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IMITATION AND TREATED TURQUOISE

By H. LEE and R. WEBSTER

ARCHAEOLOGISTS tell us that the turquoise found in the Sinai peninsula was used for beads and jewellery in both the Old and Middle Kingdoms, and even as early as pre-dynastic times. It may well be expected then that imitation, as so often occurs, would follow, and indeed one form of imitation known as *faience* was also as old as the pre-dynastic times, say before 4777 B.C.

Faience, a glazed siliceous ware, was said to have been invented at Faenza, Italy, in the 13th century and is a glazed earthenware, of which Wedgewood ware is a modern example. The ancient faience of Egypt is somewhat different in that the broken surface shows it to consist of two or sometimes three layers. Always there is an inner core of fine gritty material, which may be powdered quartz, with an outer coating of coloured glaze, and, occasionally, there is a third middle layer between the core and the glaze. This when present is very marked owing to the differences in colour and density and was probably used to enhance the glaze.

Although primarily intended and used as a pigment, *frit* was composed of a crystalline compound of silica, copper and calcium. It was probably made by heating together silica, probably in the form of quartz pebbles, a copper compound which was generally malachite, and calcium carbonate and natron (a natural sodium carbonate), but there are variations of this. The date when this material, called by Vitruvius *caeruleum*, and by Theophrastus *kyanos*, was first used is uncertain, but it has been found as early as the 4th dynasty (3998-3721 B.C.).

Glass has been reported prior to the 18th dynasty (1587-1328 B.C.). The glass of ancient Egypt—and Egypt is usually accorded the honour of the discovery of glass—is generally opaque, rarely transparent and always coloured. Copper compounds were usually the colouring agent in the Egyptian blue-coloured glass, but one specimen from the tomb of Tutankhamen (*circa.* 1350 B.C.), analysed by W. B. Pollard, was found to be coloured by cobalt. The finding of cobalt glass as early as the 14th century B.C. is of importance since no cobalt, or very little, is found in Egypt, and this pre-supposes some connexion with abroad — maybe Greece or Rome. The foregoing imitations have archaeological interest only.

Glass imitation gems were made in Roman times, the *gemmae vitreae* of Pliny, but turquoise was not the most popular stone in the period of the Roman Empire. Again in the Dark and Middle Ages, when the centre of the glass manufacture was Venice, and after 1291 at Murano, turquoise-coloured glasses again had no great vogue.

Some forms of blue enamel can imitate turquoise. The basis of all enamels is an easily fusible colourless silicate glass to which the colour and the desired degree of opaqueness are imparted by mixtures of metallic oxides. The molten mass, after cooling, is reduced to a fine powder and washed. The moist powder is then spread, usually with a spatula, upon the surface of the metal. The whole is then fired in a furnace till the enamel is melted, when it adheres to the metal. Enamel, which is really just an opacified glass, has been used from early times, both in the Near East, Europe and the Orient. Blue enamel is obvious for what it is by reason of its vitreous lustre, and because the coloured areas are not in settings.

Glass imitations of turquoise consist, usually, of an opaque white glass to which a trace of copper oxide, or oxide of cobalt, is included in order to produce the colour. Such imitations are often finished on the upper surface with a layer of clear glass. The density of glass imitation turquoises varies between rather wide limits according to the type of glass used. Most commonly the density falls within the range 2·80 to 3·30 ; likewise the refractive index varies between 1·55 and 1·60.

Turquoise imitations in glass quite often show, on examination with a hand lens, small pits on the surface, which are surface bubbles cut across, or small bubbles just visible below the surface. The luminescence shown by glass " turquoises " when bathed in invisible ultra-violet light shows characteristic differences from the glows shown by true turquoise, and from many other types of imitation turquoises. Glass imitations do not conduct electricity, while much real turquoise and some other turquoise imitations often do.

Imitations of turquoise in coloured china (porcelain) are not common. Such material is characterized by its constant density of 2·3. Owing to the fact that most often these pieces are finished with a vitreous glaze the refractive index will be that of the glass finish.

The popularity of turquoise during the 18th and 19th centuries gave an impetus to its imitation and fake turquoises made of many different materials were produced during this period.

There should be discussed first, however, a number of natural minerals which simulate turquoise. Most are too rarely met with to need comment in this article but mention must be made of *lazulite* and *variscite.* Lazulite occurs as monoclinic crystals of a sky-blue colour or as finely granular masses known as *blue spar.* Such material is found in Salzburg, Switzerland, near Diamantina in Brazil, and as nodules at Death Valley, California, and at North Groton, New Hampshire, in the United States of America.

The chemical composition of lazulite is very similar to that of turquoise, being a hydrous aluminium phosphate, but containing in addition some iron and magnesium. The mineral forms an isomorphous series from the bright blue *lazulite,* $(Mg,Fe)Al_2(PO_4)_2(OH)_2$, to the darker *scorzalite,* $(Fe,Mg)Al_2(PO_4)_2(OH)_2$. Lazulite may be easily distinguished from turquoise by its higher density which approximates to 3·1, although the refractive index (1·61-1·64) overlaps that of true turquoise. The hardness is 5½ on Mohs's scale, which is rather less than that for true turquoise. There is no copper present so that a test for copper giving a negative result will prove that a suspected piece is not turquoise. Lazulite does not show the turquoise absorption spectrum.

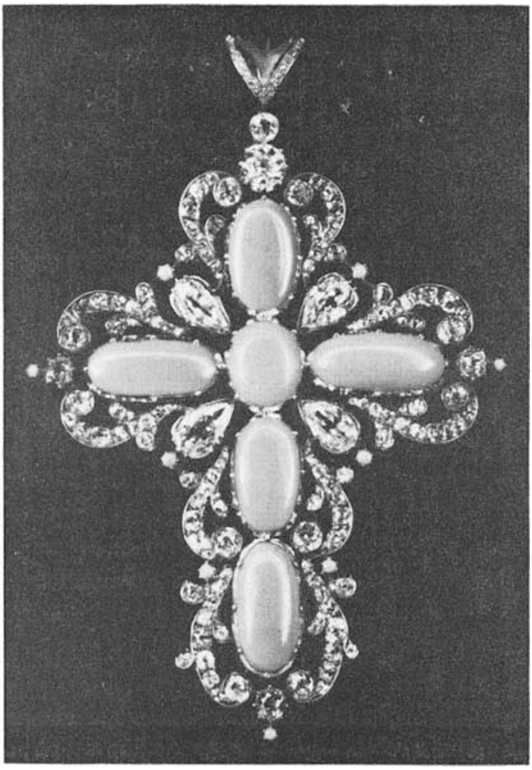
The mineral *variscite* is a hydrous aluminium phosphate, Al,PO_42H_2O, but by isomorphous replacement usually contains some iron, producing a series in which the pinkish or amethystine *strengite,* Fe,PO_42H_2O, is the iron end member. Variscite resembles turquoise but is usually greener in colour. The green nodules from

Fairfield, Utah, called *utalite*, and veins from Lucin in the same state of North America have both been used for jewellery purposes. Large masses and small nodules are found near Brisbane in Queensland, Australia, and other localities for variscite are Freiberg in Saxony, Pontevedra in Spain and Arkansas in the United States of America. Variscite has a slightly lower density than for normal turquoise, approximately 2·4, and has a refractive index near 1·57. There is no copper in its composition and the material does not show the turquoise absorption bands in the blue of the spectrum, but quite often lines in the red are seen, which may be due to chromium.

What is probably variscite of great transparency and fine colour is the mineral *callainite*, or *callais*, which was used in pre-historic times as a precious stone. It was found in an ancient Celtic grave at Mané-er-H'roek, near Locmariaquer in Brittany, France.

Although not strictly a mineral, the material called *odontolite*, or variously " Bone turquoise," " Tooth turquoise," " Occidental turquoise," " Turquoise de la nouvelle roche," or " Fossil turquoise," is the bones and teeth of certain extinct vertebrates, such as the mastodon and dinotherium, which have during the process of fossilization become impregnated with the mineral *vivianite*, a phosphate of iron, $Fe_3(PO_4)_2 8H_2O$, a mineral which is sometimes called " Blue iron earth " (*not to be confused with the glauconite sand, or " blue earth," of the Baltic amber deposits*). The material when taken out of the ground is a dingy greyish-blue in colour, but after moderate heating it changes to a fine deep sky blue. Some material is impregnated with a copper mineral instead of the iron *vivianite* producing a green odontolite, but such material does not seem to have been used in jewellery.

Odontolite varies in refractive index from 1·57 to 1·63 and has a density, for the gemmy material, just above 3·00. The hardness is 5 on Mohs's scale, and thus is softer than true turquoise. Owing to the carbonate content of the original bone or dentine the material " fizzes " when a spot of acid is placed upon it (do this on an inconspicuous part of the specimen, for the acid destroys the polish), and, further, in many cases the organic structure can be seen on the surface by magnification. Odontolite is found at a number of places but is especially abundant in the Miocene beds of Simorre, near Auch, in the Department of Gers in Southern France, a



A charming diamond and odontolite cruciform pendant, the odontolites bordered by Diamond scroll work, the centre stone with a pear-shaped diamond set in each angle.

The property of Her Royal Highness the Duchess of Aosta, this piece has a long history. It was a presentation gift to the Princess Royal by the King of the Belgians, her sponsor, on the occasion of her Christening, 10th February, 1841. It belonged to Princess Charlotte of Wales. More recently it was given by Her Majesty the Empress Frederick to Her Royal Highness Princess Sophie of Prussia, on the occasion of her marriage, October 1889.

(Photograph by courtesy of Sotheby & Co.)

locality which was known before the French Revolution as Languedoc, and where for a time the deposits were systematically worked.

By calcining recent ivory and staining the resulting product by soaking it with copper sulphate solution an imitation odontolite is obtained. Such imitation odontolite has the density of ivory, that is near 1·80, so distinction is easy.

Imitation turquoises made of suitably stained chalcedony are not common, but such objects may occasionally be encountered. Stained chalcedony is much more translucent than turquoise and may be definitely identified by the typical density of 2·63 and the refractive index of 1·53. Another rare imitation is bone stained blue (or green), probably with phosphate of iron. Such material has the characters of bone, that is it has a refractive index of 1·55 and a density of just over 2·00. The bone structure is usually visible when the piece is examined with a hand lens. A " reconstructed turquoise " has been made from finely powdered ivory bonded with a copper stain and cement. Coloured clay is another fake turquoise.

Many attempts have been made to produce an imitation turquoise which would have a composition near to that of the genuine mineral. The first of these substances is that which was known as " Viennese turquoise," and, according to Koch-Dudich, was made by finely grinding and intimately mixing malachite, aluminium hydroxide and phosphoric acid. This was then heated to over 100°C and was then compressed into a compact mass using great force. Another type was said to have been made by pressing together a precipitate of aluminium phosphate coloured blue by copper oleate. There have been others, all of which were made on similar principles, but they have scant importance.

These " pressed " or " reconstituted " types of imitation turquoise, which have a hardness of 5 to 5½ on Mohs's scale, give, when a snap density is taken, a value near 2·4, but after soaking the value may rise to over 2·6. The refractive index of such imitation turquoise has been found to be remarkably low, about 1·45. Such imitations blacken or fuse to a black glass when heated and do not decrepitate as does true turquoise. Further they do not exhibit the turquoise absorption bands at 4300 and 4200Å. Such pressed imitations have been found to be moderately electro-conducting, although this is no test, for much real turquoise behaves similarly.

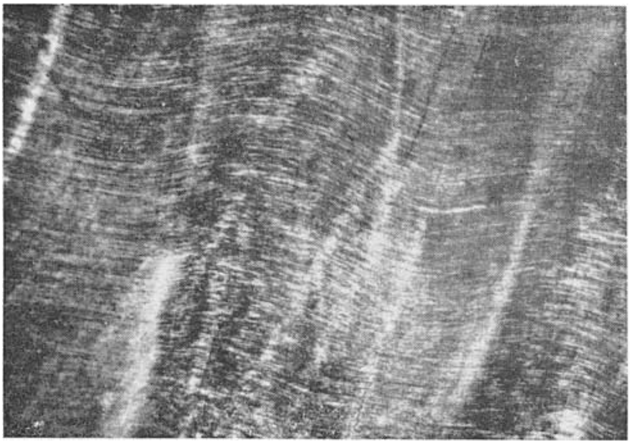
The easiest test for " reconstituted turquoise " is to place a spot of hydrochloric acid on an inconspicuous part of the specimen. The acid liquid will quickly turn to a yellow-green colour, which will stain a piece of filter paper (blotting paper) when the acid is soaked up by it. Such an effect does not occur with real turquoise and carefully applied the test does not damage the stone except for taking away the polish at the spot where the acid is applied.

Much of the turquoise matrix sold in the East is said to be a crude imitation consisting of some form of blue substance, often glass or china, which is embedded in a black mass resembling hard pitch. This may usually be detected by soaking the stone in methylated spirits, which dissolves the black substance and also by the fact that the matrix is black or nearly so, whereas limonite is dark brown. M. Weinstein mentions a clever fake made from clay into which matrix has been introduced.

During 1957 a " synthetic turquoise " was sold to the gem cutters of Idar-Oberstein which was subsequently found to be a new type of imitation, an imitation which has a lovely blue colour, which is made more convincing by the addition of sinuous dark veins of " matrix." The production and marketing of this material makes an interesting story.

Since 1953 a young chemistry student from Bremen, who was studying in Hamburg, had been working on the production of an artificial turquoise and in 1957 he finally produced a suitable " turquoise." This material was sold to the Idar-Oberstein cutters, apparently as turquoise and without disclosing the man-made nature of the product. One report says that the Mineralogical Institute of the University of Hamburg, to whom samples had been sent for test, could not prove that it was manufactured. Further, it is said that solicitors were consulted, who were of the opinion that it would be correct to call the product turquoise without the qualification synthetic.

The buyers of this " turquoise " later became suspicious and samples reached Prof. K. Schlossmacher of the Idar laboratory, who,



Wave-like structure of the canals as seen in a thinnish section of recent elephant ivory.

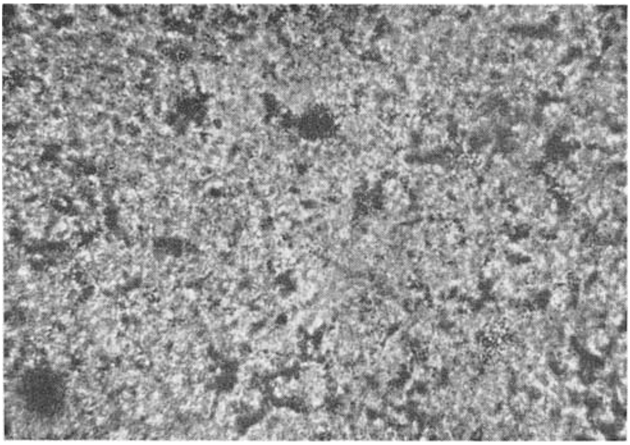
in view of the difference in density and refractive index thought the material was not turquoise and sent samples to the University of Mainz for confirmation. By X-ray powder photography and chemical analysis the material was found to be a mixture of *bayerite* and a copper phosphate—$Cu_3(PO_4)_2 3H_2O$—the " matrix " being probably an amorphous iron compound.

Bayerite is a by-product of the clay and aluminium industry, and is a material which has the same chemical composition as the mineral *hydrargillite* (*gibbsite*) an aluminium hydroxide with a formula usually given as $Al(OH)_3$. Bayerite is not identical with hydrargillite but gradually alters into it.

The Idar cutters made enquiries and found that the material was artificially produced. They then brought a charge against the student of "misusing gemmological terms." The student was found guilty and sentenced to eight months in jail, a sentence against which he lodged an appeal, the final result of which is not known to the authors.

Examination of a sample of the German material, which is now being marketed as a turquoise imitation under the trade name " Neolith," showed the material to have a hardness of about 3 on Mohs's scale, and a refractive index, so far as the vague reading could be determined, of about 1·55. Owing to the porous nature of the material the density determinations were unsatisfactory. A snap determination gave values as low as 2·33, but after allowing the pieces to soak for some time, values near 2·4 were obtained. Chemical tests proved the presence of phosphorus, aluminium and copper ; the test for iron by potassium ferrocyanide was considerably masked owing to the presence of much copper.

When heated this German material blackens but does not decrepitate like true turquoise. A thinnish section microscopically examined showed the material to have a granular structure as though a fine-grained powder had been consolidated by pressure. There is no convincing absorption spectrum to be seen, the turquoise bands at 4300 and 4200Å not being present. Under long-wave ultra-violet light (3650Å) this German imitation shows a bluish glow pin-pointed with bright blue spots, an effect which is also seen, but much less strongly, under the short-wave lamp (2537Å). A test for electro-conductivity showed that the blue material did not



Thin section of American turquoise from Gleeson mine, Gleeson, Arizona, × 200 before enlargement of 1½ times.

conduct, but where a " vein " passed right through the piece the conduction was strong along this " vein of matrix."

K.Schlossmacher has suggested that a spot of Thoulet's solution (Sonstadt's solution)—a saturated solution of potassium mercuric iodide in water—which at one time had a vogue as a heavy liquid (density of 3·18), when placed on this German imitation will produce a brown stain and thus provide a test. It has been found that the hydrochloric acid spot test mentioned earlier as a test for the " Viennese turquoise " types of imitation also provides the answer here, the acid turning strong yellow-green. Hydrochloric acid is a much more easily obtained chemical than Thoulet's solution.

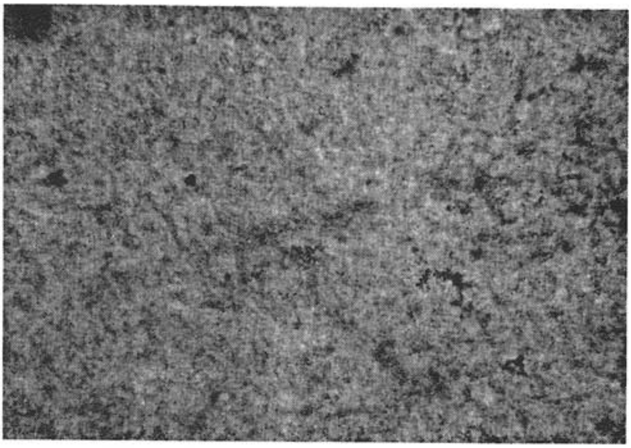
An imitation of turquoise which has a somewhat different mode of formation emanated from the United States of America about 1953. This material, which has a good blue colour, but is neither so fine nor does it take such a good polish as the German " Neolith," is " veined " with brown markings. The general appearance of this material seems to suggest that small nodules of a blue material have been bonded with some sort of cement—in fact it is bonded with a styrenated alkyd type of artificial resin. Examination with a lens showed the blue masses to consist of small white and blue grains producing a fine mottling, and this granular structure was confirmed by microscopically examining a thinnish section.

This plastic bonded material has a hardness estimated at $2\frac{1}{4}$ on Mohs's scale and the density was found to be about 1·85. Later samples of this type of imitation were found to be harder and denser, the hardness reaching to $3\frac{1}{2}$ on Mohs's scale and the density to about 2·39. The refractive index, as far as could be observed from the vague shadow-edge seen on a refractometer, is 1·56. There are no absorption bands in the blue as are observed in true turquoise and under the long-wave ultra-violet lamp a bluish fluorescence was seen. In this type of imitation turquoise the hydrochloric acid spot test also gives a positive result which makes distinction easy.

Plastic bonding by similar means of real turquoise, particularly the pale chalky material from Arizona, is now carried out in order to " harden " the raw material so as to make it usable for the arts. This bonded, but unfinished, turquoise is in the main exported from the United States of America to Hong Kong, Tokio, Osaka, Bombay and Idar-Oberstein. The remainder is sold to cutters in the United States who provide calibre-cut stones for setting into machine-made Indian type jewellery. The small sized nuggets are made into costume jewellery, probably by first fashioning by the tumbling process. Some turquoise is treated specially for the Navajo and Pueblo Indians of the American south-west who use it to make their own jewellery and for the jewellery they sell to the tourists.

Specimens of plastic-bonded real turquoise were found to have a density which varied from 2·18 to 2·5 and had a hardness of about 3 on Mohs's scale. The refractive index, as far as could be measured on a contact refractometer, was about 1·61. The luminescent glow under ultra-violet light was weakly blue but this has little diagnostic value. Unlike the imitation turquoises discussed earlier, this material, a true turquoise, shows, albeit weakly, the two absorption bands in the blue-violet shown by real turquoise. The lower density will assist in identifying this type of bonded turquoise, but the most satisfactory test is to identify the plastic bonding by chemical means.

A newer departure consists of bonding the chalky Arizona turquoise with colloidal silica, a stable opalescent liquid consisting of an aqueous dispersion of SiO_2 with a density of 1·21. The type used is " Ludox " made by The Monsanto Chemical Company of



Thin section of silica-bonded American turquoise. × *200 and 1½* × *enlargement.*

St. Louis, Missouri. Such silica-bonded turquoise has a more natural, although on the whole a paler colour than the plastic-bonded types.

A sample of silica-bonded turquoise which consisted of a nodule with a botryoidal surface to which crystals of pyrites, and, maybe, quartz were adhering was examined. One end of the nodule was polished with a curved surface. For the purposes of this investigation this nodule was sawn into four pieces, and from one piece a thin section was made. The hardness was found to lie between 4 and 4½ on Mohs's scale and the density had a mean of 2·66. Two of the pieces had a density of 2·65 and two of 2·67. This result, in view of the bonding, is surprisingly high. The refractive index was found to approximate to 1·61, and the material shows weakly the two absorption bands of turquoise. Examination of the thin section showed the structure to agree with that shown by a thin section of turquoise from the Gleeson mine, Gleeson, Arizona.

The effective identification of silica-bonded turquoise seems to necessitate the determination of the silica-bonding, which is not an easy assignment, for silica is to some extent always present in natural turquoise and, indeed, appears to be very much in evidence in the raw Arizona turquoise.

The exact method used in impregnating turquoise with plastic or colloidal silica is not known. Much of the Arizona turquoise is sufficiently porous to allow impregnation by soaking in the liquid plastic. This plastic subsequently polymerizes ; the silica remains in the colloidal state. Alternatively the chalky turquoise could be reduced to powder and then formed into a paste with the plastic or silica which subsequently hardens. Such treatment does not give an increased hardness as such, but merely " bonds " the very friable and porous natural turquoise used. The bonding, too, may well be the cause of the darker and brighter colour of the finished material rather than this being effected by the addition of colouring agents.

Recently a number of carved figurines, up to twelve inches in height, which had apparently come most probably from China, have been seen. Two such pieces which have been examined gave inconclusive tests of the nature of any bonding. The general impression is that these pieces are rather soft and more easily powdered than the known bonded types worked upon. One specimen had " matrix veins " painted on, and the first impression was that the piece was a plaster imitation. It was later proved, by a phosphate reaction and by the weak turquoise absorption spectrum that could be observed in light reflected from its surface, that the figure contained turquoise. The density of this piece was found to be 2·1, but another figure of similar colour had a specific weight of 2·58, a value quite near to that of American turquoise. The inference is that the pieces are exceedingly lightly bonded turquoise —and may be Arizona material—the low density specimen with plastic and the heavier specimen with silica. However, at this stage we do not feel justified in publishing any other of our findings.

In connexion with bonding turquoise it is interesting to recall that F. B. Wade mentioned that a little after he had published an article " *On the cause of colour in precious stones* " in 1942, he was besought by a turquoise miner in Nevada to assist him in finding out how to prevent the fading of the somewhat porous turquoise he was then mining.

After some experimentation Wade gave the miner the following advice—to soak the pieces of porous turquoise in sodium silicate (water glass) for a greater or lesser time according to its degree of porosity, then to transfer the stones to some concentrated hydrochloric acid, and subsequently to wash them and soak them in a

The wavy structure as seen in this thin section of odontolite proves the organic nature of the substance (compare with the picture of ivory structure). This section was ground very thin and does not give the relief shown by the thicker section of ivory.

highly concentrated deep blue solution of cuprammonia sulphate (made by adding an excess of ammonium hydroxide to a saturated solution of copper sulphate). Experiment had shown the turquoise to become stained to a deep blue which on drying became less blue but still of excellent colour for the purpose. As the coloration was only " skin deep " the miner was advised first to cut and sand his stones before treatment and then to dry and polish them.

Incidently Wade advised the miner to claim (not to admit) that *his* turquoises had had the colour " stabilized " and that every stone was warranted not to fade for a year and that any which faded would be replaced without cost. Experience with such treated stones showed that the colour held. Was this the beginning of an idea for the bonding of turquoise ?

One of the greatest difficulties encountered in deciding whether a specimen is natural or one of the many imitations is due to the fact that the majority of the imitations most likely to be encountered are very similar in composition to the actual mineral. Many are in fact reconstructed from the pulverized mineral itself while others are composed of the identical components comprising the real mineral.

Turquoise is in fact an hydrated double phosphate of copper and aluminium—aluminium phosphate, copper phosphate, or aluminium hydroxide with a phosphate and an alternative copper salt all occur in the more common simulants. Obviously chemical tests on these lines are anything but conclusive. Even if elaborate quantitative tests are carried out some of the imitations approach very nearly to the natural turquoise, which itself varies over quite appreciable amounts. One thing, however, entirely foreign to any natural turquoise, and inevitably present in any simulant is the material with which the components are bound together. More often than not the binder is organic in type, usually one of the synthetic plastics, though it may be entirely inorganic, as is the case with one of the latest simulants and which more nearly approaches the natural product in most chemical and physical properties.

A few simply applied chemical tests will not only give positive proof of the spurious nature of the specimen, if such is the case but, what is still more convincing, will enable the actual binding material used to be identified.

The first test which should invariably be applied is most simple, one indeed which can scarcely be considered a " chemical " test—merely the heating of a small fragment or some scrapings in a small narrow test tube—the use of a small narrow tube is emphasized, preferably about three inches long and a quarter of an inch in diameter. Heat gently at first, afterwards heating more strongly.

Turquoise gradually turns black, or at least brown, small droplets of water may be observed on the cooler part of the wall of the tube and if an appreciable sized particle has been taken decrepitation will most likely occur. Furthermore, what is very characteristic, it remains in quite discrete particles.

Simulants with inorganic binders behave very similarly, probably, however, not so evenly as the real stone. The colour change also is not so distinct and often returns to a somewhat lighter colour.

Simulants with organic binder. These behave in an entirely different manner. The substance blackens readily and at the same time usually becomes sticky. The degree to which this takes place is, however, dependent on the amount of binder present. In some very lightly bound simulants, which have been tested, the product is so lightly bound that this is not apparent. There is often an appearance of fusion; this however is not really correct—what does happen is that the binder fuses, turns black and conceals the minute particles of the inorganic constituents. Watched carefully several other effects are noticed. A cloudiness of water droplets condenses on the wall of the tube. A yellowish liquid is often seen to condense on the cooler part of the tube and under suitable conditions with some binders a sublimate of feathery crystals form. Vapours are evolved which have characteristic odours. These vapours have also certain reactions to indicator papers and other chemicals. The significance of each of these observations is dealt with below.

These simple tests are as far as the reader may care to go and certainly, if carried out with care, do indicate the general class to which the binder in the specimen belongs ; but most convincing proof of all is to be able to name specifically the actual binder used.

MORE EXHAUSTIVE CHEMICAL TESTS

Inorganic binders. While quite a number of inorganic materials may be used to bind together the loose aggregate of crystalline material, actual crushed turquoise or appropriately coloured substitutes, up to date this field rather surprisingly appears to have been explored only to a very limited extent compared with the number of organic binding agents which have been tried. "Artificial stones " of quite fine texture and useful hardness have been known and used outside the gem trade for many years. These include sulphates, oxides and other compounds which, by partial hydration or the formation of oxy-salts such as oxychlorides, are self-setting and do constitute a further possible entry into the field of gem simulants. The contemporary inorganic simulant of turquoise is one bound with silica. While the identification of the forementioned types may require a fairly full routine chemical analysis, the description of which would be entirely out of place here, the latter lends itself to a simple test.

The silica is used in this process in the form of an aqueous dispersion and it follows that it is truly amorphous in character and binds much in the same way as the organic binders and not by crystallization. Silica occurring in natural turquoise is substantially crystalline, however fine the material may appear. A number of compounds of amorphous type, and amorphous silica in particular, possess the useful property of adsorbing on the surface other chemicals. If then we take a solution of a compound which is so balanced that any withdrawal of the constituent with which the compound forms a soluble complex results in precipitation we have a very delicate test for any substance which acts as an adsorbent. Several such solutions may be used. One which is particularly useful is a solution of the red-brown silver chromate in ammonia. This results in a straw-coloured ammine which under normal conditions is quite stable. If it comes into contact with anything which takes up ammonia, the loss of ammonia from the solution results in the immediate precipitation of the red-brown silver chromate easily seen on the turquoise and forming a very sensitive test.

To prepare this solution silver chromate is first prepared by adding potassium dichromate solution to silver nitrate solution and thoroughly washing (preferably by decantation) the precipitated silver chromate. Distilled water should be used for this. Strong ammonia is then added drop by drop till the greater part of the solid is dissolved. It is most important that some of the silver chromate remains undissolved to ensure that there is no excess of ammonia. Stir the suspension thoroughly in order to make sure the excess of the chromate will not dissolve and allow to stand for at least one hour. Decant and filter off the clear liquid. The solution lasts quite well and if after some time there is some precipitate of chromate this does not interfere in any way. Just neglect it and use the clear solution. The test is carried out by placing a drop of the solution on an area of the stone, preferably a smooth surface but one which is not a " show " surface as the brown stain usually requires a certain amount of abrasion to remove entirely. The test can of course be applied to powder or scrapings.

Organic binders. These are many and the number is increasing rapidly. Binding materials of greater permanence and greater hardness are continually coming on to the market. So far as their identification is concerned from the gemmologist's aspect they have one thing in common; they all admit of easily carried out tests which give very characteristic and in many cases quite specific reactions. While it is not considered likely that the average reader will wish to attempt the identification of all the probable ones used, there are several which are frequently encountered, and the identification of these may be considered well worth-while, if only to be able to give a precise reply to the question " What is it ? "

It is important to note that before any further testing is carried out, particularly the specific tests, as many observations as can be made by the simple heating in a dry test tube as mentioned above should be made, as this test alone may give the specific answer to the investigation and will almost certainly, if due attention is given, indicate the class to which the binder belongs. The following points should be noticed :—

Blackening. The " tarry " blackening of the organic constituent is entirely different from the darkening which occurs with the natural stone.

Watery condensation. The liquid droplets on the wall of the tube, while apparently similar to those evolved by the natural stone may prove to be either acid or alkaline to indicator paper. The inferences here are that if the liquid is neutral or slightly acid it has little significance. Minerals may have been used which give off acid vapours. If strongly acid they are probably due to either hydrochloric acid or acetic acid. Hydrochloric acid may be evolved from some artificial stones or from certain organic binders such as the vinyl or similar products, although we have not yet encountered these compounds in this connexion. Acetic acid may also be evolved from vinyl and similar compounds. The significance of an alkaline reaction will be explained in detail later.

Oily liquid condensation. Usually somewhat yellowish in colour and condensing some distance away from the watery material. Several tests should be applied to this. This is most probably the product of the decomposition or depolymerization of the plastic binder and very likely *styrene.* The irritating smell of this compound is quite characteristic and if the reader is not familiar with it he should heat a small fragment of polystyrene. He should then have no difficulty in deciding whether the original liquid is from *polystyrene* or not. This is a very suitable binder and a number of simulants have been met where this has been used. Another similar liquid has a rather sweetish smell, similar to some types of toffee. This is probably the decomposition product of an *alkyd* resin. The usual procedure adopted in this case is to heat this part of the tube again carefully, keeping the part of the tube further up as cool as possible, when quite often the crystalline component of the oily liquid will condense on the cooler part in feathery crystals. These crystals are phthalic anhydride—a decomposition product of an alkyd resin. This type of resin is very often used along with styrene. If the separation suggested does not produce crystals the tests mentioned below under crystals should be carried out on the actual liquid.

Crystals. Under suitable conditions crystals will form on the cooler part of the tube without any further treatment. These usually take the form of feathery rosettes on the wall of the tube or occur in a form resembling cotton wool growing across the tube from the wall. These are practically specific for *alkyd resin.* That these crystals are in fact phthalic anhydride from an alkyd should be confirmed by one of the following tests. Phthalic anhydride condenses with either :

Resorcinol to form fluorescein
Thymol ,, ,, thymol phthalein
Phenol ,, ,, phenol phthalein.

The method is exactly the same in each case. The test is carried out on the crystals if present, or if not, on the liquid (see above) and is carried out *in situ.* A small quantity of one of the above is mixed with the crystals or oil, about twice as much should be taken and placed in contact. Mixing is carried out with a glass rod on the end of which is a drop of concentrated sulphuric acid. When thoroughly mixed this part of the tube is gently heated in the small flame of a bunsen burner or spirit lamp, which heating is most conveniently carried out by rotating the tube on the glass rod. When fusion is complete, marked in the case of resorcinal being used by the melt having a ruby red colour, the tube is allowed to cool off slightly and the melt rinsed out with water into a small beaker. The solution is now made alkaline by the addition of a few drops of caustic soda or sodium carbonate.

The *resorcinol* mix gives a strong green fluorescence (due to fluorescein).

The *thymol* mix turns a bright blue (sodium thymol phthalein).

The *phenol* mix turns a bright pink (phenol phthalein).

The change should be quite distinct, a light suggestion only of these changes should be ignored. A positive test in each case is quite specific.

Vapours. The vapour emitted from an artificial turquoise may be acid, neutral or alkaline. Those vapours which are alkaline are the only ones which need consideration at this stage. They all turn a moistened neutral or red (acid) litmus paper blue and may be ammonia (obvious by smell), amine (characteristic fish-like odour) or melamine (intensely fish-like odour). The last two signify a ureaformaldehyde resin and melamine-formaldehyde polymer respectively. The writers have not encountered either of these resins as binders for artificial turquoise but they are possibilities. The phenol-formaldehyde resins are not dealt with under this heading as there is a very simple and specific test which is carried out on the original simulant.

Phenolic resins (Bakelite and others). If a small fragment or a few scrapings of one of these resins is boiled with a small quantity of distilled water in a micro-test tube sufficient phenolic material is leeched out to give a very positive reaction with 2·6 dibromoquinonechlorimide. This is used in the form of an aqueous suspension. Several drops of the yellow suspension are added to the extract from the resin and the mixture is gradually made alkaline with a very dilute solution of caustic soda. If phenol be present a deep blue colour develops.

The tests suggested above will serve to identify the binders most likely to be met with in artificial turquoise. They are all simple to carry out and do give positive reactions and call for little in the way of apparatus and chemicals.

List of the necessary materials

Micro-test tubes. 3″ × ¼″ diameter to 3″ × ⅜″ diameter.
Narrow glass rod.
Small beaker (or wide neck bottle).
Litmus paper (red).
Feigl's solution (silver chromate in ammonia).
Resorcinol, *or* thymol, *or* phenol.
Caustic soda. Concentrated sulphuric acid.
2·6 dibromoquinonechlorimide.

Finally it is suggested that the reader unfamiliar with the odours of the products mentioned should do blank tests on fragments of the known resins.

With so many successful simulants of turquoise available it would seem unnecessary to produce a composite stone, but such an object has been reported by B. W. Anderson. This doublet was said to consist of a front half of a low cabochon of suitably opacified and coloured glass cemented to a piece of blue-stained chalcedony which formed the back.

Other treatments of real turquoise are oiling or waxing, and dyeing. Much turquoise is of fine colour when it is taken from the mine but often tends to pale as soon as any contained moisture dries out. Wetting such a stone may temporarily deepen the colour but a better method is to soak the stone in wax or oil—petroleum jelly (Vaseline), melted paraffin wax or paraffin oil are substances which have been used. Such practices are said to be commercially acceptable, but some traders frown upon the practice. In the authors' opinion the danger in oiling turquoise lies in the likelihood of the oil getting contaminated or altering in character and then giving the stone a patchy murky yellowish-green appearance. E. Gübelin, in a private communication, mentions a turquoise which was badly stained from some grease or oil and with the exception of a tiny spot on the top which remained forget-me-not-blue, the whole stone had gained a murky complexion. To try and correct this bad discoloration Gübelin boiled the stone for two or three weeks in ether. This was done by placing the stone in a bulb-shaped phial filled with ether. The phial was closed by a rubber stopper into which a very long glass tube was inserted (air condensor). The boiling was carried out on a water bath whose temperature was kept constantly at approximately 40°C. This procedure extracted the grease from the turquoise and after two or three weeks the stone showed a yellowish-green colour which bleached well by bathing the stone in hydrogen peroxide, exposing this to the sun. After this treatment, lasting about a week, the turquoise had assumed its original beautiful forget-me-not blue.

Poor colour turquoises have had their colour " improved " by staining with Prussian blue. This treatment does not seem to penetrate far into the stone, like the copper coloration of Nevada turquoise, hence the colour wears and the stones become patchy. Ammonia is said to take away this stain as, of course, with any alkali.

A problem which faces the trade with these new types of bonded real turquoise is what to call them. " Reconstructed turquoise " or " Reconstituted turquoise " are scarcely true for they are not a true reconstruction, as is " Pressed amber " which contains no foreign material in its make up. " Dyed and hardened turquoise " as suggested by K. Schlossmacher is again not really acceptable for there is no proof of any dyeing in much of this material. The writers suggest that the term " Bonded turquoise " is probably the best and truest description.

In conclusion we thank Mr. Harold Maryott of Miami, Arizona, for the gift of many of the specimens of both natural and bonded turquoise worked upon, and to the Officers of H.M. Geological Survey, in particular Mr. E. A. Jobbins, for carrying out the necessary slicing of the silica bonded nodule and preparing a thin section.

REFERENCES

Anderson, B. W. *Gem Testing*, p. 254. London. 1958.

Andrews, G. F., Webster, R. *The specific gravity of odontolite.* Gemmological News, pp. 757-758, Vol. 66. London. 1940.

Anon. *Die neue türkisimitation.* Zeitschr. d. Deutsch. Gesell. f. Edelsteinkunde, pp. 17-18, No. 25. 1958.

Anon. *Gemstones and " gemstones "—great discovery is student's downfall.* Sie und Er. 26. June, 1958.

Anon. *Reconstructed turquoise.* Dictionary of Gems & Gemology, p. 190. Los Angeles. 1948.

Anon. *Turquoise imitations.* Horological Journal, p. 9. London. September, 1890.

Batchelor, H. H. *Queensland turquoise.* Gemmologist, p. 63, No. 63, Vol. VI. October, 1936.

Benson, L. B. *Highlights at the Gem Trade Lab. in Los Angeles.* Gems & Gemology, p. 295, No. 10, Vol. IX. 1959.

Crowningshield, G. R. *Highlights at the Gem Trade Lab. in New York.* Gems & Gemology, pp. 269-270. No. 9, Vol. IX. 1959.

Feigl, F. *Laboratory Manual of Spot Tests.* p. 210. New York. 1943.

Koch, S., Dudich, M. *Precious stones.* Viennese turquoise on page 418. (In Hungarian).

Lee, H. *Tests on the bonding of artificial turquoise.* Gemmologist, pp. 199-200, No. 280, Vol. XXIII. November, 1954.

Lee, H. *Further notes on American artificial turquoise.* Gemmologist, p. 56, No. 284, Vol. XXIV. March, 1955.

Lewis, M. D. S. *Feigl's test for amorphous silica as applied to opal and turquoise.* Gemmologist, pp. 217-218, No. 192, Vol. XVI. July, 1947.

Liddicoat, R. T. *Handbook of gem identification.* 3rd Edition, p. 195. Los Angeles. 1951.

Liddicoat, R. T. *Reconstituted turquoise.* Gems & Gemology, p. 330, No. 6, Vol. 5. 1946.

Lucas, A. *Ancient Egyptian materials and industries.* pp. 101, 115, 122, 284. London. 1934. 3rd Edition, 1948.

MacLeod, H. *The adulteration of turquoise.* Gemmologist, p. 110, No. 299, Vol. XXV. 1956.

Parkinson, K. *A study of turquoise.* Gemmologist, pp. 6-8, No. 121, Vol. XI. 1941.

Pough, F. H. *Turquoise.* Jewelers' Circular-Keystone, p. 252. December, 1945.

Schlossmacher, K. *Türkis, gefärbt und gehärtet.* Zeitschr. d. Deutsch. Gesell. f. Edelsteinkunde, pp. 11-16, No. 29. 1959.

Smith, G. F. H. *Gemstones*, p. 440. 13th Edition. London. 1958.

Steinwehr, H. E. v. *Eine neue türkisimitation.* Zeitschr. d. Deutsch. Gesell. f. Edelsteinkunde, pp. 3-4, No. 21. 1957.

Strong, H. A. *A sketch of Chinese arts and crafts.* p. 222. Peiping. 1933.

Wade, F. B. *On colour in some turquoise.* Gemmologist, pp. 138-139, No. 190, Vol. XVI. May, 1947.

Webster, R. *A new imitation turquoise from Germany.* Gems & Gemology, pp. 115-117, No. 4, Vol. IX. 1957/8.

Webster, R. *Imitation turquoise from the U.S.A.* Gemmologist, pp. 190-192, No. 279, Vol. XXIII. October, 1954.

Webster, R. *Queensland turquoise.* Gemmologist, pp. 45-47, No. 144, Vol. XII. July, 1943.

Webster, R. *Turquoise imitations.* Australian Gemmologist, pp. 5-7, No. 4, Vol. 4. October, 1959.

Weinstein, M. *The world of jewel stones.* London. 1959.

TAKING CARE

By A. E. FARN

WAS it Marie Antoinette who said "Why don't they eat cake if there's no bread ?" Certainly a little cake now and again is welcome, but it is the regular plain food which is so essential to well ordered progress and steady building of sound economic structure, both dietary and physical. In similar vein does the professional gemmologist work.

Other people's jobs are far more interesting it seems than one's own, though in my case I must admit I find my own completely satisfying from an interest point of view. At one time of day I envisaged work as a professional gemmologist being a series of exciting rare stones, in fact all the interesting ones ending in " ite."

I'm afraid such is not the case. When something new occurs it is quite an occasion. Being a Hatton Garden worker necessitates a very down to earth contact with the commerce of the jewellery world (without whose existence gemmology would not survive) and the requirement is to know whether it is genuine or synthetic, real or cultured, followed by " how much ? " Routine testing means parcels of calibré rubies, sapphires, emeralds, single stone rings, brooches, pendant necklaces, and other items of jewellery, and the ordinary run of coloured gemstones including the precious and others of lesser cost. Seldom are diamonds tested. The emphasis recently has been on the more expensive stones, which are being artificially produced in extremely close characters to those of nature.

A purely routine test of a pearl brooch, set with two rubies and two emeralds, was left on my desk. A quick glance through the microscope established " silk," double refraction and " chatter " marks in both red stones to establish them as genuine rubies. Of the two green stones one had such obvious colouring spangles of faded blue that I thought it was painted on the back to influence a poor colour of mediocre emerald. I must add here that it was impossible in its setting to obtain a refractive index, but from observation a host of two-phase inclusions were readily apparent. The brooch was in very poor condition and an accidental touch caused the rectangular green stone to fall out and rather to my surprise I found the " blue patches " were not staining but the gelatine colouring layer of a soudé emerald doublet, which had deteriorated and lost its green hue and changed to blue. Anyone, of course, could have quickly seen the obvious now that the stone was out of its setting.

The second stone was a little smaller and square in shape in a box-setting with crimped edges and once again I could not get a reading on a refractometer because of the setting. The stone turned red under the Chelsea filter ; its inclusions were twisted veil-like feathers of liquid drops. These feathers had a curled look about them and were in two directions almost at right angles to each other. Apart from the feathers a host of large two-phase inclusions were seen on a large scale and I thought the stone to be Colombian, though I was *not* happy about the feather structure, which looked similar to some I had seen in Igmerald and Chatham synthetic emerald. I decided to ask permission to have the stone taken out.

So far I had based my partial identification on the fact that the stone was red under the filter, had two-phase inclusions, and was green in colour. The feather particularly seemed suspicious to me. I hadn't seen any quite similar in any other type of Emerald whether Sandawana, Colombian, Habachtal, Indian or South African, but basically the two-phase inclusions suggested Colombian or Brazilian type.

However, since it is better to state facts I felt justified in having the stone taken out. I was surprised to be challenged on this necessity because I hadn't taken an absorption spectrum, but quite frankly I couldn't easily differentiate between absorption spectrum of synthetic or natural Emerald. However, it proves the necessity of taking all possible precautions and a spectrum revealed a broad absorption between 6020Å and 6060Å and no signs of chromium. Between crossed filters the stone was a very weak red or muddy pink, not by any means what one would expect from an emerald, except of the very lowest quality. Under the Chelsea filter the stone was a distinct red and this fact and the curled feather prompted me to think in terms of Chatham synthetic emerald. Fortunately we have varied types of ability at our beck and call and after the denouement of the spectroscope, a second opinion was very definitely for paste bubble layers and larger single bubbles. This of course prodded me to further intensive study of the internal inclusions of the stone, on which I had based my first conclusion. *Now* of course

FIG. 1. *Two-phase bubbles in beryl base seen through quartz top.*

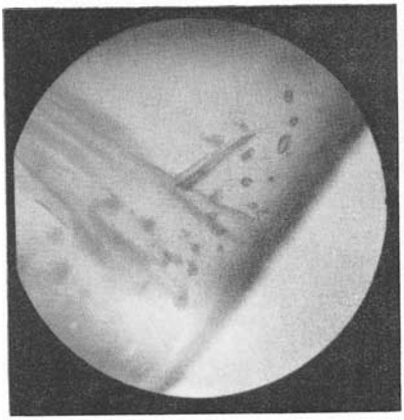


FIG. 2. *Demarcation line, liquid feather and two-phase inclusions.*

FIG. 3. *Groups of two- and three-phase inclusions in beryl base.*

the stone was carefully cleaned and to my intense relief I found the feather to be of natural origin, and the large bubbles to be indeed two-phase and natural. However, the cleaning had revealed very minute signs of a break in colour which was not a natural feature and at last the truth began slowly to filter through that this was an old-type soudé emerald of quartz construction (hence the two-phase inclusions and liquid feathers), with a colouring layer of some organic substance which did the trick of turning red under the Chelsea filter. There were no obvious signs of a junction or layer of opacified flattened bubbles often seen in ordinary soudé emeralds. In fact the routine test this time of ordinary gem-set jewellery proved to be not " a piece of cake " but certainly a change of diet. The stone weighed just the bare half carat. Having established that the stone was a quartz-topped doublet I immersed it in monobromonapthalene and was surprised to find the top layer clear and transparent and the bottom layer full of feathers and two-phase inclusions. This surprised me since I thought that it should have been the other way round. By way of interest I placed the back of the stone on the refractometer and obtained a beryl reading. I checked all four sides of the back and reached the same conclusion each time. This was indeed a new thing to me. I suspended known quartz in a suitable liquid of carefully checked S.G. and placed the doublet in it and it sank slowly whilst the quartz indicator slowly rose—this was not a positive check so I put in a known soudé emerald of quartz top and bottom and this stone sank much more rapidly. Thinking perhaps that my beryl readings were due to rounded facets or parallax I decided to check the stone in nitrobenzene, which had an R.I. of 1·56. The stone showed quite a distinct difference in relief when viewed through the side with the layer vertical in the matching liquid. An immersion contact photograph using the technique perfected by B. W. Anderson seemed the next step and here I was assisted by R. Webster, who speedily produced the immersion contact photograph seen (Fig. 1). The inclusions showing junction and liquid feathers and two-phase inclusions (Figs. 2-3) were taken by R. K. Mitchell. To all these people I owe thanks for their very ready assistance.

THE OCULAR THERAPY OF STONES

By WILLIAM EMMOTT

Reproduced by courtesy of the author and the journal *The Optician*, April, 1960.

FROM earliest times stones of all kinds have been awarded a variety of attributes.

These have been mainly due either to the history of their formation or to folk-lore, and their value as therapeutic agents was praised by many ancient philosophers including Galen, Theophrastus and Pliny.

Shakespeare utilizes the science of gemmology very frequently to provide metaphors, but only once does he refer directly to any stone as possessing curative properties, and since pearls are encysted foreign bodies which have found their way into the oyster with consequent pain, this gem is entirely appropriate for a poetic description of tears.

For instance, one of the characters in *King John* says that :—

> " His grandam's wrongs, and not his mother's shames
> Draw those heaven-moving pearls from his poor eyes."

The emerald, the Indian agates and to a lesser degree the sapphire, share the magical quality of curing eye diseases on sight.

In his *Natural History*, Pliny has much praise for agates, the mere sight of which, he says, will cure eye diseases, inflamed eyes and eyelids, and headaches.

Looked at intently, the sapphire was supposed to be protection from eye diseases, but should there be a foreign body in the eye it was only necessary to place the stone on the eye. It was claimed that the power from the stone would then pass into the eye and loosen the foreign body.

" The deep-green emerald, in whose fresh regard weak sights their sickly radiance do amend "* was of the utmost importance in early pharmacies ; whether it was powdered and used internally, suspended over the affected part or worn as a charm, its efficiency was considered to be infallible.

The mere sight of it was said to strengthen the memory and restore failing vision, for which latter purpose engravers kept them on their benches to relieve the strain consequent upon the intricacy of their work.

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* *A Lover's Complaint*—Shakespeare.

The Emperor Nero is traditionally supposed to have made constant use of an emerald for visual purposes, the exact nature of which is not known and which would depend on how the stone was cut. It is fairly certain, however, that this particular stone was chosen in preference to any other on account of its claimed therapeutic qualities.

The opal has suffered many vicissitudes as a popular gemstone. The Romans thought much of it both as an ornament and for its curative properties. It was claimed that it not only strengthened the sight and cured eye diseases but also was capable of rendering the wearer invisible. There are no specified methods of application extant, methods which would certainly have been mentioned by Pliny had such been the case. This omission and the claim that it makes the wearer invisible leads one to suppose that its properties were fabulous and not considered of any use in the early pharmacies.

Of the non-precious stones hæmatite and its varieties enjoyed a great popularity among ancient physicians as a remedy for eye diseases.

This stone, which is of blood-red colour on account of its probable high red peroxide of iron content, is described by one of the most ancient writers* as " all serviceable."

Galen thought much of it and a solution in water sufficed for bloodshot eyes and inflamed eyelids. Should there be tumours on the eyelids, solution in the white of an egg was required. In either case the application was made by pouring through a tube a few drops at a time into the eye. Should the case not respond readily, the solution was made thicker until a cure was effected.

A variety of hæmatite called schisto or splitstone when ground and mixed with woman's milk was said to be particularly useful for arresting discharge from eye corners and for reducing procidence of eyes.

Procidence is another term for prolapsus, a falling down from a normal position, and it is hardly likely that Pliny intended to mean a falling down of the eyeball itself but of either the lens or the iris.

As was the case with many stones used in ancient pharmacies, hæmatite acquired talismanic virtues in addition to those of medicine. For instance, Zachalias of Babylon, besides recommending it as

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* Sotacus.

a cure for diseases of the eye and liver, strongly urged everyone presenting petitions addressed to Kings to ensure success by having a piece of this stone about his person.

Magical properties are also attributed to Gorgonia, Heliotropium and Median Stone. The former is a coral so named from the fact that though it is soft in the sea it gradually hardens on removal from water, and its virtue lies in its alleged ability to counteract the evil eye.

Heliotropium, found in Ethiopic Africa and Cyprus, is normally of a leek-green colour streaked with blood-red veins, but if placed in a vessel of water and exposed to the full sunlight it changes to a reflected colour as of blood.

Magicians said that if it was combined with the plant heliotropium and incantations were uttered the carrier would be rendered invisible.

Median stone is said to possess powers of good and evil according as it is used. Should it be dissolved in the milk of a woman who has borne a son and applied to the eyes, it will even restore sight to the blind, but should it be dissolved in water and the forehead bathed, the sight will be destroyed.

Pumice, now used either for removing stains or polishing, was employed in early pharmacy for the treatment, when combined with woman's milk, of eye ulcerations. It is somewhat difficult to understand how the abrasive nature of this stone can have any beneficial effect on the eye, and yet it was claimed that it had both a healing and a cleansing effect on ulcerations. It is, however, easier to appreciate the claim that applied in a powdered form it would produce new flesh on cicatrizations of the eye and remove all scars.

It would be very interesting to know the exact method of application, but unfortunately no details are extant.

A dangerous " cure " is to be found in Egyptian folk-medicine. It is the Kabbas stone, which usually forms part of a talismanic necklace. The stone was rubbed on a mother-of-pearl shell into which drops of water were allowed to fall. The liquid becomes whitish and was then used as an eye lotion for cases of purulent ophthalmia, with inevitable results of further damage to and often loss of the eyeball.

The continued and general use of this and similar " remedies " over a considerable period gives one a good idea as to the hold which superstition and folk-lore had on the minds of the people.

Although amber is fossilized resin and not in the literal sense a stone it was used and referred to in antiquity both as having been shed as tears by mythological figures and as a cure for sore eyes.

In Scandinavian mythology Freya is said to have shed tears of amber on the departing of Odin into the world, and Sophocles, the Greek poet, said that amber was produced in far eastern countries from the tears shed by birds in mourning for Meleager.*

Shakespeare, however, gets a little nearer to realities when, in one of Hamlet's speeches, he utilizes the original resinous quality of the " stone " to describe the discharge of mucous often seen in and around the eyes of elderly people. He says : " Slanders sir, for the satirical rogue says here that old men have grey beards, that their faces are wrinkled and their eyes purging thick amber and plum-tree gum."

So far as its medical properties are concerned, Callistratus describes it as being " good for any age whether taken in drink or attached to the body as an amulet. Worn upon the neck it is good for fevers and diseases of the throat and if it be beaten up with Attic honey it is beneficial for dim sight." Moslems also regarded it as beneficial for dim sight and sore, inflamed eyes, but it was necessary to reduce it to ashes before application.

Long before foreign-body spuds were invented, a favourite method of removing foreign bodies from the eye was to place small " eye stones " underneath the eyelid to induce a copious flow of tears. It was expected, as it would actually do in some cases, that the foreign body would move as a result. There is no evidence extant as to how far this method was successful or what the procedure was should the case be one where the body was firmly embedded in the cornea. It is fairly safe to assume, however, that anyone having to endure this "treatment" would be only too willing to say that " it was out " whether that was actually so or not !

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* Pliny denounces this latter story as " one of the frivolities and falsehoods of the Greeks."

REFERENCES

Bostock and Riley, Ed. *Pliny's Natural History.*
Dictionary of Folk-Lore.
Kunz. *Magic of Jewels and Charms.*
The Works of Shakespeare.
Walker. *Folk Medicine in Modern Egypt.*

Gemmological Abstracts

ANON. *More on Beilby.* The Mineralogist, 1960, 28, 4-5, pp. 90-92

A note on a paper published in the Australian Journal of Science. While this paper refers mainly to polished metal surfaces, it is applicable to gemstone surfaces. Hooke, Newton and Herschel all held that the asperities in a roughly ground surface are cut away during polishing leaving a series of fine grooves or " scratches." Rayleigh agreed that the asperities are worn down but thought that the material is removed in an almost molecular fashion.

In 1921 Beilby advanced the radical view that, instead of asperities being worn away, the depressions in the surface are filled in by material which is smeared across the surface, covering it with a layer which he thought was glass-like or amorphous in character. This has come to be known as the " Beilby " layer. The idea of the layer being truly amorphous has been modified slightly in more recent times, but the basic concept of a layer which is physically distinct from the substratum and which has lost its obvious crystalline properties is still retained.

Beilby did not propose any specific smearing mechanism, although he inferred that surface tension forces were responsible. A most plausible mechanism was afterwards advanced by Bowden and Hughes, which was based on observations that very high local temperatures can be attained when two solids rub past one another. They suggested that the asperities in the surface are melted when abrasive particles rub across them, the liquid so formed depositing in and filling adjoining depressions.

It was further proposed that, due to very rapid chilling, this molten material solidifies in an amorphous-like condition.

A paper by L. E. Samuels reviews work carried out at the New South Wales Branch of the Defence Standards Laboratories which strongly supports the earlier view that polishing is essentially a fine cutting process, and is believed to establish with reasonable certainty that the Beilby layer does not exist.

The new theory is that metallographic polishing occurs primarily by cutting, the individual abrasive particles acting in a similar manner to a planing tool. Material is removed and scratches are produced ; the better the polish the finer the scratches. The surface is crystalline but deformed, the magnitude of deformation decreasing with increasing fineness of polish to a surprisingly low level in the case of the finest polishes. Moreover, the deformation decreases rapidly with the depth so that comparatively perfect material is exposed by a very light etch.

S.P.

SEAL (M.). *Graphitization of diamond.* Nature, 1960, Vol. 185, pp. 522-523.

The extra X-ray and electron diffraction spots in partially graphitized diamond previously attributed to an intermediate carbon structure are shown to be due to silicon carbide and other impurities.

R.A.H.

TOLANSKY (S.) and SUNAGAWA (I.). *Spiral and other growth forms of synthetic diamonds : a distinction between natural and synthetic diamonds.* Nature, 1959, Vol. 184, pp. 1526-1527, 6 figs.

Phase-contrast microscopy has shown that synthetic diamonds may have highly perfect cube faces or cube faces showing growth spirals : a dendritic habit has also been observed. Such observations have not been made on natural diamonds and may be characteristic of synthetic diamonds which are grown rapidly and which may contain metal carbide impurities.

R.A.H.

TOLANSKY (S.) and SUNAGAWA (I.). *Interferometric studies on synthetic diamonds.* Nature, 1960, Vol. 185, pp. 203-204, 8 figs.

Crystal defects or surface films lower the reflectivity of synthetic diamonds and increase the visibility of fringe systems obtained with double beam interferometry. The appearance of the crystal surfaces is described.

R.A.H.

WASKEY (F. H.). *Gemstones of Alaska.* Lapidary Journ., 1960, XIV, 1, pp. 16.

Gemstone collecting areas in Alaska have not been sufficiently prospected and the material so far found is unsuitable for faceting.

S.P.

BOVENKERK (H. P.), BUNDY (F. P.), HALL (H. T.), STRONG (H. M.) and WENTORF (R. H., Jr.). *Preparation of diamond.* Nature, 1959, Vol. 184, pp. 1094-1098, 11 figs.

Diamonds have been grown from carbon in the presence of catalysts at pressures ranging from 55-100 kilobars and at temperatures ranging from 1200°-2400°C. Catalysts include Cr, Mn, Ta and the group VIII metals or those of their compounds which will react to give free metal under the experimental conditions. The habit and colour of the diamonds produced varies with temperature of formation.

R.A.H.

BENSON (L. B.). *Highlights of the Gem Trade Lab. in Los Angeles.* Gems and Gemology, Vol. IX, No. 12, pp. 355-357 and 378. Winter 1959/60.

Among many interesting items referred to were a pair of "jade" birds which were found to be serpentine. A badly fashioned sapphire, probably cut from a distorted piece of rough, would have lost 50% of the weight if cut correctly. The question " Is it ruby or purple sapphire ? " is emphasized with a current example. Corundum, including brown coloured asteriated material, is reported to have been obtained from a Finnish deposit north of Inari, which lies near to the Arctic Circle. A large clear inclusion of possibly biotite gave an apparent double refraction to a spinel. An interesting pearl, which has a black spot and an encircling black band, is mentioned.

2 illus. R.W.

CROWNINGSHIELD (G. R.). *Highlights of the Gem Trade Lab. in New York.* Gems and Gemology, Vol. IX, No. 12, pp. 358-361 and 377. Winter 1959/60.

The destruction of the settings which entailed loss of the diamonds, probably by electrolytic action, when jewellery is left in a hypochlorite-type bleach, is reported upon. Doublets consisting of grey-blue synthetic tops and natural corundum bases are mentioned. The apparent change of colour of a pink diamond to brown after bombardment with X-rays is said to be due to continued phosphorescence. The original pink colour returns after gentle heating. The question of nomenclature when only part of the stone is of typical colour was illustrated by the case of a beryl figure

which was colourless with patches of blue. Could it be called aquamarine. Some discussion is made on this problem. The small relative size of the nucleus of a large Australian cultured pearl is commented on and some notes are given on the Japanese cultured pearls dyed roseé. Some baroque beads were found to be green plastic-coated beryl and these showed red under the emerald filter. Some notes on the coloration to an orange colour of brown zircons by X-radiation, and on the spectroscopic examination of blue diamonds, are also given.
3 illus. R.W.

ANON. *Pearl fishing beds in Ireland.* Gemmologist, Vol. XXIX, No. 345, pp. 64-65. April 1960.

A short note on the pearl fishing beds of the River Strule, which are said to be now practically exhausted. Fishing is carried out as in the Scotch pearl fishing by the use of a glass-bottomed bucket. Only amateurs fish to-day.

R.W.

DERBY (C. H.). *Opal.* Gems and Gemology, Vol. IX, Nos. 11 and 12, pp. 323-332 and 350 ; 362-370. Fall and Winter 1959/60.

The history, locations of the mines and the mining of opal are given. Particular mention is made of the South Australian deposits of Coober Pedy and Andamooka, which are now more important than the deposits at White Cliffs and Lightning Ridge in New South Wales. The geological features are given for both Coober Pedy and for Andamooka. Andamooka opal is darker than the opal found at Coober Pedy or White Cliffs and compares favourably with opal from Lightning Ridge.
14 illustrations and 5 maps. R.W.

POLLARD (E. R.) ; DIXON (C. G.) ; DUJARDIN (R. A.). *The "Pork-knockers" of British Guiana.* Gemmologist, Vol. XXIX, No. 343, pp. 30-36. February 1960.

Extracts from *Diamond Resources of British Guiana*, a publication of the British Guiana Geological Survey. Diamonds were first found in British Guiana in 1887 as a result of placer gold-mining around the Mazuruni, Cuyuni and other rivers. The diamonds are recovered from alluvial deposits derived from the sandstones of the Roraima formation. These deposits are discussed in detail. The mining is carried out by prospectors called " pork-knockers." Notes are given on the methods of mining, on the production and on the prospects for the future.

1 illus. R.W.

MACINTOSH (E. K.). *Seeking gems in South Africa.* Gemmologist, Vol. XXIX, No. 344, pp. 48-49. March 1960.

The author of the article has found many gems in the Union of South Africa, Rhodesia and neighbouring areas. These include rose quartz in Namaqualand ; amethyst and amazonite from Kakamas, and jasper and tiger's-eye at Prieska and Griguatown. Agate, jasper and coloured quartz is found around Kimberley, as well as the Drakensberg range in Basutoland. Verdite and stichtite are found around Barberton. " Transvaal jade "—massive grossular garnet is found near the chrome mines near Rustenburg, and cornelian and jasper in Rhodesia.

R.W.

WELLER (G. T.). *A gypsum mine in Sussex.* Gemmologist, Vol. XXIX, No. 345, pp. 61-63. April 1960.

Describes the mining of gypsum near Mountfield in Sussex. The mineral is mined from the Purbeck Bed in the Upper Jurassic and includes the satin-spar variety.

3 illus. R.W

JANKS (R. A.). *Two gemmological gadgets.* Gemmologist, Vol. XXIX, No. 343, pp. 21-23. February 1960.

Describes a combined light source and stand for the Rayner refractometer, and a metal and glass pot to fit into the Rayner immersion cell in order to facilitate examination of stones in polarized light.

3 illus. R.W.

ALEXANDER (A. E.). *Dyed pearls.* Gemmologist, Vol. XXIX, No. 343, pp. 28-29. February 1960.

Pearls are usually dyed black by the use of silver nitrate. Mention is made of an optical system giving an intense beam of light of small area as a means of indicating whether a pearl has been dyed. The use of X-rays in the dyeing of pearls is mentioned.

R.W.

JONES (T.). *Irradiation of Pearls.* Gemmologist, Vol. XXIX, No. 343, p. 38. February 1960.

Brief details of experiments carried out with the coloration of natural and cultured pearls by irradiation with neutrons.

R.W.

HOLDSWORTH (J. R.). *Ruby.* Australian Gemmologist, Vol. 2, No. 8, pp. 5-8. February 1960.

A general article on the mining, characters and history of ruby, with notes on the synthetical product and on those stones which simulate ruby.

R.W.

F.T.C. CONSENT ORDER ON " CHATHAM EMERALDS "

The following companies and individuals have consented to a Federal Trade Commission order forbidding them to misrepresent that their " Chatham Emeralds," " Chatham Cultured Emeralds " or any other manufactured stones are natural stones: Carroll F. Chatham, trading as Chatham Research Laboratories; Anglomex, Inc., and Dan E. Mayers, its president and principal owner; Ipekdjian, Inc., and its wholly owned subsidiary, Cultured Gem Stones, Inc., and Adom and Georges Ipekdjian, their president-treasurer and vice-president respectively.

The order, agreed to by both respondents and F.T.C.'s Bureau of Litigation, was accepted in an initial decision which the Commission affirmed.

In its complaint of 13th October last, the F.T.C. said Mr. Chatham manufactures the stones and sells them to Anglomex, which in turn resells to the Ipekdjian concerns. The latter sells to jewellery retailers and to the public. All respondents co-operate in advertising and promoting the products. The complaint charged that these typical advertising claims were exaggerated, false, misleading and deceptive:

" Chatham Emeralds "
" Chatham Cultured Emeralds "

> " These stones are identical to natural emeralds in all of their properties: Chemically, physically, optically, with the same crystal faces, atomic arrangement, and even the same inclusions and ' gardens '."

The F.T.C.'s order provides that respondents must stop:

> Claiming that manufactured stones are cultured, natural stones, or identical to natural stones;
>
> Using the word " emerald " or the name of any other precious or semi-precious stone to describe such stones unless it is preceded by a word such as " synthetic " which clearly discloses the nature of the product and the fact that it is not a natural stone. This does not mean, however, that the manufacturing method or process used by Mr. Chatham must be disclosed.

The agreement is for settlement purposes only and does not constitute an admission by respondents that they have violated the law. It is understood that " Chatham Created Emeralds " may be used in future to describe the laboratory-produced stones.

ASSOCIATION NOTICES

COUNCIL MEETING

A meeting of the Council of the Association was held at Saint Dunstan's House, Carey Lane, London, E.C.2, on Wednesday, 16th March, 1960. Mr. F. H. Knowles-Brown presided.

The following were elected :—

FELLOWSHIP

Bergan, Kjartan E., Sandefjord, Norway. D.1959
Gaudernack, Lilly, Sandvika, Norway. D.1959
Sidoli, Julien, Milan, Italy. D.1959

ORDINARY MEMBERSHIP

Arend, Robert, Richmond Hill, Ontario, Canada
Beresford, Charles E., Birmingham
Buzalewicz, Sobieslaw, Cracow, Poland
Engstrom, Lars G. H. Hagersten, Sweden
Glasgow, George H., Plockton
Green, Leslie, Rainhill, Nr. Liverpool
Ho, W. K., Rangoon, Burma
Jhaveri, Himatlal C., Bombay, India
Leek, Stanley H., Toronto, Canada
Lewis, Roy, Ottawa, Canada
Nolan, Constance J. C., Gomersal, Nr. Leeds
Podolsky, Paul, London
Rowley, Clement J., Sneyd Green
Szymczyk, Joseph, London
Wilson, William I. S., Loanhead

PROBATIONARY MEMBERSHIP

Cozens, Jonathan R., Taunton
Hill, Alan R. C., Salisbury, S. Rhodesia
Hodgkinson, John A. W., Aberdeen
Wolmark, David C., Ruislip

The audited accounts for the year ended 31st December, 1959, were approved for submission to the 30th Annual General Meeting. The Council nominated the Officers of the Association for re-election and Mr. T. H. Bevis-Smith for re-election and Messrs. C. T. Mason and E. Levett for election to the Council.

OBITUARY

The Council of the Association records with regret the death of John H. Stanley, F.G.A. Mr. Stanley was associated with Bristow J. Tully in the latter's gem business in New Bond Street, London, and between 1927 and 1942 was the official correspondence course instructor to the Association. He was most painstaking in his work and endeared himself to many students by his helpfulness and kindly words of encouragement. He was Treasurer of the Association from 1942 until 1947. Before his retirement from business he was with the City Jewellers, Gowland Brothers, of Cornhill, where he kept contact with the Association and continued his interest in music, for he was a competent violinist. John Stanley was one of the pioneer gemmologists who greatly helped the Association in its early days and he will be sadly missed.

MIDLANDS BRANCH

A film show for members of the Midlands Branch was held at the Auctioneers' Institute, St. Phillips Place, Birmingham, on Friday, 4th March, 1960.

Mr. B. Shipton, Vice-Chairman of the Midlands Branch, presided in the absence of the Chairman, Mr. T. Solomon.

The films shown, both dealing with cultured pearls, were " A Pearl is Born " and " Cultured Pearls."

Both films were excellently made and dealt with the whole operation from the raising of the oyster until its maturity, the insertion of the mother-of-pearl bead, and finally the reaping of the pearl harvest.

Members of the Midlands Branch held their second annual dinner and dance on Saturday, 26th March, 1960, at the Medical Institute, Edgbaston, Birmingham. Mr. T. P. Solomon, Chairman of the Midlands Branch presided. Among the guests were Mr. N. A. Harper, Vice-Chairman of the Gemmological Association and Mrs. Harper, Mr. R. Weston, President of the British Jewellers' Association and Mrs. Weston and Mr. R. Webster.

There were some very witty speeches by Mr. T. P. Solomon who proposed the toast of the Association, Mr. N. A. Harper who responded, Mr. A. E. Shipton who proposed the toast of the guests and Mr. R. Weston who responded. The evening was a great success with over a hundred members and guests present.

* * * *

The seventh annual general meeting of the Midlands Branch was held at the Chartered Auctioneers' and Estate Agents' Institute, Birmingham, on Friday, 29th April, 1960. Mr. Trevor Solomon presided.

The Secretary reported on a most successful year, which had included talks by Mr. B. W. Anderson, Dr. H. Proctor and the showing of various films. Mr. Solomon, who was vacating the chair after serving as chairman of the branch since its inauguration seven years ago, handed over office to Mr. A. E. Shipton, who had served the Branch as Secretary and Vice-Chairman. Mr. Shipton paid tribute to the long service which Mr. Solomon had given to the Branch. Mr. W. W. Bowen was elected Vice-Chairman and Mr. J. R. Shaw was re-elected as Secretary. The following members were elected, after ballot, to serve with the officers on the committee : Miss J. Rice, Mr. J. S. Harper, Mr. K. Hoskyns, Mr. T. P. Solomon, with Mr. N. A. Harper as an ex-officio member.

It was proposed that an outing to Berkeley Castle and the Servern Wildfowl Trust, Slimbridge, be organized during the summer.

After the meeting Mr. Solomon gave a talk on " Antique dealing," and spoke of his recollections of the trade and gave a broad outline of the principles governing the classification of various articles as antiques.

At the end of the meeting Mr. Solomon was presented with a rare book on diamonds.

WEST OF SCOTLAND BRANCH

The seventh annual meeting of the Association's West of Scotland Branch was held in Glasgow on 21st April. Mr. E. Macdonald presided in the absence of the chairman.

Mr. Ian Mackenzie, the chairman, was re-elected to office together with Mr. C. D. Wade, Secretary. Mr. A. McWilliam was nominated for co-option to the Council of the Association.

The annual summer outing of the Branch has been arranged for the week-end of 21st-23rd May. The place chosen to be visited is Strontian, Argyllshire.

TALKS BY MEMBERS

BROWN, A. J. Bayliss : " Gemstones," St. Andrews Church, Ilford, 19th April, 1960.

BAGLEE, G. : " Gemstones," Backworth Women's Institute, 6th April ; East Stanley Women's Institute, 12th April, 1960 ; " Gemstones," Good Companions Club, Newcastle-upon-Tyne, 4th May ; Chester-le-Street Business and Professional Women's Guild, 26th May, 1960 ; " Gemstones," Seaton Deleval Afternoon Tea Club, 7th June, 1960.

BLYTHE, G. : " Gems," Young Liberals of Eastwood, 5th April, 1960.

CAIRNCROSS, A. D. : " Gemstones," Dunbarney Men's Guild, 22nd October ; Trinity Church Women's Guilds, 3rd November ; Kinnoull Church Women's Guild, 3rd December ; Dunning Parent-Teachers' Assn., 7th December ; Scone New Church Women's Guild, 8th December ; Dundee and Angus Watchmakers' and Jewellers' Assn., 12th December, 1959 ; Letham Townswomen's Guild, 25th February ; Soroptimists' Club of Crieff, 3rd March ; Scone Old Church Women's Guild, 10th March ; Scone Old People's Welfare, 25th March ; Inverness Assn. of University Women, 19th March, 1960.

LAUVLAND, K. : "Jewellery and gemstones," Norwegian Y.W.C.A., London, 20th April, 1960.

LEIPNER, H. : " It isn't necessarily so," a talk based on errors and fallacies which have been perpetuated from author to author over the ages. Gemological Society of San Diego, California, 4th May, 1960.

SOLOMON, T. : " Gemstones," Handsworth Conservative Association, Birmingham, February, 1960.

WARREN, K. (Mrs.) : " Gemstones," Eltham Parish Church Women's Fellowship, 24th May ; Evening Townswomen's Guild, Crofton, 13th June, 1960.

WELLER, G. T. : " Diamonds," Rotary Club of Maidstone, 11th March ; Resident's Association, Tunbridge Wells, 18th March, 1960.

THE LAPIDARY JOURNAL

The *Lapidary Journal*, a leading American gem-cutting and jewellery-makers' magazine directed principally to the amateur hobbyist, has been sold by the founder Lelande Quick to Lee S. Packard, of San Diego, California, a printing firm executive.

Hugh Leiper, F.G.A., co-author of the recently published gem-cutting book *Gemcraft*, and for the past two years associate editor, has been appointed editor of the Lapidary Journal. Mr. Leiper was formerly editor of the *Mineral Hobbyist* of Austin, Texas. He has published numerous papers on gem research, some in the *Journal of Gemmology.*

GIFTS TO THE ASSOCIATION

The Council of the Association is grateful for the following gifts to the Sir James Walton Memorial Library :—

Samples of rough gem material from John R. Fuhrbach, B.Sc., F.G.A., G.G., Amarillo, Texas, U.S.A.

Volumes of the Industrial Diamond Review from Robert Webster, F.G.A.

"Podstaroy Mineralogii," by A. G. Bietiechten, from S. Buzalewicz, Cracow.

A selection of books, including a complete set of the Industrial Diamond Review, from Mr. Robert Webster, London.

A copy of Robert de Berquen's *Les merveilles des Indes Orientales et Occidentales, ou nouveau traité des pierres precieuses et perles*, Paris, 1661.

ANNUAL MEETING

Mr. F. H. Knowles-Brown presided at the 30th Annual Meeting of the Association held at Saint Dunstan's House, Carey Lane, London, E.C.2, on 5th May, 1960.

Among those present was a member from Scandinavia, Mr. H. Tillander, one of Helsinki's foremost jewellers and a " leading light," so the Chairman called him, in the development of gemmology in Finland.

The Chairman, in moving the adoption of the annual reports and accounts, said there had been a steady increase in membership in the past year which in itself was an indication of the steady growth of the Association. The Tully Medal had not been awarded that year and the reason for this was that the standard set was high. The medal provided students with an object to aim at and the fact that it had not been awarded meant that no one had reached that level. It would have been easy to pick out the best man and give him the medal, but the examiners had not taken the easy way out and the Association as a whole could be grateful to them for this, for it kept the value of the Association's diploma very high and internationally valuable.

The Officers of the Association were re-elected as follows :—

President : Sir Lawrence Bragg, F.R.S.
Chairman : Mr. F. H. Knowles-Brown.
Vice-Chairman : Mr. N. A. Harper.
Treasurer : Mr. F. E. Lawson Clarke.

Mr. T. H. Bevis-Smith was re-elected and Mrs. E. Levett and C. T. Mason elected to serve on the Council.

This concluded the formal business of the meeting and Mr. Knowles-Brown then called upon Mr. Tillander to speak to members.

Mr. Tillander said that the gemmological movement in Finland had started quite recently, in fact about 18 months ago, but they had worked hard and made progress. They had a number of students sitting for the first time for the preliminary examination and about 12 would be sitting for the diploma this year. Naturally they had had initial difficulties, particularly with translation, but these had now been largely overcome.

He went on to discuss a method which he had developed for the identification and evaluation of diamonds. He had found it very useful and he thought perhaps other retailers might be interested in it. Naturally people's judgment varied but he thought his system would give pretty accurate results. It was based on an American system though different from it in certain particulars.

He then showed a foolscap form divided into 20 sections. At the top of the page was a drawing of the stone, showing top, bottom and side view, upon which notes could be made concerning inclusions.

Below this was a ruled half-column lettered from F 1 to VS 2, SI to 4.P 12, and numbered 0-9 for purity. Zero stood for the stone which was absolutely flawless—very rare.

Section 3 dealt with the colour of the stone, using the normal colour-descriptive names, in accordance with U.S. custom. The fourth panel concerned the minimum and maximum diameter of the stone as measured by micrometer or gauge. Section 5 recorded depth and four panels, X.A.B. and C., could be marked according to the cut—X for excellent, A for good, etc.

The proportions of the stone were dealt with in the following sections and No. 9 showed the size of the table. Mr. Tillander said that this section had taken him some time to work out. He used an ordinary loup, using the picture to match up the stones.

Sections 10 and 11 noted, after examining a stone from the side, if the table was parallel with the girdle or not, also if the table was not in the centre. The twelfth panel noted the crown angle, whether perfect and within 33-35 degrees, or if too low as in the second drawing or too high as in the third. It was not altogether necessary to do this, but if a stone did not look right, a jeweller would want to find out why. Checking it in this way would give him the reason. The thirteenth panel dealt with variations in the culet. Section 14 concerned facets where grinding had varied and next came the thickness of the girdle, a matter which the Americans calculated most precisely in maintaining the weight of a stone in its cutting.

The first drawing in the sixteenth panel showed top and bottom facets meeting exactly, while the other two could be marked according to variations. Sections 17 and 18 dealt with the straightness of the girdle and variations in the size and shape of the base facets. Panel 19 applied to stones where little could be found that was wrong, but it might be noted that the pavilion facets varied or did not meet at the same points. Such points could be noted on the drawings. At the bottom of the page there was space for general remarks on the character of the cut, etc.

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