polaroid discs. It is no larger in size than a pocket loupe, and the design is based upon that of the usual folding magnifying glass. The stone is held in a " cell " which fits into the body of the instrument and is held firmly, but at the same time allowing rotation, by the pivoted top cover containing the upper polaroid disc. Instructions on how to use, and the use of, the polariscope are given, and some facts on the " extinctions " observed with doubly refractive stones and the anomalous effects seen in synthetic stones and pastes due to strain. 1 illus. R.W.

TRUMPER (L. C.). *Distinguishing kornerupine from enstatite.* Gemmologist, Vol. XXIII, No. 276, pp. 125–127. July, 1954.

A comparison of the properties of the two minerals named, with particular reference to the brownish-red enstatite reported upon earlier by R. K. Mitchell. (*Journ. Gemmology Abs., Vol. IV, No.* 5, *p.* 214). 1 illus. R.W.

WILD (G. O.). *Punched card system for gems.* Gemmologist, Vol. XXIII, No. 276, pp. 133–134. July, 1954.

Describes a system for the quick identification of gems from their observed characters ; i.e. refraction, colour, specific gravity, birefringence, dichroism, hardness, transparency, etc., by the " business efficiency " punched card system. For ordinary trade gemstones some 150 cards need to be prepared and some 300 needed to cover all gem materials. There is a slip in the illustration in that carbon tetrachloride is referred to as having an R.I. of 1·62 (CCl_4 has n 1·46). 1 illus. R.W.

CUSTERS (F. F. H.) ; DYER (H. B.). *Discrimination between natural blue diamonds and diamonds coloured blue artificially.* Gems and Gemology, Vol. VIII, No. 2, pp. 35–37. Summer, 1954.

Natural blue diamonds are found in few mines, the Premier mine of South Africa being the most important. Diamonds may be artificially coloured by bombarding them with atomic particles either in or outside the atomic nucleus, which have been given high speeds ; e.g., neutrons from a nuclear reactor, protons and deuterons by cyclotron, and the electron most commonly by a Van de Graaf generator, which may also be used to accelerate protons and deuterons. High speed particles striking a diamond may eject atoms from the lattice site to an interstitial position. Such a displacement is known as radiation damage and can cause absorption of light by electronic transitions previously forbidden in the undamaged lattice. Pile-irradiated diamonds turn green and other colours have been reported after deuteron bombardment. Blue diamonds, nearly indistinguishable by eye from natural blue diamonds, have only a superficial colouration (depth of penetration of the electron is stated to be only 0·5 mm), but owing to reflection and refraction in a brilliant-cut stone this effect is not seen. All natural blue diamonds were found to be electrically conductive and this is considered to be the property of a special type of diamond classified as Type IIb. Blue diamonds owing their colour to bombardment are either Type I or Type IIa and are non-conductive. Simple conductivity experiments suggested as means of identification of artificially coloured blue diamonds. Type I diamonds are transparent down to 3000A only and Types IIa and IIb down to 2250A. Type IIa after " blueing " by bombardment then show clearly observable absorption at 2700A. It is suggested that a suitable filter which is selectively transparent at about 2700A, a photoelectric cell sensitive to that waveband, or a substance which will fluoresce in that range, may be suitable as detectors. It has been established that natural blue diamonds show a very strong absorption in the infra-red (from about 1 to 2 microns), whereas neither Type I nor Type IIa absorb appreciably in this part of the spectrum. It is suggested that a suitable filter in conjunction with a suitable infra-red detector might be used for distinction. All these devices are still in the laboratory stage but may admit of simplification for general use. R.W.

SINKANKAS (J.). *The gem and ornamental stone market of Hong Kong to-day.* Gems & Gemology, Vol. VIII, No. 2, pp. 47–53. Summer, 1954.

A survey of the present conditions in the jewellery and ornamental stone trade in the British Crown Colony of Hong Kong, which is adjacent to Communist China. " Soochow jade " is a fine quality translucent serpentine. Two distinct classes of carved work are noticed—the old work of painstaking care and design, and the newer work of poor artistic merit but with slick finish. Some descriptions are given of the articles fashioned in the various quartz minerals, in amber, turquoise, serpentine, fluorite, beryl, lapis lazuli, tourmaline, malachite, corundum and some others. Jades are discussed and such discussion will be carried further in the next instalment.

R.W.

ANDERSON (B. W.) ; PAYNE (C. J.). *The spectroscope and its applications to gemmology.* Gemmologist, Vol. XXIII, Nos. 275/6/7, pp. 110–113 ; 119–123 ; 142–147. (Parts 10–11–12), June/July/August, 1954.

The series continues with a discussion on the colouring agents which are the cause of the colour in gem materials. The reason why some agents produce colours in some cases and not in others is said to be not properly understood. The elements with atomic numbers 22 to 29 (the so-called " transition elements ") are the most common colouring agents. The position of the absorption bands of a given element varies considerably according to the species of the host mineral. Only in idiochromatic minerals can the absorption spectrum be said to characterize the entire species. A chromium spectrum may be said to betoken a mineral containing aluminium, and the didymium rare earth spectrum to be indicative of a calcium mineral. Titanium and nickel do not seem to produce definite absorption bands. The chromium spectrum in general is described. The brighter greens and reds seen in chromium-coloured minerals, as against the duller shades of the iron-coloured greens and reds, are ascribed to the fact that the absorption regions in the chrome-coloured minerals are sharply defined while those of iron are more diffused by weaker absorption over areas where general transmission occurs. The chromium absorption spectrum consists of broad absorption regions in the green and in the violet, and many fine lines in the orange and blue. Mention is made of the reason for these fine lines and there is a discussion on the reversibility of certain of these lines in the red part of the spectrum producing " fluorescence " lines. The stones showing Cr spectra are ruby, red spinel, pyrope garnet, alexandrite, emerald, topaz, jadeite, nephrite, demantoid and uvarovite garnets, diopside, enstatite, euclase, kyanite, hiddenite, aventurine quartz, stained green chalcedony and glass. Part 11 (No. 276) gives the historical outline of the earlier work carried out on the chromium spectrum of ruby, and a full table is given of the lines seen in a ruby spectrum. There is a distinct difference between the absorption spectrum of extra-ordinary and ordinary rays in ruby, which is said to be most marked by the alteration in width of the broad absorption in the yellow-green. The absorption in the violet extends well into the near ultra-violet, followed by a further region of transparency to about 3000A in natural stones and not before 2700A in the synthetic ruby. The copper sulphate filter method is recommended for examination of the fluorescence lines. Part 12 (No. 277) details the absorption and fluorescence spectrum of red spinel. The spectrum of this gemstone does not show clearly lines in the blue, nor " hair lines " in the red. Identification is by a group of fluted or " organ pipe " fluorescence lines diminishing in strength from the centre outwards. Best observed by the copper sulphate filter placed before the strong light source. Distinction between the spectrum of red spinel and pyrope garnet mentioned. Reference is made to the absorption and fluorescence spectra of the rare synthetic red spinels. Some blue types of synthetic spinels (blue zircon and aquamarine colours) show a ruby-like fluorescence spectrum but with the main emission line some 20/30 angstroms below the corresponding line in ruby. 3 illus. R.W.

MEHTA (M. G.). *Diamond polishing in India.* Gemmologist, Vol. XXIII, No. 277, pp. 139–141. August, 1954.

A description of a Bombay diamond polishing works. Workers are all said to belong to the Patel tribe from Surat and Navasari to the north of Bombay. Only differences from the operations as performed in Western diamond polishing works are that the stones are bruted all over, which is said to leave much less work to be done by the crossworker, who also completes the brillianteering. The native workers sit " tailor-fashion " on the floor so that all work benches are low. Bruting is done in a different manner from recognized Western practice, the bruted stone being held in a vertical and stationary holder fixed to a pivoted bar controlled by a cross bar ; the other diamond being fixed to a wooden arm which may be swung across the stone to be bruted. The cast iron scaifes are spun by electric motors, and are 14 ins. in diameter. The Indian polisher works from the inside to the outside of the scaife—the reverse way to that employed in Western countries. The diamond powder employed is obtained from the bruting operation, the powder and olive oil being applied to the whole of the scaife and during the operation paraffin is continuously applied by means of a wooden stick. 3 illus. R.W.

BARBER (R. J.). *The nature of jade.* Gems & Gemology, Vol. VIII, No. 2, pp. 38–46. Summer, 1954.

This is apparently the first instalment of a monograph on jade. Some consideration of the derivation of the term jade is made ; the legends and superstitions and some notes on the archaeological finds in this material are given. The naming of nephrite by Werner, and the finding by Damour that some jade was a different mineral—to which he gave the name jadeite—is mentioned. Both nephrite and jadeite are discussed from the point of view of the colour and its cause. " Imperial jade " is by Ridgway colour standards a " veridian green " rather than an " emerald green." It is suggested that mauve jadeite is coloured by manganese or vanadium, and the bluish green-grey material by vanadium and beryllium. The tomato-red coloured jadeite is said to owe its colour to the oxidation of iron with a little vanadium. Nephrite is softer but tougher than jadeite. Nephrite is infusible at moderate heat while jadeite fuses readily to transparent bubbly globules. Densities given are 3·33 to 3·50 for jadeite and 2·91 to 3·01 for nephrite. Both minerals are said to be products of deep-seated disturbances of original rocks, but the chemical and physical influences which have combined to produce them, and explanations of their modes of origin, are somewhat controversial. Sources of both jades are given and historical surveys of the original finds give added interest. 5 illus. R.W.

WEBSTER (R.). *Inclusions in a Madagascan yellow beryl.* Gems & Gemology, Vol. VIII, No. 2, pp. 60–62. Summer, 1954.

Four types of inclusions were noticed in this yellow beryl from Madagascar. They are :—tabular hexagonal green platelets; cavities showing crystal form with either eroded surfaces or a crystalline deposit on their inner surfaces, and containing a bubble with an included second bubble which disappeared on warming ;

cavities which seemed to be filled with a solid substance as through the liquid had crystallized out, some of which had " tails " and appeared like " mice " ; and tubes parallel to the vertical crystal axis were observed. The density was 2·71 and the refractive indices ω 1·581 ε 1·575 ; ω—ε 0·006. The dichroic colours were : for the ordinary ray a light pinkish brown, and for the extraordinary ray yellow. The absorption spectrum showed two vague bands in the blue at about 4500A and 4200A. There was no fluorescence and no radioactivity. 6 illus. P.B.

HARDY (E.). *Australia's "permanent interest" in pearling industry.* Gemmologist, Vol. XXIII, No. 277, pp. 155/6. August, 1954.

A general report on the Australian pearling industry. Japanese now allowed to fish in the Arafura Sea under certain limiting conditions. Bulk of Australian pearl shell goes to the United States of America where it is mainly used for the manufacture of pearl buttons. The manufactures are carried out in the States of Pennsylvania, Maryland, New Jersey, New York, and to a small extent in Iowa. Shell fished from the seas of Micronesia are mainly black-lip, gold-lip and trochus. Because of their larger size the shells of these are used as " blanks " for artificial pearl formation. Gold-lip and silver-lip oysters are employed to produce cultured pearls in the Micronesian islands (Palau, etc.), and these fisheries are American sponsored. It is stated that the nacre is laid down more rapidly and the production of pearls can be produced by these species in two years rather than the three to five years required by the Japanese pearl oyster (*pinctada martensi*). Some notes are given on pearl culture in general, and on the other localities of pearl-bearing mollusca. R.W

DEANE (N.). *Adventures in lapidary work.* Gemmologist, Vol. XXIII, Nos. 275-6-7, pp. 114–118 ; 128–132 ; 150–153. June, July and August, 1954.

The series (Parts 4, 5 and 6) continues with the telling of the difficulties of purchasing rough material, mention being made of the snags in buying opal. Australian garnet was found to cut into rather dark stones and the Australian sapphires obtained by the writer were rather unattractive. Tiger's-eye cuts well but is rather tough to saw and care is needed to orient the stone correctly for the eye to develop. Green tourmaline from South West Africa was found to be dark and some experiments in lightening the colour by heat-treatment are mentioned. There was some betterment of the colour but cracks were apt to develop when the stones were heat-treated. Some Madagascan green tourmalines similarly heated did not lighten in colour and cracked so badly as to be ruined. A supply of rough from Ceylon was found to be of variable quality—the best stones probably being kept for cutting in Ceylon—and much of the parcel from this locality was incorrectly named. A surprise was the finding of a kornerupine. Some experiments on the heat-treatment of Ceylon zircons are described. The writer's first attempts at cutting facets and the apparatus used are fully described. Experiences with quartz, beryl, spinel, topaz, spodumene, enstatite and euclase are referred to and some notes on the order in which the facets are cut are given. The final instalment refers to the cutting of fancy shapes and the difficulties experienced with such species as apatite, brazilianite and fluorite. 11 illus. R.W.

BREEBAART (A. J.). *Two-phase inclusions in a yellow-green synthetic spinel.* Gems & Gemology, Vol. VIII, No. 2, pp. 56–57. Summer, 1954.

A report of two yellow-green synthetic spinels which showed two-phase inclusions arranged in a curved zone. Some of the cavities had straight and angular sides and may be negative crystals. Two photomicrographs are shown but the magnification of these is not given. One of the stones is in the possession of the Gemmological Association of Great Britain. R.W.

ANON. *Edelsteinkurse in Idar-Oberstein. Courses in gemmology at Idar-Oberstein.* Zeitschr.d.Deutsch.Gesell.f.Edelsteinkunde, No. 8, 1954, pp. 3–4.

In preliminary courses of one week precious stones and pearls are discussed. Students can see gems at permanent exhibition and belonging to firms. Methods of determination are explained and exercised. Diamond polishing factories, shops for grinding and engraving agate and coloured stones are visited. Apart from these courses there are correspondence courses and courses lasting a fortnight for advanced students entering the German examination in gemmology. E.S.

LENZEN (G.). *Die Entstehung orientierter Einlagerungen in Edelsteinen (Ursache der Asterien bei Sternrubinen und Sternsaphiren). The formation of orientated inclusions in precious stones (The cause of asterism in star rubies and star sapphires).* Zeitschr.d.Deutsch. Gesell.f.Edelsteinkunde, No. 8, 1954, pp. 7–10.

When a substance is made to crystallize on a crystal face of a completely different substance, the " guest crystal " will grow according to its own laws, but the direction of growth will be determined by the lattice symmetry of the " host " crystal ; i.e. the guest crystal will grow in certain directions which are " electrostatically agreeable." This has been shown experimentally by Willems. The orientation of the guest crystal will be such that the greatest possible number of " ion to ion " connections between the substances is achieved. As two different lattices are concerned, the distance between the ions of each substance is an important factor. If the host crystal keeps on growing, once crystals of another substance have formed on one of its faces, it will surround the guest crystals which become thus orientated inclusions (so-called contemporary orientated inclusions). These are of particular interest in the determination of minerals with the microscope ; well-known examples are rutile needles in corundum and the acicular hornblende crystals in garnet. The length of the unit cell of rutile in direction of the C-axis is 2·95 Å. The dimension of the corundum unit cell in the direction of the three auxiliary (hexagonal) axes is 4·75 Å. As the rutile needles are arranged in the (three) directions of the host's auxiliary axes, it can be seen that 5 rutile ions (14·75Å) correspond with three corundum ions (14·25Å). A similar relation can be shown in respect of the direction of the auxiliary (tetragonal) axes of the rutile needles and the rhombohedral faces of the corundum. The threefold symmetry of the rutile inclusions in ruby becomes visible in sections at right angles to the C-axis of the ruby, and the inclusions on account of light reflection, are the cause of asterism in cabochon-cut stones. The rays of the star are arranged at right angles to the directions of the needles. Whereas asterism in ruby can be explained in this way, no final explanation can be offered in the case of genuine star sapphires. In synthetic sapphire asterism is induced by orientated acicular rutile inclusions. In natural stones, however, one of the causes at least is " silk," i.e. a system of very narrow straight hollow channels, arranged at right angles to the C-axis and intersecting again at angles of

60 deg. and 120 deg. respectively. The origin of these channels is not certain. Some workers suggest " twinning," but possibly they are negative crystals, originally filled with rutile, which was absorbed when the host crystal (sapphire) formed around it. This assumption is supported by the zonal colour distribution, as titanium and iron are the colouring matter in sapphire.

W.S.

ANON. *Die Edelsteinausstellung in Zürich " Mensch und Edelstein." The gem exhibition at Zürich " Man and Precious stone."* Zeitschr. d.Deutsch.Gesell.f.Edelsteinkunde, No. 8, 1954, pp. 2–3.

Through combined efforts of Swiss jewellers and goldsmiths and the German (Idar-Oberstein) precious stone industry the Zürich exhibition has been a great success with over 25,000 visitors till end of July. The same exhibition was held at Berne during August and later in Basle. E.S.

REITENBACH (A.). *Ueberwundene Berufskrankheiten im Edelsteinschleifergewerbe. Conquered occupational diseases in the gem cutting industry.* Zeitschr.d.Deutsch.Gesell.f.Edelsteinkunde, No. 8, 1954, pp. 15–18.

No occupational diseases are existent to-day, but a detailed report, dated 1899, by the medical officer of the Idar-Oberstein district at that time is reproduced in full. It described silicosis (although the name is not mentioned) with following tuberculosis of the lungs and the digestive organs, and suggested as main preventive measure the general use of a new chair which was about to be introduced at the time. The chair allowed the agate polisher to sit in front of the big sandstone wheel with the head well above the dangerous grinding dust. He could still exert enough pressure on the workpiece. Previously he had to lie in a horizontal position with the chest compressed on a support and inhaling of dust could not be prevented in spite of wet grinding.

W.S.

COLOUR FILTER TESTS —GREEN STONES

by L. C. Trumper, B.Sc., F.G.A.

IT is considered most unlikely that any filter for the rapid examination of green gemstones can be any great improvement on the well known and most valuable Chelsea filter, obtainable from the Gemmological Association of Great Britain.

On the other hand it was felt that the series of experiments conducted on colour filters and reported on in the *Journal*, Vol. 3, pages 140/163, and Vol. 4, pages 27/32, would not be complete unless all the other colours of gemstones had been systematically worked through. For this purpose the Viewing Box[1] for the rapid examination of selected gemstones described was again used, providing for the same automatic feed of the Wratten, Ilford, and other filters of which the author now has more than 200 different standardized filters.

For the present examination of green gemstones, the following were selected :—

Chatham Synthetic Emerald
Muzo Colombian Emerald, ·63 cts.
Demantoid Garnets from the Urals
Blue Green Tourmaline, 2·13 cts.
Bluish Green Tourmaline, 1·475 cts.
Middle Green Tourmaline
Yellowish Green Prehnite
Green Beryl X1
Green Aquamarine, 3·178 cts.
Oil Green Peridot, 3·47 cts.
Green Sapphire, 2·83 cts.
Green Sapphire, 3·5 cts.
Green Stained Chalcedony
Green Andalusite
Green Smithsonite
Emerald Green Fluor
Bluish Green Fluor, 7·38 cts.
Middle Green Zircon, 1·32 cts.
Yellow Green Zircon, 2·73 cts.
Yellowish Green Zircon, 4.34 cts.
Green Chrysoberyl, 4·34 cts.
Alexandrite from Ceylon, ·50 cts.
Dioptase, 8·84 cts.
Enstatite, ·27 cts.
Diopside, 7·25 cts.
Chrysoprase, 19·4 cts.
Malachite

Visual examination of these twenty-seven selected green stones was a feast for the eye, as can be imagined. How relatively simple it is to compare stones when they are side by side, how difficult when they are not.

Unquestionably the emerald still stood out above the rest, yet it had to be admitted that it was quite closely followed, by first a superb emerald-green fluor bead, and secondly by a demantoid garnet from the Urals. Curiously enough this garnet exhibits no fire whatever, due partly, it is believed, to the poor cut and partly because of masking by the heavy inclusions of asbestos fibres, so typical of the demantoid garnet, and this stone could be mistaken for emerald with the greatest of ease. A further stone which would simulate emerald very easily is a green stained chalcedony.

By coincidence a green sapphire and a green zircon, both of intense slightly brownish green looked to the eye exactly the same. The typically oil green peridot stood out quite easily from the remainder, as also did the malachite cabochon and the dioptase cabochon. The chrysoprase and smithsonite could most easily be confused, the colour and general appearance being almost the same. The bluish green tourmalines could be picked out by comparison with the others.

Examination with an electric torch with an exceedingly narrow beam at once disclosed the raspberry red tint of the alexandrite and moving it about attracted attention to the demantoid by the considerable amount of fire thus disclosed.

Examination with a lens showed inclusions in the two demantoid garnets, and double refraction in perhaps one of the three zircons, the other two being of the low type.

Examination with the dichroscope disclosed that there would be no dichroism in the fluor, demantoid, low zircon, smithsonite or diopside.

Dichroism Observed

Enstatite	Green—yellowish green—brownish	(Distinct)
Chatham Emerald	Bluish green—yellowish green	(Moderate)
Colombian Emerald	Bluish green—yellowish green	(Distinct)
Stained Chalcedony	No dichroism.	

Green Aquamarine	Skyblue—Colourless	(Very strong)
Green Sapphire	Greyish green—Green ...	(Moderate)
Bluish Green Sapphire	Inky blue—Green	(Strong)
Bluish Green Tourmaline	Almost none.	
Green Tourmaline	Bluish—Green	(Distinct)
Alexandrite	Bluish emerald green—yellowish—Columbine red	(Very strong)

Turning now to examination with the colour filters at our disposal, below are given the reactions to the Chelsea filter, the Wratten 68/22 filter which closely resembles it, save that it tends to accentuate the colour change, particularly in the paler shades, in descending order of brilliance of the red colour change.

Then follow the reactions through the already standardized filters for the examination of blue and red stones, namely filters 30/34A, 30/85, 40A, and the ruby testing filter RU64 of which RU stands for an actual slice of synthetic ruby.

With the Wratten series of filters it seemed logical to first try the Minus Green 1 Filter No. 31, the Minus Green 2 Filter No. 32, and the Minus Green 3 Filter No. 33.

It may be noted that under Nos. 31, 32 and 33, the Enstatite and Peridot appeared strongly red unlike with any of the previous filters, and, of those stones previously red, the emerald becomes blue or bluish.

Examined between crossed filters only the Chatham synthetic emerald appeared distinctly red with the alexandrite and the Colombian emerald just perceptibly reddish and the prehnite very slightly tinged reddish.

Although there are clearly endless other possibilities, it is considered that the use of the Chelsea filter supplemented by the filters 30/34A and Rose Bengal 30 from the Wratten series and the Ilford Filters 502/302 could separate with a fair degree of accuracy all the transparent stones.

In the table below the gemstone is given in capitals or the colour at the point of final selection or elimination.

Chelsea Filter	Wratten 30/34A	Ilford 502/302	Wratten 30
Red	Red	Red	Red
Alexandrite	Alexandrite	Alexandrite	ALEXANDRITE
Chrysoberyl	Chrysoberyl	Chrysoberyl	ORANGE
Demantoid	Demantoid	Demantoid	GREEN
Prehnite	Prehnite	Prehnite	FLESH
Fluor	Fluor	MAUVE	MAUVE

Chelsea Filter	Wratten 30/34A	Ilford 502/302	Wratten 30
	Blackish		
Andalusite	Andalusite	BLACKISH	GREEN
Syn. emerald	Syn. emerald	Red	Blackish
Emerald	Emerald	Red	Blackish
Zircon	Zircon	RED	GREEN
Beryl	Beryl	MAUVE	Blackish
Green	Red		
Pale zircon	Pale zircon	RED	Green
Deep aquamarine	Deep aquamarine	BLUE	Yellow Green
Peridot	Peridot	BLACKISH	Yellow Green
Enstatite	Blackish	RED	Green
Stained chalcedony	Blackish	MAUVE	Bluish
Sapphire	Blackish	BLUE	Green
Tourmaline	VIOLET	Blue	Green
Diopside	Black	Black	BLACK

Of the opaque stones or translucent stones it is considered that malachite and dioptase would be recognized by their characteristic idiochromatic colour.

This also applies to chrysoprase though smithsonite is very close in appearance, but with the S.G. of the latter at 4·3 to 4·6 this gemstone feels perceptably heavier.

These stones together with diopside are green in the Chelsea filter, but blackish or bluish or greyish under all the other three.

It should of course be appreciated that the above results are based on tests with a limited number of gemstones of distinct green colour. Other green stones of a paler colour or of a more yellow green, may well give somewhat different results.

Nevertheless a selection by means of these filters would enable a separation to be made rapidly with a fair degree of accuracy.

Gemstone	Chelsea Filter	68/22 Filter	Filter 30/34A	Filter 30/85	Filter 40A	RU 64
Alexandrite	Blood red	Blood red	Bright red	Bright red	Blue green	Blue
Chatham synthetic emerald	Bright cherry red	Bright cherry red	Blackish	Blackish red	Green	Green
Demantoid garnet No. 34...	Bright red	Bright red	Red	Flesh	Green	Green
Colombian emerald ...	Bright red	Bright red	Blackish	Greenish	Blue green	Blue
Deep green chrysoberyl ...	Bright red	Blood red	Red	Pink	Green	Bluish green
Demantoid garnet No. 188	Red	Red	Red	Green	Blue Green	Green
Prehnite	Red	Red	Bright Red	Bright Pink	Grey	Pale blue
Emerald-green fluor ...	Reddish	Red	Red	Slightly reddish	Bluish	Blue
Deep green zircon... ...	Reddish	Reddish	Blackish	Deep green	Greyish yellow	Blackish
Bluish-green fluor	Pinkish	Reddish	Reddish	Grey	Grey	Pale blue
Green beryl	Trace of pink	Reddish	Blackish	Greyish	Blue	Blue
Green - stained chalcedony	Green unchanged	Pinkish	Blackish	Bluish grey	Blue	Blue
Pale green zircon ...	Green unchanged	Pinkish/flesh	Red	Pale green	Pale yellow	Brown
Deep green aquamarine ...	Apple green	Deep apple green	Reddish	Yellowish black	Blackish	Blue
Green tourmaline ...	Green unchanged	Green unchanged	Deep violet	Bluish green	Greyish/colourless	Blue/colourless
Bluish-green tourmaline	Green unchanged	Green unchanged	Deep violet	Bluish green	Greyish/colourless	Blue/colourless
Green sapphire	Green unchanged	Green unchanged	Reddish	Deep gold	Bluish grey	Blue
Deep green sapphire ...	Green unchanged	Green unchanged	Blackish	Blackish	Deep blue grey	Deep blue
Enstatite	Green unchanged	Green unchanged	Blackish	Green	Yellow green	Green
Dioptase	Green unchanged	Green unchanged	Blackish	Black	Deep blue	Deep bluish
Chrysoprase	Green unchanged	Green unchanged	Blackish	Greyish green	Grey	Bluish grey
Diopside	Green unchanged	Green unchanged	Blackish	Blackish	Blackish	Blackish
Smithsonite	Green unchanged	Green unchanged	Black	Greyish green	Grey	Bluish grey
Malachite	Green unchanged	Green unchanged	Blackish	Grey	Medium grey	Grey
Peridot	Green unchanged	Green unchanged	Reddish	Oil green	Pale gooseberry	Colourless
Green andalusite ...	Green unchanged	Green unchanged	Slightly reddish	Slightly reddish	Green	Green

	No. 31	No. 32	No. 33	Rose Bengal No. 30	Rose Bengal 30 and Minus Red 2 No. 43	Rose Bengal 30 Minus Red 30	502 302
Alexandrite	Red	Red	Orange red	Bright red	Red	Bright red	Red
Chatham synthetic emerald	Blackish	Bluish-black	Blue	Blackish	Red	Bright red	Red
Demantoid garnet No. 34	Red	Red	Orange red	Yellowish green	Red	Red	Red
Colombian emerald ...	Violetish	Blue/violet	Blue	Greenish	Purplish	Red	Red
Deep green chrysoberyl ...	Red	Red	Orange red	Orange	Red	Red	Red
Demantoid garnet No. 188	Red	Red	Dark green	Green	Red	Red	Red
Prehnite	Pink	Red	Pink	Red	Red	Red	Red
Emerald-green fluor ...	Dirty mauve	Dirty Bluish	Blue	Dirty Red	Mauve	Mauve	Mauve
Deep green zircon... ...	Red	Dirty red	Reddish	Green	Red	Red	Red
Bluish-green fluor	Mauve	Lilac/mauve	Mauve	Bluish mauve	Mauve	Mauve	Mauve
Green beryl	Blackish	Blackish	Bluish	Blue	Blue	Blue	Bluish
Green - stained chalcedony	Violctish	Bluc	Bluc	Greenish	Bluish	Mauve	Mauve
Pale green zircon ...	Reddish	Red	Orange red	Green	Red	Red	Red
Deep green aquamarine ...	Mauve	Blue	Blue	Yellowish green	Blue	Blue	Blue
Bluish-green tourmaline ...	Violet	Violet/blue	Violet/blue	Blue	Dark greenish blue	Blue	Blue
Green tourmaline	Green	Bluish	Bluish	Green	Dark green blue	Blue	Blue
Green sapphire	Red	Red	Red	Yellowish green	Golden green	Green	Blue
Deep green sapphire ...	Blackish	Blackish	Inky blue	Green	Dark blue	Blue	Dark blue
Enstatite	Red	Red	Bright orange red	Green	Green	Dark blue	Red
Dioptase	Deep blue	Dark blue	Blue	Dark blue	Dark blue	Blackish	Blackish
Chrysoprase	Grey blue	Grey blue	Grey blue	Grey green	Grey blue	Grey	Blue
Diopside	Blackish	Blackish	Blackish	Blackish	Blackish	Black	Blackish
Smithsonite	Grey blue	Grey blue	Grey blue	Grey green	Grey blue	Grey	Blue
Malachite	Deep blue	Dark blue	Dark blue	Dark blue grey	Lead grey	Black	Black
Peridot	Red	Red	Orange red	Green	Golden green	Yellow green	Reddish black
Deep green andalusite ...	Red	Dirty red	Blackish red	Green	Red glints	Red glints	Reddish black

BOOK REVIEW

First adventures in geology—the story of rock identification.

This attractive paper-covered book of some sixty pages has been prepared by the staff of the Gemological Institute of America, under the guidance of the Encyclopaedia Britannica, to form an instruction book to use with the " American Industry " educational hobby kits intended for the younger generation.

Just to whet the appetite, the introduction tells a story of an old prospector who finally, after many disappointments, makes a rich find of uranium ore. This is followed by the chapter " How to be a rock detective," and refers to the accessories supplied with the kit ; i.e. a geologist's hammer, a chisel for breaking rocks, a double-ended magnifying glass with two powers— $\times 4$ and $\times 7$, and a piece of copper and a piece of glass for making hardness tests. The kit contains also a notebook with printed and numbered information sheets and numbered gummed labels to stick on specimens. The kit is completed with 24 selected specimens of rocks and minerals which are unnamed—and of course this instruction book.

A chapter on " What to look for " gives the basic elements of mineral identification and is written in simple language. The difference between a rock and a mineral is explained, and the points to notice when examining a specimen. In this part ; colour, lustre, texture, shape (necessary in the case of crystals), cleavage and fracture, structure (and explanation of its difference from texture), weight (density by heft), and observation as to whether the specimen is likely to be one mineral or a combination of different minerals.

After a short description of the way and the nature of igneous ; sedimentary and metamorphic rocks, the reader is told to start elementary practical work by taking the card marked A from the kit, which contains 24 places each with a name on it, and the case of specimens. Reading on it is seen that a description is given of quartz ; from this description it is necessary to place the specimen on the appropriate position on the card—of course from what you have learnt you have to find the specimen of quartz from the unnamed specimens. The same procedure is to be adopted for the remaining 23 specimens from the information provided in the book. The specimens mentioned are : Basalt, Mica, Breccia, Anthracite coal, Bituminous coal, Conglomerate, Coquina (*fossil* *limestone*), Feldspar, Gabbro, Gneiss, Granite, Hornblende, Limestone, Marble, Mica schist, Obsidian, Porphory, Pumice, Quartz, Quartzite, Sandstone, Serpentine, Shale and Slate.

Having thus sorted, or identified, the twenty-four specimens, second card, card B, is taken from the kit. The specimens are then re-sorted to four groups :—Four minerals, six igneous rocks, eight sedimentary rocks and six metamorphic rocks. Explanation of these various groups being given in the text, not only as a guide, but to give an understanding of the processes of rock formation.

The reader is then advised to go out and find and identify his own specimens from what the book and kit have taught him. The tools supplied with the kit are essentially there for the purpose of the latter " field " work. Many directions are given for rock hunting ; how to describe the specimens in the case book and the labelling of the actual specimens with the numbered labels. The determination of the specimens found by the process of elimination is described. (It is suggested that if no identification is made after all that can be done, the reader should approach a Curator of a Museum. Instructions for the formation of a collection and how to store a collection of rock and mineral specimens is given.

The concluding chapters deal with elementary general geology and of fossils and their use in the determination of the ages of rocks, and how rocks are formed. The chapter " Careers with rocks " describes some of the early geologists such as Agricola, Werner, Smith, Agassiz and J. W. Dana. The various branches of geology are described. As an example that of gemmology is fully described showing the advance of that particular science in the United States. The book is completed with a short pronouncing glossary. There is no index but one does not appear to be needed.

The book is leavened with well-selected photographs of crystals, minerals and rocks, quarries and mines as well as surface features. Some parts of the text are illustrated with black and white drawings to catch the juniors' eye. The coloured cover shows the Maroon Bell Peaks, West of Aspen, Colorado.

The admirable way the book is so arranged as to gradually enlarge on the subject and keep the reader's interest, and the clear way the text is expressed, makes this book a really good elementary textbook. There is much sound advice packed in little space ; all made intelligible to the immature mind of the school age boy.

R.W.

ASSOCIATION NOTICES

1954 EXAMINATION RESULTS

The 1954 examinations of the Gemmological Association of Great Britain were held in the United Kingdom and Overseas in June. World wide interest in the examinations, which have now been held since 1913, continues unabated and centres this year included :—London and provinces, Australia, Canada, Ceylon, Germany, Holland, Hong Kong, India, New Zealand, Norway, South Africa, Switzerland, and the U.S.A.

On the recommendation of the examiners the Tully Memorial Medal and a special prize of gem testing instruments (presented by Rayner and Keeler Ltd.) have been awarded to Neville Deane of Wednesbury for his work in the Diploma examination, and the Rayner Prize in the Preliminary examination to R. E. Muir of Wilmslow.

The following is a list of results arranged alphabetically :—

EXAMINATIONS 1954

Diploma

Qualified with Distinction

Belcher, C. I., Johannesburg.
Bender, C., Cologne.
Bowden, F. A., Plymouth.
Deane, N., Wednesbury.
Furness, G. V. (Mrs.), Reading.
Lenzen, G. A. H., Hamburg.
Olsen, S. G., Bergen.
Solomon, J. P., Plymouth.
Stamness, J., Oslo.
Webb, M. H., Maidstone.
Wilson, M. E., Purley.
Wines, E. D. (Miss), London.
Zwaan, P. C., Leiden.

Qualified

Banister, H. J. (Miss), London.
Bolli, W., Lucerne.
Boxall, L. T., Richmond.
Burnett-Ham, D. (Miss), London.
Buttermore, R. D., Jnr., Parkersburg, U.S.A.
Campion, J. E., Plympton.
Chinn, A. B., London.
Goad, M. J., Sutton.
Harper, J. S., Birmingham.
Jackson, A. C., Greenford.
Kell, R. G., London.
Mahajan, B. S., Bombay.
Marsh, W., Edinburgh.
Shearman, J., Barnehurst.
Showers, A. St.G. F., Hove.
Sutton, N. J., London.
Walker, A. H., Bournemouth.
Watts, S. F., Birmingham.

Qualified

Alexander, F. E., Romford.
Allen, W. E., Newcastle-on-Tyne.
Ameringen L. J., van, London.
Anderson, J. E., Edinburgh.
Anfield, J., Edinburgh.
Bates, M. A., Ceylon.
Bell, N. F., Liverpool.
Bettis, V. A. (Miss), London.
Bialek, W., Birmingham.
Bodenham, J. E., Birmingham.
Bohe, E. R., San Diego.
Breeze, M. D., Leicester.
Brooks, E. W., Wallasey.
Brown, M. A. (Miss), Birmingham.
Bruder, E. R., Southwick.
Buttermore, R. D., Jnr., Parkersburg, U.S.A.
Cameron, J. S., Auckland, New Zealand.
Chadwick, I. (Miss), London.
Chandler, F. V., Northolt.
Clark, A. R., Glasgow.
Clark, J. A., Forfar.
Collier, P., Liverpool.
Collinge, A. D., Birkenhead.
Cooke, D. S., Melbourne.
Cooper, G. D., Colchester.
Crichton, J. M., London.
Davidson, V. A., Walsall.
Davies, B. P., Gerrards Cross.
Durricott, R. K. W., Bishops Briggs.
Dubois, J. W., Hong Kong.
Dungate, P. J., Loughton.
Fisher, P. J. (Miss), Birmingham.
Gill, M., Isle of Arran.
Grounds, W. J., Birmingham.
Hamilton, D. P., Glasgow.
Hart, J., Glasgow.
Hewitt, F. E. J., Ormskirk.
Hopewell, R. C., Grays.
Jansz, B. A., Ceylon.
Ineson, A., Wakefield.
Joseph, B. R., Birmingham.
Kahn, M. S., Welcom, S. Africa.
Kalleven Th. A., van, Arnhem.
Lenzen, G. A. H., Hamburg.
MacDonald, I. C., Glasgow.
Mahajan, B. S., Bombay.
Marsh, W., Edinburgh.
McGuigan, A. (Mrs.), Bearsden.
Mehra, P. N., Calcutta.
Messenger, S. J. (Miss), St. Albans.
Morrison, N. C., Inglewood, Calif.
Muir, R. E., Wilmslow.
Murray, K. G., Birmingham.
Nelson, P. K., New York.
Parkes, F. M. R., Brierley Hill.
Paterson, D. G., Edinburgh.
Pearce, A. M. (Miss), Old Windsor.
Phillips, W. H. M., Ross-on-Wye.
Price, J. S. (Miss), Birmingham.
Pyke, W., Birmingham.
Rankine, W. M. (Mrs.), Farnham.
Robertson, K. (Mrs.), Milngauie.
Rowe, G. P. (Miss), Abergavenny.
Sibley, A. J., West Wickham.
Silkebekken, M., Elverum.
Solomon, J. P., Plymouth.
Soukup, E. J., San Diego.
Spittle, T. R. (Miss), Birmingham.
Stern, E. (Mrs.), Wembley Park.
Sumner, R. A., London.
Tiessen, R. J., Hilversum.
Todd, G. E. (Miss), London.
Tyler, T. J., Edgware.
Urquhart, A. M., Edinburgh.
Vaughan, H. M., Ross-on-Wye.
Vince, J. O. E., Ipswich.
Walker, A. J., London.
Waller-Davies, J. M., Eastbourne.
Watts, M. (Miss), Pakenham.
Wells, R. A., Buffalo.
Whitley, P., London.
Worth, B. R., Leicester.
Zwaan, P. C., Leiden.

CHANGE OF ADDRESS

One of the earliest Fellows of the Association, Mr. Oscar D. Fahy, has recently moved from Vittoria Street to 64 Warstone Lane, Birmingham, 18.

OVERSEAS VISITORS

During September the Association was honoured by visits from Mr. Stanley Belcher, F.G.A., of Johannesburg, and Mr. H. St. C. Roberts, a Fellow of the Gemmological Association of Australia.

FORTHCOMING MEETINGS

October 20th, 1954. Reunion of Fellows and Members at Goldsmiths' Hall, Foster Lane, London, E.C.2, between 6 and 7 p.m. At 7.15 the awards gained in this year's examinations will be presented by Sir Lawrence Bragg, F.R.S., the President of the Association.

November 11th, 1954. Film evening for members, including showing of colour film " For Ever Diamond."

January 21st, 1954. An any questions evening to be held at the Medical Society of London's Hall, Chandos Street, W.1, at 7 p.m.

March 31st, 1954. Annual General Meeting.

DEPARTMENT OF MINERALOGY, BRITISH MUSEUM (NATURAL HISTORY)

Lectures in the Mineral Gallery on Saturdays at 3.15 p.m.

1954

Date	*Subject*	*Lecturer*
Oct. 23	Famous Diamonds	Miss Sweet
,, 30	How the ages of rocks are determined ...	Dr. Wiseman
Nov. 6	Gemstones	Dr. Claringbull
,, 13	Caves and cave deposits	Mr. Ellis
,, 20	Rocks of the Scottish Highlands	Mr. Francis
,, 27	Glass meteorites	Dr. Hey
Dec. 4	Gem minerals	Dr. Moss
,, 11	Physical properties in relation to crystal structure	Miss Shaw
,, 18	Sir Hans Sloane	Miss Sweet

This programme is subject to alteration without notice.

COUNCIL MEETING

A meeting of the Council of the Association was held on Tuesday, 24th August, 1954, at 19/25 Gutter Lane, London, E.C.2.

The report of the examiners on the 1954 examinations was received and approved. The Council considered it desirable to review the syllabus of examinations and it was agreed to hold a further meeting of the Council on 13th October to consider this and other examination matters.

Mr. Walter Hands, Birmingham, was elected an Ordinary Member of the Association.

The Council decided to send a message of congratulations to the National Association of Goldsmiths on the occasion of that organization's sixtieth anniversary.

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Names of authors are printed in small capitals, subjects in lower case and abstracts in italics