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GEMMOLOGICAL WORK IN THE ANCIENT MONUMENTS LABORATORY 1980-1995

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Summary

An account of the gemmological work carried out in the Ancient Monuments Laboratory by the author 1980-1995. Includes a concordance of the stones examined with an indication as to which are the subject of AML reports.

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GEMMOLOGICAL WORK IN THE ANCIENT MONUMENTS LABORATORY 1980-1995

Marjorie Hutchinson, FGA DGA

This report is an account of the gemmological work carried out in the Ancient Monuments Laboratory (AML) by the author, between 1980 and 1995. A concordance of the stones examined is appended, with an indication as to which are the subject of AML Reports, where more information may be found.

Introduction

Gemmology is the study of all aspects of gemstones; it is not confined to identification. It includes the material they are made from and possibly its source; the shape they have been cut to and how well this has been carried out; the weight, refractive index, specific gravity, inclusions and any other information available about the stone. It may be possible to assign a rough date to a stone by knowing when the material it is made of first became available or when the cut was first introduced. For example, gem quality kunzite, a lilac-pink spodumene was first discovered in California in 1902 and set in jewellery by Tiffany. This can only be used to date the stone, not necessarily the setting or piece of jewellery, as the antique and jewellery trades are constantly shuffling stones between pieces of jewellery to satisfy customers' requests or to make currently undesirable items saleable. One of the earliest kunzite-set pieces by Tiffany has had the kunzite replaced by a pink sapphire to upgrade it, as the value of the piece now resides in the manufacturer's name, not the rarity of the stone. Any gemset article which has passed through the Trade, however fleetingly, should be approached with caution.

The work of the archaeological gemmologist is very different from that of a gemmologist engaged in the modern gem and jewellery trade and requires different skills. Virtually all present day gemmologists work in the gemstone trade or for jewellers, either checking parcels of stones bought for setting in new jewellery by manufacturing jewellers, or identifying and often valuing stones for dealers, retail jewellers and auction houses dealing with antique jewellery. With large and important stones now changing hands for vast sums of money, identification techniques are becoming ever more sophisticated and for some stones, notably emeralds, it is often possible to say where the stone was mined.

One of the chief difficulties faced by the gemmologist working in the archaeological field is that the stones used for the training courses are all modern, relatively well-cut and usually faceted examples of what may be met with at the present day in gemset jewellery, together with their imitations, stones with which they can be confused, and true synthetics. In the archaeological field, however, anything can be found, from crystals of emerald to a double cabochon of pink fluorite.

Gemmology in the Ancient Monuments Laboratory

By 1978, it had become clear that ornamental stones were present in the excavated material coming into the AML for conservation and that these were either being ignored, or wrongly identified, often by the excavator. For example, a stone labelled 'agate' was actually two pieces of rock crystal with a layer of perished adhesive between them, and a green stone earlier identified as 'adventurine' was later re-identified as an emerald. This writer already had some knowledge of what are popularly called precious and semi-precious stones and she decided to formalise and add to this by taking the diploma examinations of the Gemmological Society of Great Britain. This was achieved in 1980 and gemmological work began.

For the sake of clarity, it has been decided to describe the gemmological work of AML by dealing briefly with the stones seen. More information about those marked with a superscript number in the concordance will be found in the numbered list of Ancient Monuments Laboratory Reports which follows it.

I, INORGANIC MATERIALS

BERYL - Emeralds

Emerald is the precious green form of the mineral beryl ($Be_3Al_2[Si_6O_{18}]$). Beryl can be coloured green by small amounts of chromium, vanadium and iron, or a mixture of all these and this has led to the gem trade defining emerald as green beryl coloured by chromium so as to show the characteristic chromium absorption spectrum, which may easily be seen with a hand spectroscope. All other green beryls should be called 'green beryl'. It is questionable whether all the emeralds from Old World excavations can properly be described as emeralds using the above criterion, but the term emerald is long established and the writer has never seen an excavated emerald which did not contain some chromium.

It seems that emeralds first appear in Europe round the Mediterranean in the Hellenistic period and judging by the specimens which have passed through the AML, emeralds excavated in Britain are most likely to be found on Roman sites or layers. The commonest form seen is that of the natural hexagonal crystal pierced lengthwise and used as a bead. Usually these are unworked, but occasionally what look like toolmarks suggest that the top and bottom edges of the crystal (those bordering the basal pinacoids) have been slightly rounded. Examples have been seen from Wroxeter, Shropshire (3), Great Bedwyn, Wilts (1), York (1), Lincoln (1).

Cut examples of emeralds have been examined from Wroxeter (1), Gorhambury, Herts (1) and Lincoln (1). They are not, of course, cut in the modern style: the example from Gorhambury is cut as a triangular prism (see plate 1) while that from Wroxeter is a flat plate. A bean-shaped polished emerald pebble, excavated at St Augustine's Abbey, Canterbury, previously identified as 'adventurine', presumably meaning green aventurine quartz, is probably medieval.

Emeralds are very valuable and desirable stones and Pliny lists twelve kinds of smaragdi, although some are obviously not emeralds (Pliny XVII, 65). Egyptian emeralds, which are usually considered the only ones available in the ancient world, are listed by him as 'third best', the ones from Scythia being the most desirable and next to these the Bactrian. Scythia was the area to the north and northeast of the Black Sea and Bactria is, roughly speaking, modern Afghanistan. It is interesting to note that true emeralds are now mined in the Ural Mountains, in India and western Pakistan. Stones from these areas might well have reached the Hellenistic world through Scythia and Bactria.

The Roman emeralds which have passed through the Ancient Monuments Laboratory have two marked characteristics. Firstly, those which have flat ends parallel to the basal pinacoid have a marked pearly gleam or schiller on this surface. This is particularly marked on the stones from Lincoln where the ends positively glitter. Something of the effect can be seen in the emerald from Wroxeter (plate 2). The other characteristic is the structure of the stones; they are virtually made of growth rods or tubes parallel to the 'C' axis of the crystal. Usually magnification and transmitted light are required to see them, but they can be seen clearly with the naked eye on the damaged corner of the emerald from Gorhambury, as shown in the drawing of this stone (plate 1). No emeralds being mined at present show this feature as far as this writer has been able to discover. These rods/tubes are not to be confused with the blades of actinolite seen in Siberian emeralds.

CORUNDUM

a, Ruby. Ruby is corundum (Al_2O_3)coloured red by chromium; all other colours of corundum, including pink, are called sapphire. Balas ruby is not a variety of ruby, but a red spinel ($Mg.Al_2O_4$). A superb example of this stone is the 'Black Prince's ruby' set in the Imperial State Crown. So strongly entrenched is the idea that balas ruby is real ruby that when the Black Prince's stone was set in the crown and it was necessary to disguise a hole, a plug was made from a ruby and fitted in the hole. The difference in material can easily be seen in a photograph, not least because the ruby plug fluoresces in the photographer's lights, but the spinel does not.

Only one ruby has been examined, the one set in the handsome gold ring from the Winchester Palace, London, excavation shown in plate 3. The stone showed the absorption spectrum typical for rubies and fine acicular inclusions oriented in three crystallographic directions. These, combined with the white sheen which they gave to the surface in some areas, known as 'silk', suggested that the ruby came from Burma, as this phenomenon is typically found in rubies from there. It is known that the Burmese ruby mines were fully operational by 1597 as at that date they were taken over from the Shan in exchange for Mong Mit (Momeit) (Webster 1975, 63).

b, Sapphire. As noted above, all gem varieties of corundum which are not red are called sapphire. One example of blue sapphire from York has been examined; a small polished pebble, pale and opaque, and in appearance far from the popular concept of what a sapphire should look like. In the medieval period blue sapphires were found in France, in the Auvergne. The specimens in the Natural History Museum come from Expailly, Haut Loire; Velai and near Haye Fouassilère. The last has blue and grey areas giving the effect of a star.

FLUORITE

Among the finds excavated at Acton Court, Avon, a building which has medieval origins, was a round pink semi-translucent stone, lenticular in shape (see plate 4). Part of one side had broken away along a cleavage plane. It had no discernable absorption spectrum and the surface polish was not good enough to measure the refractive index, so it was analysed by energy-dispersive X-ray fluorescence spectroscopy (ED-XRF). The result showed the stone to be made of calcium and this, combined with the excellent cleavage face suggested an identification as calcite, ($CaCO_3$). Considerable time was spent endeavouring to find out whether rose-pink calcite existed and a source was discovered in Spain. If the stone came from the Tudor layers, this was not without interest. However, when Matthew Canti (a member of the AML staff) examined the stone, using optical microscopy and a small scraping from the damaged face, he was able to re-identify the material as fluorite (CaF_2). This was confirmed by measuring the specific gravity. The mistake had arisen because fluorine is too light an element to be detected by ED-XRF. Mistakes like this arise when not enough thought is given to the limitations of the analytical method or instrument used.

GARNET

Many specimens of red garnet have been examined, almost all from Anglo-Saxon contexts and predominantly almandine ($3FeO.Al_2O_3.3SiO_2$), although the absorption spectra have sometimes suggested a high enough proportion of pyrope ($3MgO.Al_2O_3.3SiO_2$) to affect the spectrum. The chief difficulty in identifying them has been organic and other residues obscuring the surface of the stone. An interesting case was that of two studs from Sancton, Humberside. These were from a cremation and were labelled 'glass'. They had been cut as round cabochons and orientated acicular inclusions were so numerous in part of one of them that it may have displayed that wavering band of light commonly called a cat's eye, or even a star. On the base of one of the stones were globules of metal, possibly from the melted setting, and the surfaces of both stones were obscured by a brittle, metallic looking coating which on analysis was identified as copper, zinc and possibly lead. Notwithstanding this indication of the temperature reached during cremation, the garnets were only cracked superficially.

QUARTZ

The different varieties of quartz (SiO_2) have provided some of the most interesting stones seen, ranging from common rock crystal to a variety not officially discovered until the 1950s.

Crystalline quartz

a, Amethyst. Amethyst is a mauve to purple variety of quartz, the darker shades being nowadays the most desirable. The colour comes from the action of natural radioactivity in the earth on small amounts of iron in the stone, not from manganese as was commonly thought and this is why heating amethyst will alter its colour. Most of the currently available citrine (a yellow to brown variety of quartz, rarer than amethyst) is heat-treated amethyst. The amethyst beads examined have tended at best to be a slightly translucent, mauve, amethystine quartz, rather than the transparent purple stone understood by the term nowadays. Examples seen include two date-shaped beads from a sixth or seventh century Saxon cemetery in the grounds of the old 'Goblin' works, Leatherhead, Surrey. According to Meaney (1981 75-6) these beads are usually found singly or in pairs; are excavated chiefly in Kent; and in pagan contexts appear to be seventh century. She notes that their distribution is similar to that of cowrie shells, see SHELL below.

b, Rock crystal. Rock crystal, the purest, colourless form of quartz, has been examined in various forms. As beads, including the large faceted type usually described as spindle whorls (see AML Report 52/95), as cut stones, as parts of composite stones and as struck flakes. These last, from Beeston Castle, Cheshire, were the most surprising. In 1985 four pieces of colourless material were sent to the AML for identification. One was a fancy cut lead-glass stone from a piece of modern jewellery, two were struck flakes and the last was a snapped blade. This use of rock crystal instead of flint is most unusual in England and on enquiry many other colourless specimens from the site were submitted resulting in the discovery of over twenty probable struck flakes (AML Report 73/89). The craggy cliff Beeston Castle stands on has been inhabited since prehistoric times and there is no local source of flint, but rock crystal could have been transported to the area by glaciers coming from the north or west.

Composite stones made of rock-crystal or glass are dealt with later in Section III, COMPOSITE AND IMITATION STONES, but two or three examples of single stones cut in the popular medieval style known as a 'hog's back' have been examined. One of these, from Guisborough, Cleveland, was still in its mount, backed by a gilded reflector. Altering or improving the colour of stones is a very old practice and Cellini (24, 28-9) gives instructions for the manufacture of coloured reflecting foils to put behind stones. It may be that medieval taste admired the limpidity of rock crystal resting on a gold reflector, but is is quite possible that the face of the reflector was painted with a coloured, transparent varnish, which would colour the whole stone. At a later date this was common practice and it is very hard to identify in a closed setting if reflector/stone contact is perfect and the reflector has not corroded.

Smokey quartz. This is a variety of quartz coloured by aluminium. Two items have been identified from Mucking. Both were very pale examples.

Microcrystalline quartz

The crypto- or microcrystalline quartz family differs from crystalline quartz in that it consists of minute fibres and grains only visible at high magnification. These are not crystals, but granular or platy subparticles. The microcrystalline family is known as chalcedony and although the name is usually reserved for translucent blue-grey shades, it embraces chrysoprase and other coloured examples, and all the agates, which are colour-banded chalcedony. Its structure means that it is porous and easy to dye, as evidenced by the blue and green agate slices frequently seen for sale. Many examples of chalcedony have been examined, but the ones commented on here were of special interest.

a, The Lullingstone 'Opal'. This stone attracted attention when the excavator of Lullingstone Roman Villa, Kent, submitted the manuscript of his excavation report and attempts were made to find it among the small finds, which are divided between English Heritage and Dartford Museum. No opal was found, but investigation as to the common conception of an opal lead to a milky buff chalcedony bead (plate 5) which the excavator confirmed was his opal. This bead can be identified as chalcedony and not common opal since fine banding, resembling fingerprints is easily visible under low-powered magnification and can be seen on plate 5. Terms such as 'opal glass' and 'opalescent' meaning milky, combined with the poor quality white opals in high street jewellers enable the main characteristic of precious opal, the play of colour, to be forgotten or overlooked. Opal is made up of spheres of silica gel arranged in a siliceous matrix. If the spheres are all the same size and regularly arranged, they act as a natural diffraction grating and colours are seen by reflected light. If the spheres differ in size and are not regularly arranged common or potch opal results, which looks like a slightly translucent glass.

b, The Beads from Ardleigh. These were 29 brown beads from late fourth century AD Roman inhumations, found in the top of a Bronze Age barrow (plate 6). They were identified as a brown chalcedony (AML Report 84/92). They quite deliberately were not assigned a variety name such as sard or cornelian. In the hand they looked uninteresting, but by transmitted light they changed completely and became a rich crimson, with black dendritic inclusions (plate 7). The holes were also unusual, frequently being pear- or egg-shaped at the ends, with the appearance of having been made this way. Identical beads have been found in Caerleon, Wales, (Zienkiewicz 1986, 154), Lankhills, Hants and other places but this is by far the greatest number from one site in northern Europe. According to Clarke (1979, 295) they are typical of Sarmatian-period cemeteries in Hungary and the examples in the Beck Collection, Cambridge come from Hungary and the Crimea (Hutchinson, forthcoming (a)).

c, Plasma. In 1986, a translucent green intaglio sent to the Ancient Monuments Laboratory together with other finds from Wroxeter, Shropshire, was found to be made from a chalcedony coloured green by chromium (plate 8). This was extremely surprising, since, as far as the mineral world was aware, chrome-green chalcedony was first discovered in Africa in 1955 and named mtorolite. Mineralogists were completely unaware of its use in Roman times. It transpired later that Henig had already published the intaglio in his Corpus, identifying the stone by appearance as plasma (Henig, 1978, 319).

It is curious that this early occurrence of chrome green chalcedony had escaped notice for so long, as it is not particularly uncommon: Henig's Corpus lists 1035 Roman intaglios and cameos and seventeen are described as plasma. Investigation showed that Tardy and Level (1980, 379) had noted that there were about fifty Roman examples of prase in the Cabinet de Medailles in Paris and that these showed a strong chrome spectrum, but apparently they did not appreciate how odd this was. (In practice, the terms 'prase' and 'plasma' are virtually interchangeable as they merely describe a colour, see Hutchinson (forthcoming b), for more information on this).

VARISCITE

In 1987 two beads from York were submitted to the Ancient Monuments Laboratory for identification. Both were faceted, one being cut as an octagonal prism (plate 9). Analysis by ED-XRF detected aluminium and phosphorus with chromium and iron as the major elements present. This suggested that they were made from variscite ($Al(PO_4).2H_2O$), an opaque, light green mineral and not from jade as originally thought. As this result was very unexpected, the analysis was confirmed by specific gravity and X-ray diffraction. Variscite had only been identified twice before from excavations in Britain; part of a ring from Gadebridge (Neal et al 1990, 138) and Colchester, where three beads were found (Crummy 1983, 34). With one exception, all the beads have been cut in a manner which strongly resembles that of a natural emerald crystal, though having eight sides instead of six. This suggests that variscite was being cut as an imitation smaragdus, possibly by someone who had never seen one. The Old World source is usually thought of as Saxony, but it is also to be found in the south of Brittany. This is presumably the source of the variscite beads (in french callais) found in considerable numbers in the Breton megalithic tombs. However, according to Tardy and Level (1980, 157, 486) the Breton material is bluer and more translucent than usual.

As the writer has so far failed to obtain specimens of either the French or German material, it is not possible to say where the raw material for the variscite objects so far identified in the UK came from. The main commercial source is Utah, USA and variscite from this source is a bright apple-green,with perhaps a faint tinge of blue.

II, ORGANIC MATERIALS

AMBER

The surface of excavated amber varies enormously in appearance ranging from virtually unweathered, through powdery yellows to a vivid, opaque, crumbly brick-red. This is purely superficial and largely depends on the sizes of the particles making up the present surface of the amber: it does not indicate the original colour. 533 amber beads from Mucking, Essex, were examined for technological evidence and identification of material, and many interesting features were observed. They are reported on in AML Report 52/95.

Probably the most surprising discovery was the extent to which wear had modified the shape of the beads. Examples from one double string had so many well-defined wear facets that it was originally thought that they had been deliberately cut this way. Wedge beads were observed to have very sharp edges and elongated holes, also with sharp edges, and it is suggested that these beads were originally disc beads which have become wedge shaped through mutual abrasion. Another curious feature is that the surface of the beads seems to be better preserved on the higher parts than in depressions, which is the opposite of what would be expected. It is difficult to account for this unless grease from handling is acting as a preservative.

A large number of these beads have very clear tool marks in their holes (plate 10) and much could be learnt from a careful study of them. This is one reason why labels should never be attached to beads by threading them through the holes.

CORAL

Excavated coral frequently goes unrecognised and is identified as ceramic or glass because burial changes the colour of the surface to buff and coral is generally expected to be red. However, the characteristic structure still shows clearly on the surface and it is easily identified when this is looked for. Several coral ornaments from excavations have passed through the AML ranging from Late Iron Age to medieval and among these were four beads from Wroxeter. These had been identified as ceramic on account of their colour, even though the structure could be seen clearly and one of the beads still had a patch of red, unaltered surface. Coral is also found as a decoration on the bow of Late Iron Age brooches. Again, the structure is easily recognisable even though the surface may now be fragile and chalky. Assuming this coral is the red <u>Corallium rubrum</u>, which is what it appears to be, its nearest source would have been the Mediterranean Sea.

JET AND JET-LIKE MINERALS

Attempts at identifying and separating these by gemmological means have been confined to streak tests (jet has a brown streak) and examination of surface features such as parallel cracking and evidence of a woody structure. Interested readers are directed to Davis (1993) and Allason-Jones and Jones (1994) which describe work identifying and provenancing these minerals. Further work is currently being undertaken by Siobhan Watts at Bradford University.

Medieval sites have produced beads from rosaries and Roman sites, notably Wroxeter, can yield large quantities of bangles and other items of jewellery. However, the Anglo-Saxon cemeteries at Mucking, Essex, produced some very interesting examples. Only ten jet-like beads were found, but on some, wear has been so severe that, although originally faceted as 'cut-cornered cubes', ie, cubes with the corners cut off, they are now wedge shaped and on one or two beads the facets have virtually disappeared. Victorian jet beads have been worn for about 100 years now, yet wear appears very slight: this invites speculation as to how long the Mucking beads were worn.

Two other beads, one annular and one cut-cornered cube, are unfinished. The annular example is covered with small flat facets showing the scratches left by the abrasive and the cut-cornered cube was abandoned with the facets just roughed out, (see plate 11). These beads may be providing interesting evidence of local manufacture, (see AML Report 52/95).

PEARL and SHELL

a, Pearl. A stone-set Roman ear ring, with a pendant of four or five whitish beads thought to be pearls, was submitted for identification of the stone and verification of the pearls. It is an interesting survival as soil conditions are often inimical to the preservation of pearls (Allason-Jones 1989, 128). The stone was glass, but examination of the structure of the pendant beads showed that they were natural, not artificial pearls. It was unfortunate (but understandable), that the pearls had already been consolidated with a resin as this rendered examination under ultra-violet (UV) light useless. In an unconsolidated state, it might have been possible to say whether the pearls were of marine or freshwater origin, as freshwater pearls fluoresce. (It should be remembered that modern cultured marine pearls also fluoresce as the bead in the centre is almost invariably made from freshwater mother-of-pearl. However, careful examination will show whether the glow comes from within the pearl or from the surface).

b, Shell. Two interesting groups of beads made of shell were examined and identified. Among the beads from the Goblin Works site at Leatherhead, were three whitish beads with curious ridges down one side (see plate 12). Examination by low-powered microscope revealed the characteristic structure of shell, and the ridges suggested the 'teeth' of one of the larger cowrie shells. It was not known, however, if the lips of the aperture were thick enough to produce beads of this size. A tiger cowrie (Cypraea tigris) was purchased and sawn in half and this demonstrated that there was sufficient thickness of shell on one side of the aperture to make similar beads. On being told of the probable identification, the conservator who had submitted the beads remarked that a large cowrie shell had been found in another grave. It was decided to take the shell and the beads to the Natural History Museum for confirmation of the identification. There, Dr J D Taylor identified the complete shell as a panther cowrie (Cypraea pantherina), a close relative of the tiger cowrie and unique to the Red Sea (plate 13). By the size and spacing of the ridges on the beads, he concluded that the beads must have been made from either a tiger or panther cowrie. It later transpired that these beads had originally been misidentified as fish vertebrae.

The second group of shell beads is included as a warning against assuming that everything found on an ancient monument is old or antique. Visitors at a Mesolithic stone circle found some small white discs with holes in their centres, weathering out of the ground in the centre of the monument, (see plate 14 for a photograph of them). Being worried lest these ancient relics should be lost or stolen they gathered them up and sent them to a member of the AML. It was assumed that they were crinoid ossicles, known on thee Northumbrian coast as St Cuthbert's beads, and they came to the writer to have the identification confirmed. Crinoid ossicles are segments of the stem of a fossilised 'sea-lily', an animal which was related to star-fish and as the ossicles are disc shaped and have a natural hole in the centre it is easy to suppose that early man would have strung them as beads (plate 15).

Crinoid ossicles have a distinctive radial structure on their flat surfaces (see plate 16), which enables them to fit together properly. This is purely superficial, but examination of the discs from the Mesolithic monument showed no sign of a radial structure but revealed a layered structure which extended right through them. They are in fact modern shell beads from a necklace similar to that in plate 17. A rod of shell was formed and then sawn into segments; on some it is possible to see the raised 'nib' left where the bead snapped off. Far from being an ancient necklace of fossils weathering out, the discs were beads from a modern visitor's broken necklace in the process of being buried!

III COMPOSITE AND IMITATION STONES

Composite stones.
Some of the most interesting stones which have been examined have been composite stones, such as those in the three rings from St Augustine's Abbey, Canterbury. They are made of gilded copper alloy with a hole through the back of the large shank as though they were sewn onto a glove. The bezels are not the same shape, but they are all in the same style; a circle of tall turret-like collets set with small glass pastes, surrounding a composite stone. Only one has the central stone still in place. In each case the stone, either glass or rock crystal, is in two parts with a reflector below it and it seems quite probable that these stones are medieval examples of a type of imitation stone known as a soudé stone. Green versions of these stones are still available and are sold as 'soudé emeralds'. They are very convincing as can be seen in plate 18.

They consist of two layers of a colourless transparent material with a coloured layer, traditionally coloured gelatine, sandwiched between them (plate 19). An experimental stone was made up of two flat-based pieces of rock crystal, slightly moistened to get good contact and exclude air, with a piece of blue photographic filter between them. Members of staff of the AML were invited to comment, but no matter what angle the stone was held at, no one realised that the stone was not blue all through.

Imitation stones.
Green glass beads, hexagonal or octagonal in section with flat ends (plate 2) are found on many Roman excavations and it has been suggested that these were made as imitation emeralds or smaragdi. This does not seem unreasonable in view of the fact that green minerals such as variscite and chrysoprase (Crummy 1983, 34) have also been found cut to the same plan.

Not everything passing through the AML is excavated and a modern necklace given to the writer on her retirement had several beads on it which were colourless glass, painted with brightly coloured transparent varnish (plate 20). This went unrecognised until wear caused the varnish to peel. There is no reason why this extremely cheap and simple method of imitating expensive stones should have not been used in the past. Possibly the remains of a superficial layer get washed off in the field.

It is interesting that one type of imitation stone, described by Pliny (XXXVII 157) and still available today, has not so far been recognised amongst excavated material: this is heat-crackled quartz. Rock crystal is heated and then thrown into a bucket of cold dye. The thermal shock cracks but does not break the stone; the dye is drawn into the cracks by capillary action and the whole stone is coloured by reflection.

CONCLUSION

It is believed that there are now three qualified gemmologists in the UK working in the archaeological field, two of them in a national museum, and it is hoped that this report shows that more are needed. At present, there is not enough awareness in the archaeological world as to what a gemmologist can contribute to support an archaeological gemmologist full-time. However, it is a specialisation which can be combined with conservation to advantage, as conservators are usually the first to handle material after it has left the excavation.

ACKNOWLEDGEMENTS

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CONCORDANCE.

A superscript number thus [6] indicates an AML Report by M E Hutchinson on that stone or group of material. The number refers to the list of Reports at the end of this concordance.

I INORGANIC MATERIALS

SITE	AML No.	SITE REF
Corundum, ruby and sapphire		
Ruby		
[11] London, Winchester Palace	N/A	WP83 (5211) /514\
Sapphire		
York	?	
Beryl, emeralds		
Great Bedwyn,	?	
Canterbury, St Aug's Abbey	767481	
[2] Gorhambury	814713	3816 (2004) /3191\
[12] Lincoln	910221	SM 76 (AYF) /St45\
[12] Lincoln	910222	SM 76 (ANG /St46\
Wroxeter (?)	7716553	
Wroxeter (WB)	788145	
[6] Wroxeter (WP)	824010 (pt)	WP 82 (22F) D718 /509\
Wroxeter (Thermae)	?	
York	N/A	1985.9 [1292] /1121\
Fluorite		
Acton Court, Avon	890579	
Garnet		
[10] Market Lavington		W381; (1146); /171\
[14] Mucking, Cemetery II	?	Grave 281/3
[9] "	69030	Crem (197)
[8] Sancton	?	A1531
Wickford		CEH 860213 L(8) Cat 1705
"		CEH 860214 L(111) Cat 3634
Quartz		
Amethyst		
[4] Leatherhead, Goblin Wks	N/A	bead 1. GW 85 S14. K 860159
		bead 2. GW 85 S14. K 860159
Rock crystal		
[1] Battle Abbey	793442	small 'hog's back' stone
[5] Beeston Castle	852667	BC0235/175xx
	856077	BCOW0612/3241
	865081	BC0884 s.342
	873488 - 873525, excepting 873490, 497, 500, 504, 506, 513, 517, 520,523,	
Canterbury, St Aug's Abbey	?	large 'hog's back' stone
Guisborough	?	
[16] Mucking, Cemetery II		334/10 z 3 and 125
		548/5
		690/3k 11-12

SITE	AML No.	SITE REF
Smokey Quartz		
[16] Mucking		615/3k groups 10a and 10b
		843/6
Micro-crystalline quartz		
[13] Ardleigh	7910456-8	Grave 651
	7910500-25	Grave 638
[7] Birdoswald	9014095	3906 I-IV 082.05 2336 229.27
	9014097	3771 VI 057.34 2338 214.35
Gorhambury	?	(562) /1029\
Lullingstone	851419	
[16] Mucking Cemetery II		649/7 o 7
[15] Wroxeter (WB)	8650250	WB84 (109) /4064\
<u>Variscite</u>		
[6] Wroxeter (WP)	824010 (pt)	WP 83 (33C) /823\
York	N/A	1981.12 I [1133] /35\
		1983.32 [1294?7] /1044\
II ORGANIC MATERIALS		
<u>Amber</u>		
[16] Mucking		533 beads
<u>Coral</u>		
[6] Wroxeter	824010 (pt)	WP 75 (22) D168 /193\
		WP 80 (6N) D439 /109\
		WP 80 (20) B266 /124\
		WP 81 (21) D566 /349\
<u>Jet-like Materials</u>		
[16] Mucking, Cemetery I		99/4 ri 11 (BM 1970 4-6 13)
		99/4 rii 49(BM 1970 4-6 13)
		99/4 riii 5(BM 1970 4-6 13)
		99/4 riv 83(BM 1970 4-6 13)
		99/4 rv 13 (BM 1970 4-6 13)
Cemetery II		530/1
		860/3 t 36a and 36b
		860/3 u 36x and 36y
<u>Pearl</u>		
Gloucester, King's School		12/86 (75) SF 11
<u>Shell</u>		
[4] Leatherhead, Goblin Wks	N/A	bds 5-7 GW 85 S14. K 860159
		shell K 860158
III COMPOSITE AND IMITATION STONES		
Canterbury, St Aug's Abbey	743661)	3 finger rings
	765753)	
	78203077)	
Corbridge		green glass beads
[6] Wroxeter (WP)	824010 (pt)	8 green glass beads

Ancient Monuments Laboratory Reports by M E Hutchinson dealing with gem materials.

1, Identification of a gemstone from Battle Abbey, East Sussex, AML 793442. [1982], Ancient Monuments Laboratory Report 3585.

2, Identification of a polished green stone from Gorhambury, Hertfordshire. [1982], AML Report 3627.

3, Identification of two gemstones from Camber Castle, East Sussex. [1986], AML Report 4904.

4, Identification of beads and a shell from the Goblin Works, Leatherhead, Surrey, 1995. [1987], AML Report 16/87.

5, The identification of 43 pieces of colourless material from Beeston Castle, Cheshire, excavated 1981-1985. [1989], AML Report 73/89.

6, Identification of the non-glass beads from Wroxeter (WP) Shropshire. [1990], AML Report 107/90.

7, Identification of material of three intaglii from Birdoswald, Cumbria. AML Site No 2028, CEU Site Code 420. [1991], AML Report 74/91.

8, Identification of two gemstones from Sancton, Humberside (AML Site Number 1251). [1991], AML Report 119/91.

9, Identification of a red stone in an Anglo-saxon buckle plate from Mucking, Essex. [1992], AML Report 10/92.

10, Identification of a red stone set in an Anglo-Saxon buckle from Market Lavington, Wiltshire. AML Site No. 2245. [1992], AML Report 9/92.

11, Identification of a red stone set in a gold ring, from the Winchester Palace Site (WP 83) London. [1992], AML Report 33/92.

12, The Identification of two green stones from St Mark's Church, Lincoln. [1992], AML Report 40/92.

13, The examination and identification of 29 beads from Ardleigh, Essex. [1992], AML Report 84/92.

14, Identification of a red stone from Mucking, Essex. Cemetery II. [1993], AML Report 40/93.

15, Identification of a green stone from Wroxeter Roman City, Shropshire. [1994], AML Report 32/94.

16, A technical examination of the non-glass beads from two Anglo-Saxon cemeteries at Mucking, Essex. [1995] AML Report 52/95.

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HUTCHINSON, M E, forthcoming b, A Review of Green stones from Roman Excavations in the British Isles, PACT

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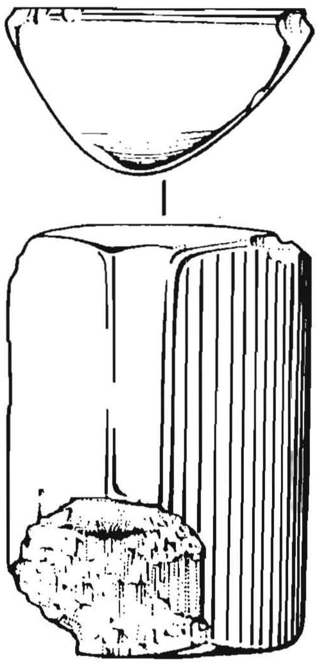

PLATE I. Emerald, cut as a triangular prism. Note the lengthwise growth features showing on the damaged corner. Gorhambury, Herts. AML 814713. Size: 27.5mm x 18.5mm. Drawn by the excavator, D Neal.

PLATE 2. Emerald crystal pierced as bead (top left) and eight polygonal green glass beads, possibly imitations. Wroxeter, Shropshire. AML 824010 (pt) 35mm slide no. 7594.

PLATE 3. Gold finger-ring set with a pear-shaped ruby. Note the surprising lack of wear on both claws and shank. London, Winchester Palace Site. WP83 (5211) /514\. Diameter of ring; 22.4mm. Size of stone; 5.6 x 4.1mm.

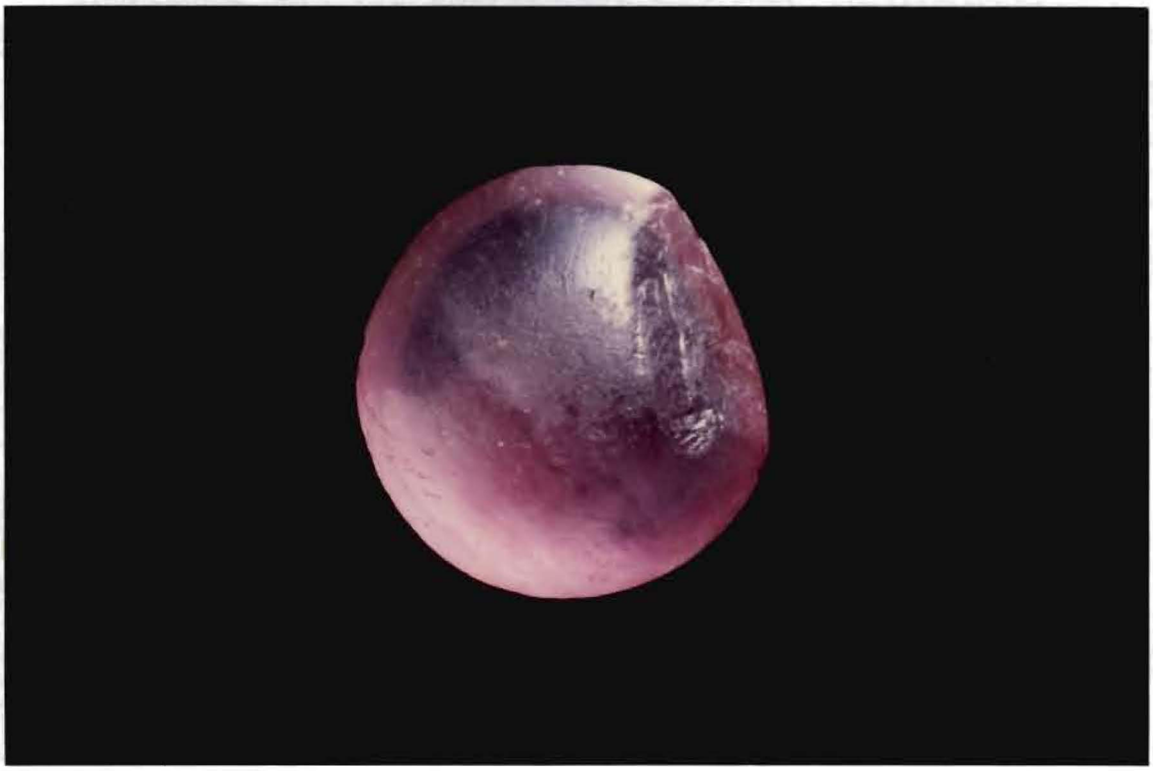

PLATE 4. Double cabochon of rose pink fluorite. The flat facet is a cleavage. Scale; c 4:1. Acton Court, Avon. AML 890579. 35mm slide no. M890556.

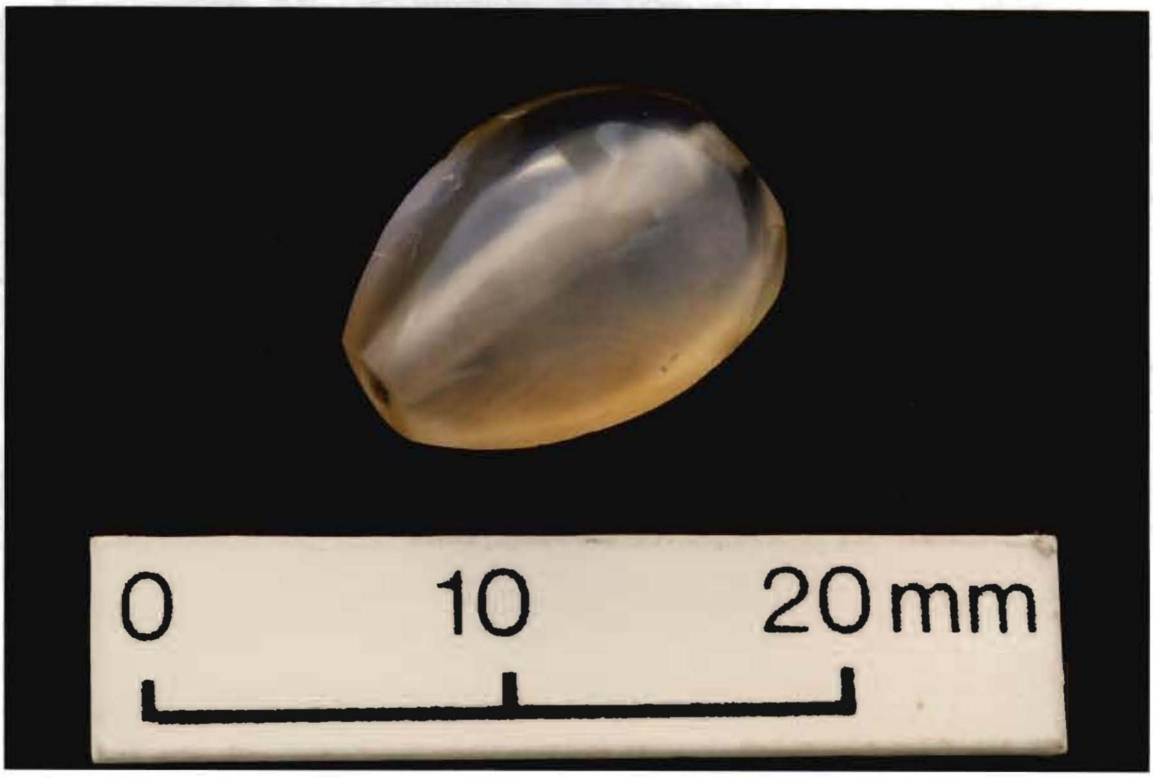

PLATE 5. Milky chalcedony bead: the Lullingstone 'opal'. Even though monochrome, the banded structure can be seen. Lullingstone, Kent. AML 85149. 35mm slide no. 7595.

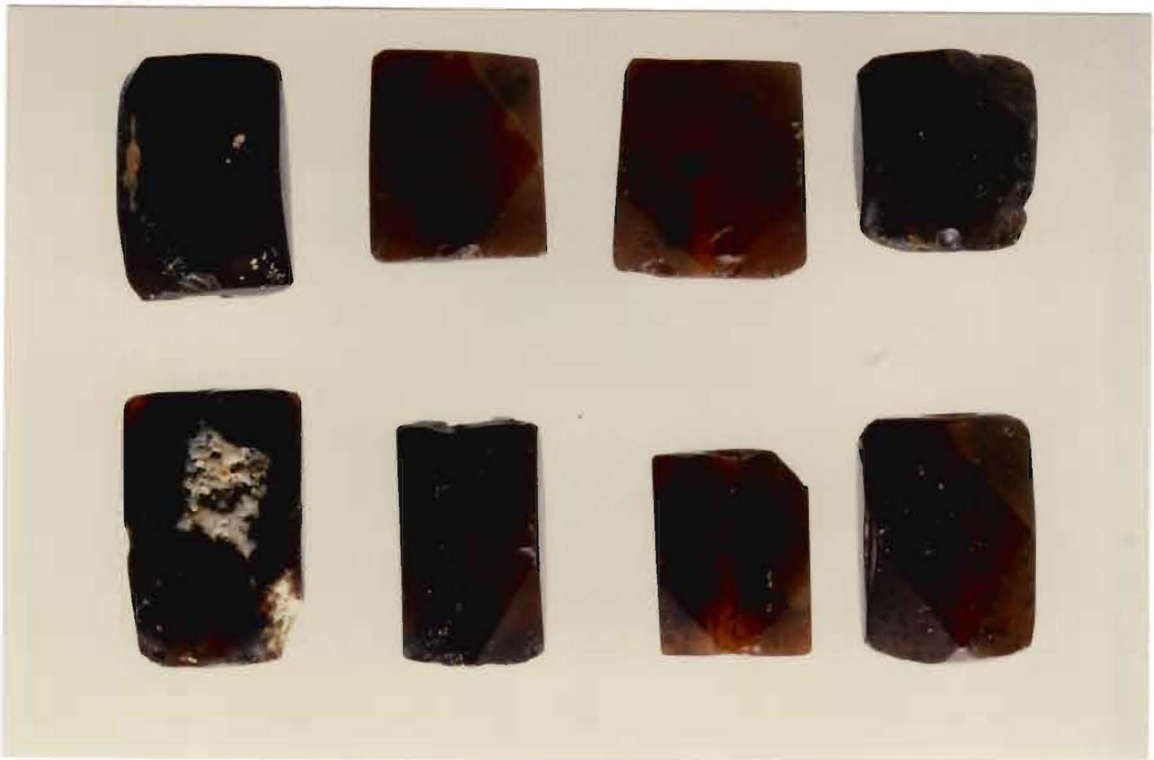

PLATE 6. A representative sample of the brown chalcedony beads from Ardleigh. They are common in Sarmatian-period graves in Hungary but unusual elsewhere.
Ardleigh, Essex. Scale; c 2½:1. 35mm slide no: M 890565.

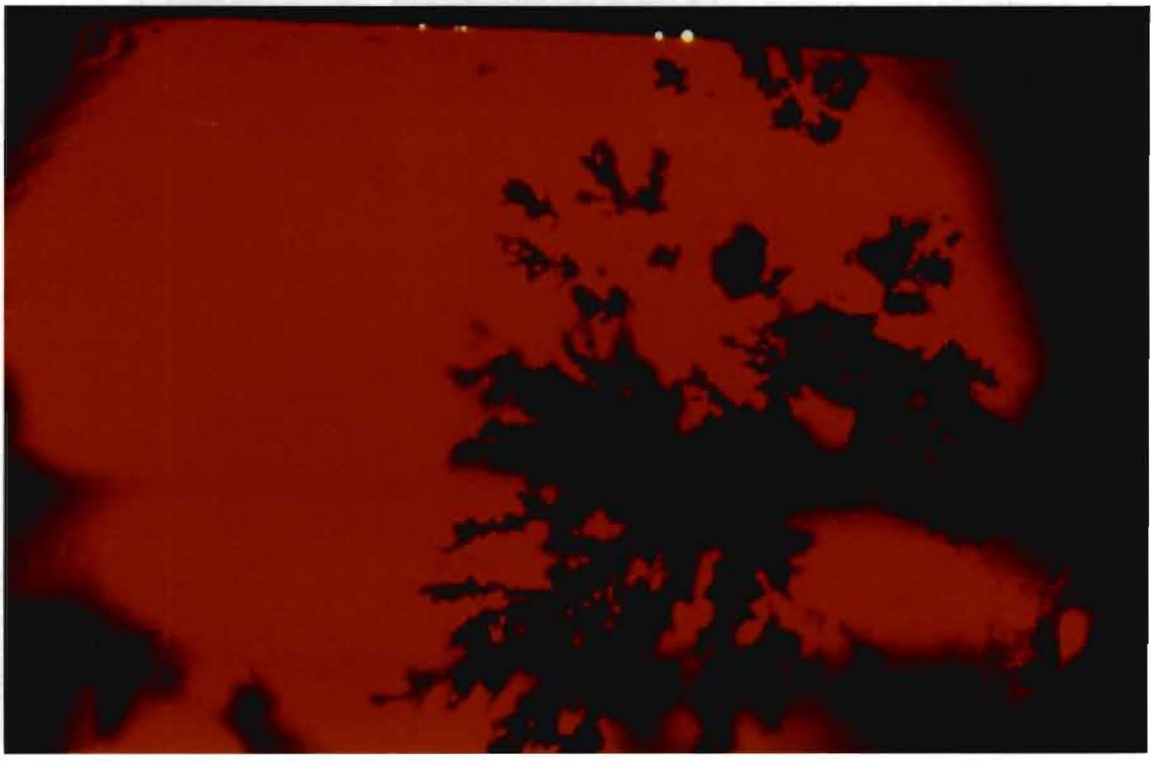

PLATE 7. Dendritic inclusions and the surprising colour of the beads in Plate 6 seen by transmitted light. This colour has lead to other examples being misidentified as garnet.
Ardleigh, Essex. AML 7910504. Field of view: c 8.3 x 5.6mm.
Wild film 48.

PLATE 8. A 'plasma' intaglio made from chalcedony coloured green by chrome. Similar Roman intaglios have been identified as 'plasma' or 'prase'. Wroxeter. AML 8650250. Size: 13mm x 9.7mm.

PLATE 9. Two variscite beads. The righthand one may be intended to imitate an emerald or smaragdus even though it is octagonal rather than hexagonal in section.
York. 1981.12 I [1133] /35\; 1983.32 [1294] /1044\

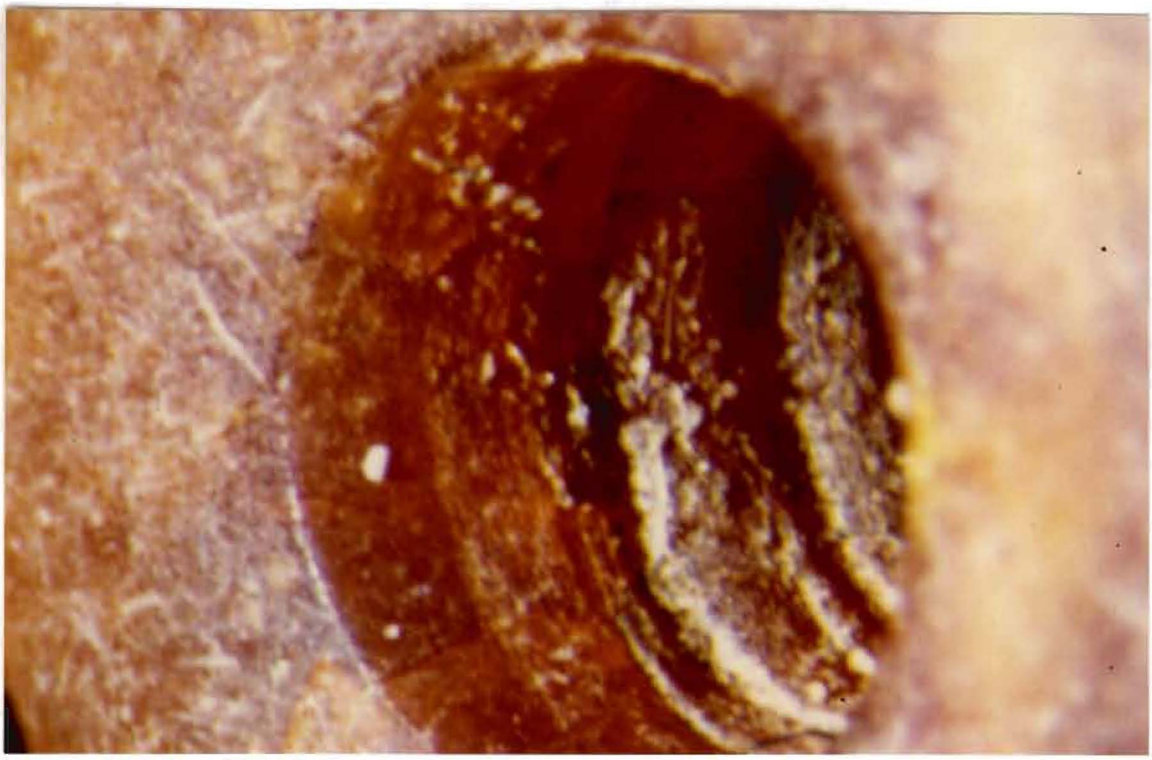

PLATE 10. Hole in an amber bead showing the preserved tool marks. Notice the edge of the hole has been kept sharp by abrasion against the next bead. Field of view: 4.1 x 2.8mm. Mucking, Essex. CII 785/1g (1). Wild film 69, 13.

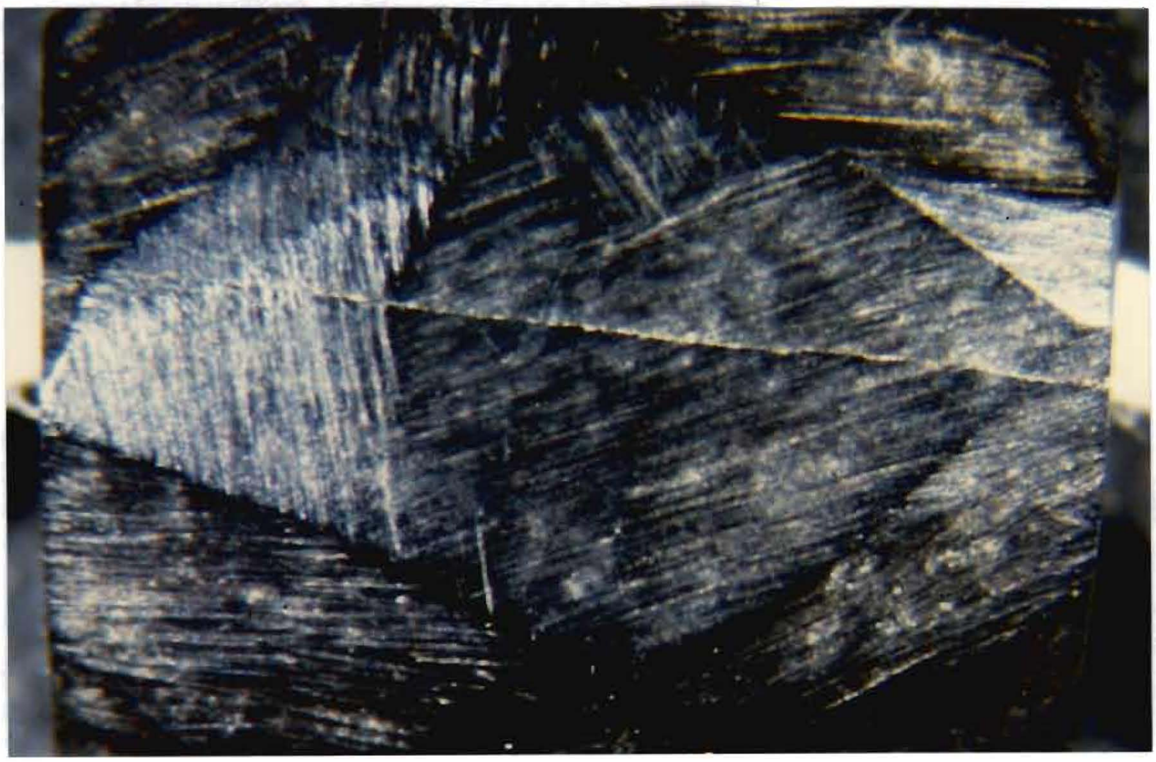

PLATE 11. Unfinished jet bead showing the large diamond facet at the roughed out stage. Note the differing directions of the abrasion lines, (the line down the length of the bead is a natural flaw). Field of view: 8.3 x 5.6mm. Mucking, Essex. AML 35. CI 99/4rv 13. Wild film 69, 30.

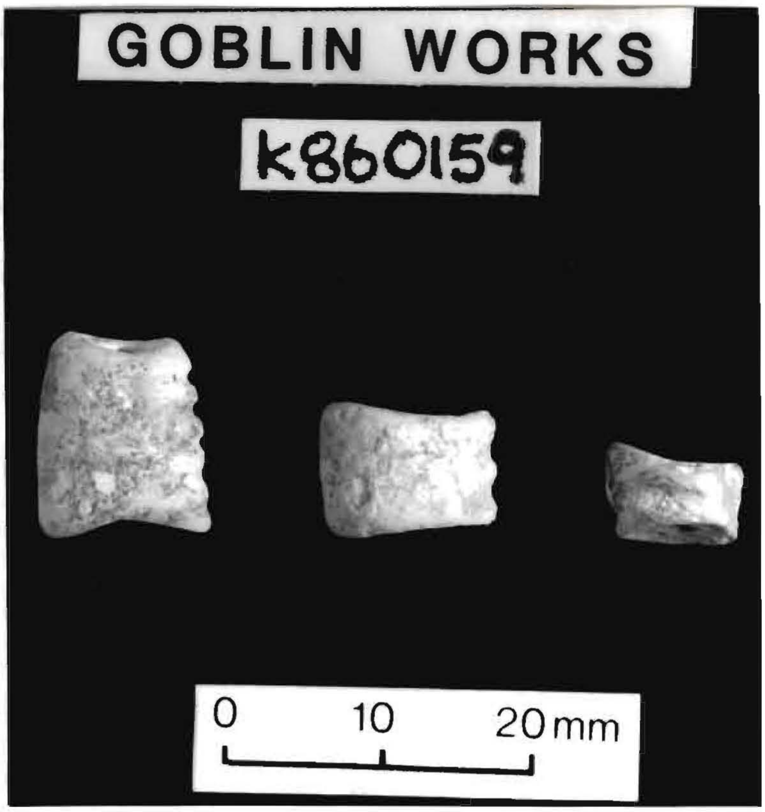

PLATE 12. Three beads made from cowrie shell showing the diagnostic ridges down their sides.
Goblin Works, Leatherhead. Picture no. A 860942.

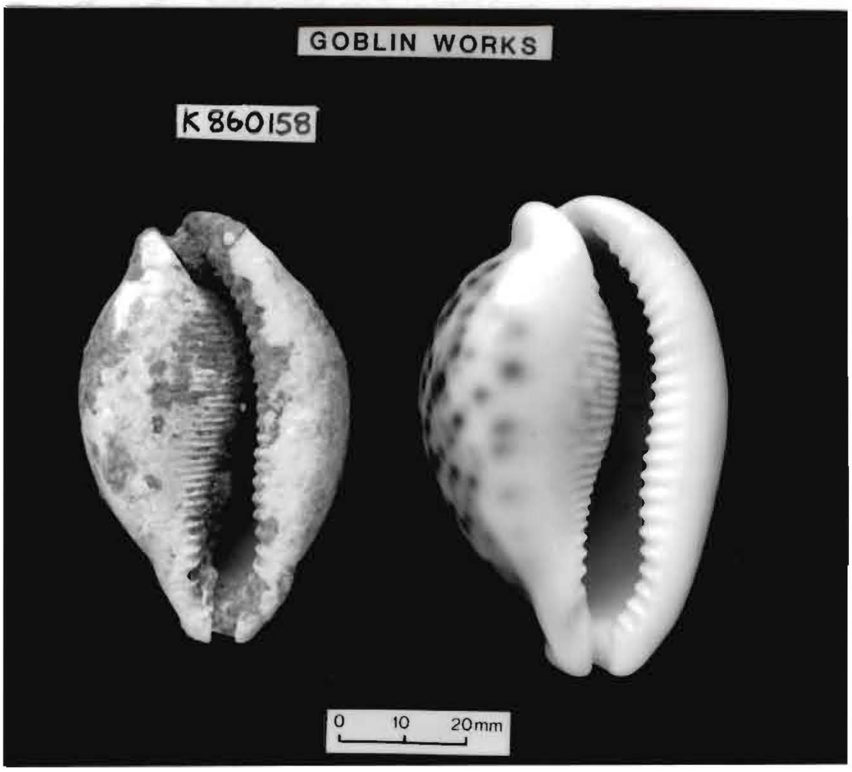

PLATE 13. Two specimens of Cypraea pantherina, the Panther Cowrie. Left, from a Saxon grave; right, a modern example.
Goblin Works, Leatherhead. Picture no. A 860940.

PLATE 14. Disc-shaped shell beads. A group of those found in a Mesolithic stone circle, supposedly weathering out. M E Hutchinson. 35mm slide no. 7603.

PLATE 15. A group of crinoid ossicles. Note the radial markings on the flat surfaces and the stacked examples M E Hutchinson. Max diameter 7.5mm; 35mm slide no. M890566.

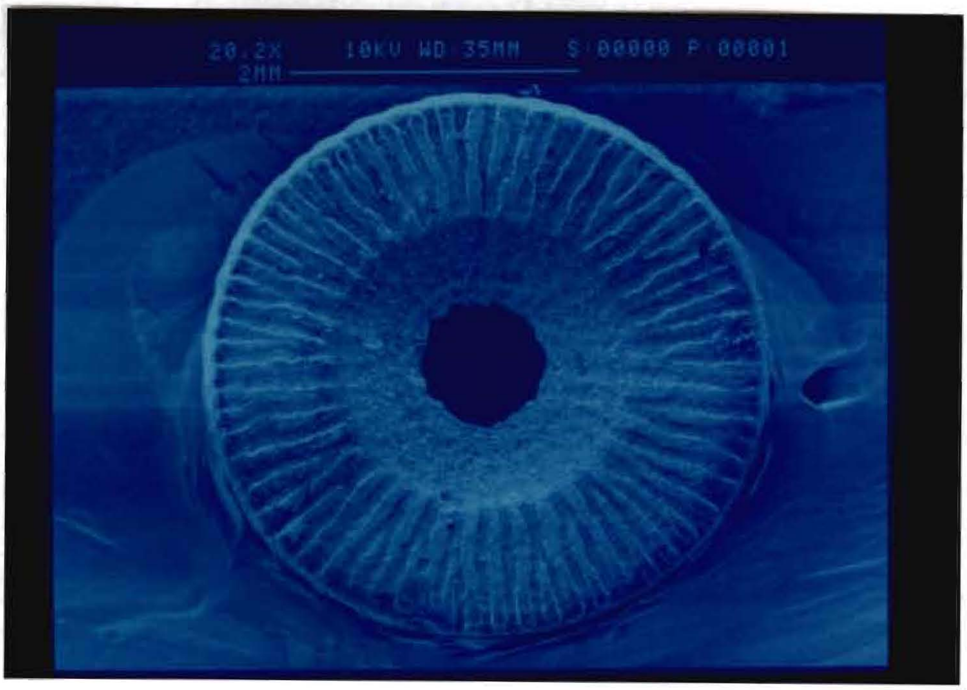

PLATE 16. Scanning electron micrograph of the surface of a crinoid ossicle. The radial structure is purely superficial; it enables the stacked ossicles forming the 'stem' of the 'sea-lily' to fit together properly.(This is a tinted b/w image) M E Hutchinson. 35mm slide: AML SEM Film.

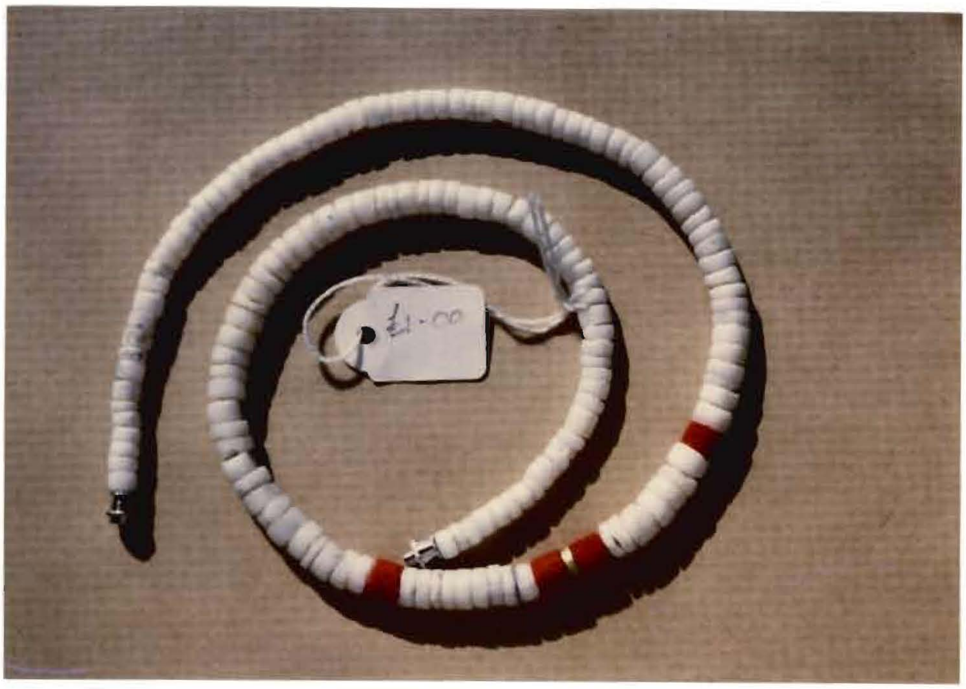

PLATE 17. A modern shell bead necklace. The beads on Plate 14 probably came from a similar example. Private Collection. Max. diameter of beads: 6.0mm.

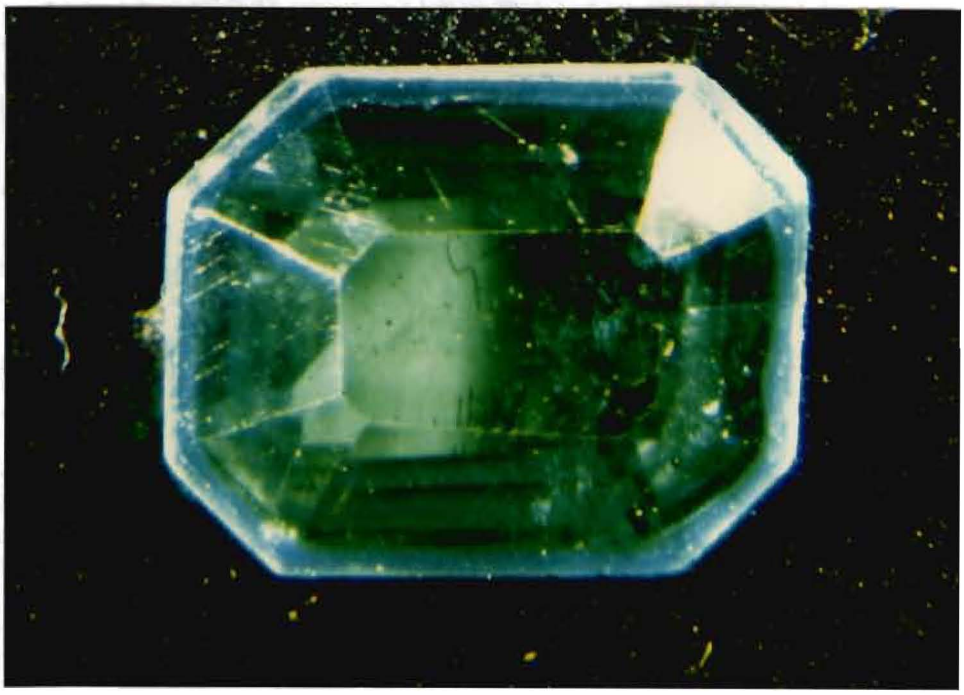

PLATE 18. Modern soudé emerald viewed by reflected and transmitted light, showing how the central green layer reflects throughout the stone.
Field of view: 8.3 x 5.6mm.
Private Collection. Wild film 21.

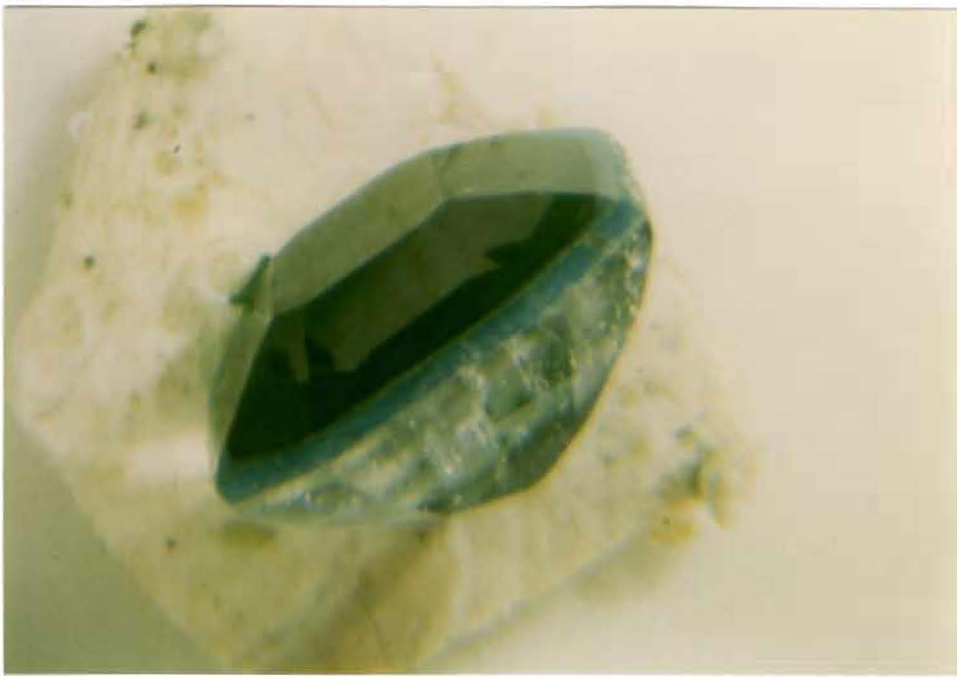

PLATE 19. Modern soudé emerald viewed immersed to show the three-part structure: a central green layer with colourless material on each side. Even underwater, the colourless top looks green.
Field of view: 8.3 x 5.6mm.
Private Collection. Wild film 21, 20.

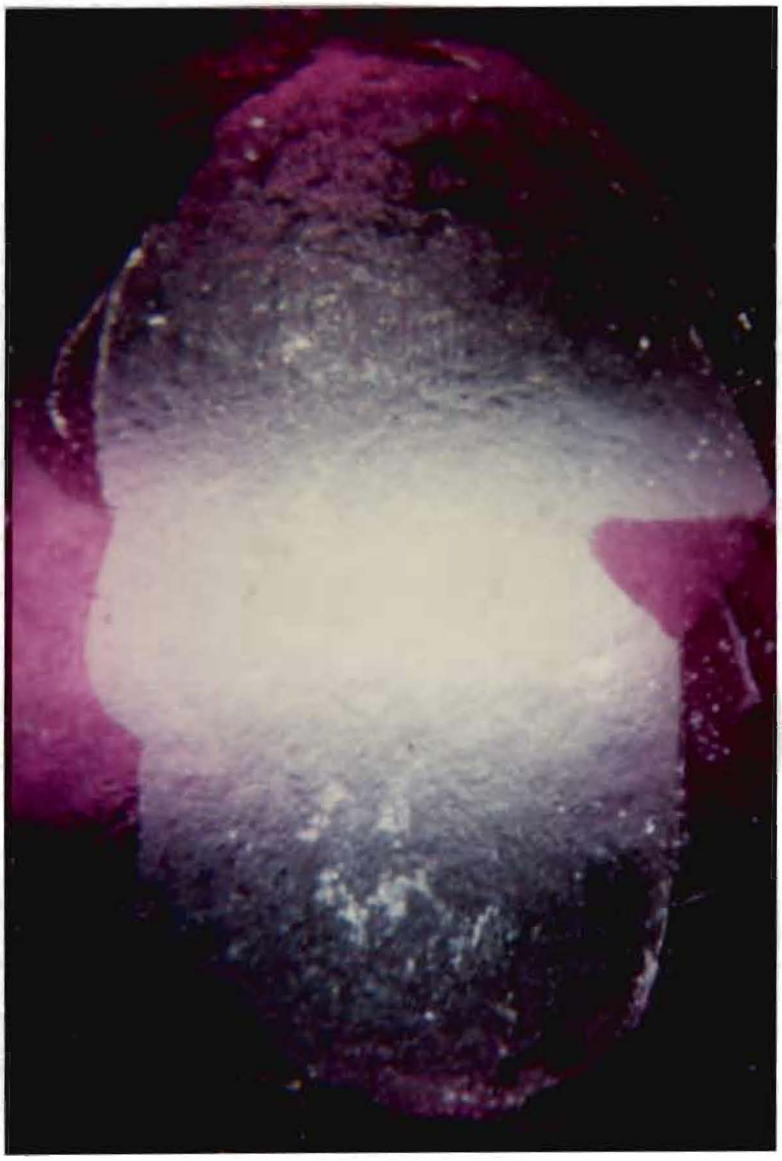

PLATE 20. Modern colourless glass bead which has been painted with pink varnish, now peeling, to colour it. The surface of the glass has been frosted to ensure good adhesion.
Field of view: 8.3 x 5.6mm.
M E Hutchinson. Wild film 69, 32.