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THE GILSON SYNTHETIC EMERALD PROCESS

By F. DUŸK

IN the production of synthetic materials the chemist usually seeks only the ultimate results of his experiments, unworried by any fortunes that may follow. This was true of Ebelmen and Moissan, whose works are famous in the history of chemistry. Certain synthesizing experiments, notably those of Professor E. Nacken of Vienna, did not get past the laboratory door. Some who have aimed to put their manufacture on a legitimate industrial plane have been successful and the latest French synthetic emerald process of Pierre Gilson found itself surrounded by publicity after its announcement.

In connexion with synthetic emeralds some important observations have been made. Professor W. F. Eppler has discovered crystals of ilmenite in the Gilson synthetic emeralds and has drawn a comparison in structure between the Gilson process and those used by Nacken and Carroll Chatham in the U.S.A.[1].

The same statement has been made by Dr. E. Gübelin, who indicates the presence of phenacite[2]. In the last samples which have been submitted to us we have also established the presence of small hexagonal fragments of ilmenite, some agglomerated crystals of a whitish nature and, amongst others, some of a brownish colour showing bubbles of gas on their surfaces (Fig. 1).

Figure 2 gives a general view where one can trace the usual liquid inclusions. These channels, containing liquid and bubbles of gas, are shown considerably magnified in Figure 3. Synthetic emerald crystals, though well formed, usually have smooth terminal faces.
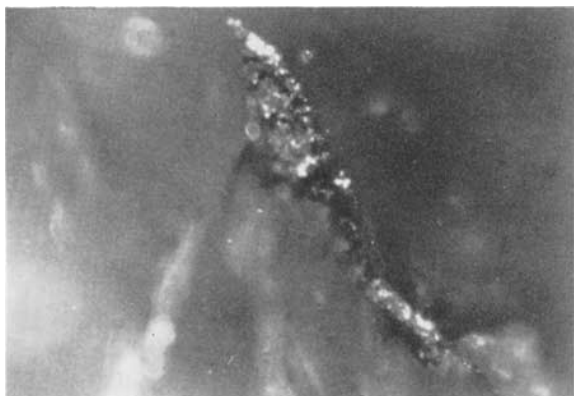

Fig. 1
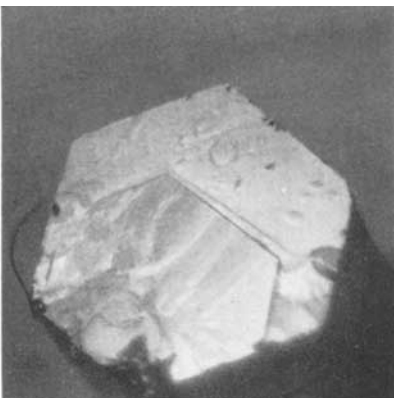
Fig. 3

FIG. 4   FIG. 5

Analysing these surfaces has caused much interest, and it has been noticed that there is a similarity in the formation pattern of the products of Chatham (Fig. 4) and Gilson (Fig. 5). The latter shows more perfectly made crystals, but the two terminal faces show similar distortions.

The distinction between natural emeralds and the Chatham and Gilson synthetic stones is made easy by the process instituted by Professor K. Schlossmacher[3]. This is by immersion in benzyl benzoate (R.I. 1.569) and observation of the facet angles. If, when the focus is raised, the angle lights up, the emerald is natural. If the angle goes black it is one of these two synthetics.

In a solution of bromoform diluted with xylol, a piece of rock crystal may be immersed so that it just rises to the surface. In the liquid so prepared the synthetics will float and the natural emeralds will sink. Under the microscope, with nicols crossed (dull polarization), the synthetics appear in bright colorations and their irregular forms seem to be the result of internal tensions, whilst the true emerald shows chromatic polarizations following the line of crystallization, i.e., rectilinear. Under ultra-violet rays the Chatham synthetics react with red fluorescence and the Gilson synthetic emeralds show olive-green.

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MAW-SIT-SIT proves to be JADE-ALBITE

By E. GÜBELIN, Ph.D., C.G., F.G.A.

IN a previous report the first phase of a comprehensive investigation to determine the nature of a decorative gemstone from North Burma and its colouring agent, present in the form of ultra-minute green grains, was described and the preliminary results were elucidated. It was found that Maw-sit-sit was a rock whose ground-mass consisted essentially of albite, which received its vivid green colour from a green pigment-mineral, the chemical composition of which failed to be disclosed by the analytical methods employed[1].

In face of the extreme difficulty of separating the pigment-mineral from the albite ground-mass and concentrating it in sufficient quantity to carry out a chemical or X-ray analysis, it was decided to examine the highly polished surface of a small piece of Maw-sit-sit in the Electron Microprobe Analyser, which had meanwhile been installed at the Institute of Crystallography and Petrology of the Swiss Federal High School of Technology in Zurich (Fig. 1). One of the most significant advances in new
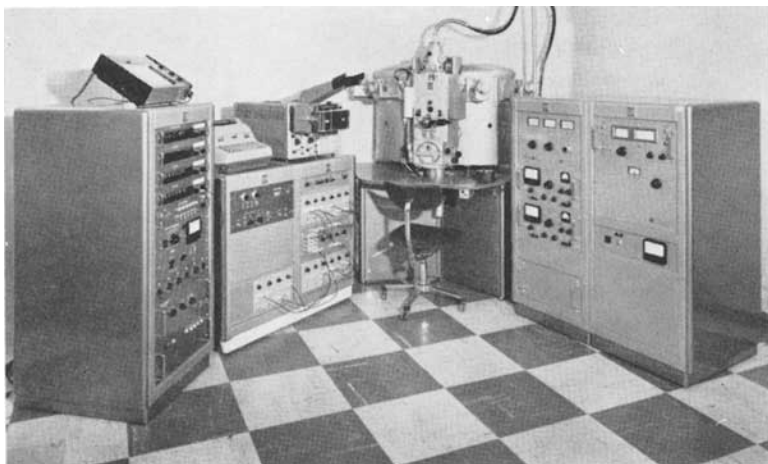

FIG. 1. The EMX Mark II Electron Microprobe X-ray Analyser made by the Applied Research Laboratories, Inc. (Glendale, California, U.S.A.). The basic EMX installation consists of three sections: microprobe spectrometer, probe electronics and recording console.

analytical techniques during the last few years has been the development of electron-probe micro-analysis. This new technique provides a non-destructive elemental analysis of extremely minute volumes at the heterogeneous surface of a solid specimen, in that the qualitative and quantitative analysis of a volume of a few cubic microns (1 micron = 0·001 mm) can be readily accomplished. The apparatus yielding this interesting information is called a microprobe.

A finely focused beam of electrons is directed at the highly polished surface of the specimen under examination exactly on the spot to be investigated. This electron bombardment causes characteristic X-rays to be emitted by the atoms affected by the electron excitement. Crystals of appropriate materials are employed to diffract the X-rays into their component wave-lengths and the selected rays are focused onto X-ray detectors. The X-ray photons entering a detector are converted into pulses of electrical energy. The number of the pulses is directly proportional to the intensity of the X-radiation entering the detector, which in turn bears a relationship to the mass concentration of the element producing the X-rays. The pulses of energy from the detectors can be utilized in various types of read-out systems.

Analyses can be performed for all elements above atomic number 10 (thus H, He, Li, Be, B, C, N, O, F, Ne are excluded). The sensitivity (limit of detectability) of this method of micro-analysis ranges from 1 part in 10^5 (0·001%) to 1 part in 10^3 (0·1%) depending upon the analyte, matrix and spot size. The relative accuracy is 1–2% if the concentration is greater than a few per cent and if adequate standards are available. The spatial resolution in some cases is 1 micron or less.

Although microprobe analysis finds primary application in metallurgical research it lends itself excellently for the investigation of the heterogeneous composition of rocks.

In this apparatus the polished surface of a tiny sample of Maw-sit-sit was bombarded with electrons, from the reflective behaviour of which information could be obtained about the nature of the various elements forming the surface. With an aperture of 11μ of the diaphragm the examination yielded the following composition of a pigment grain: chromium, iron and silica were present in great quantity (amount X0%), with a ratio chromium: iron of 3:1. Titanium, calcium and potassium represent the minority

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(amount only $X\%$).   Sodium and aluminium could not be analysed on account of their atomic weight being too low.   The ratio of iron to chromium concurs with that found by the chemical analysis in the previous communication (p. 339)[1].   This evidence corroborates that Cr and Fe are present in the pigment only.   On the polished surface of the sample under examination the distribution of the individual elements could be studied.   The observation that the reflection of the electrons is much more intensive from the pigment grains than from the albite ground-mass further substantiates that the chemical elements constituting the colouring substance possess a higher atomic weight on the average than those of the albite rock, whereby the areal distribution of the intensities of chromium, iron, calcium and potassium also correspond to the relative concentration of the pigment grains.   Thus the experimental proof has been established, that the pigment in the Maw-sit-sit is a chromiferous mineral (as well as iron-bearing).   This result substantiates the formerly described observations through the evidence delivered by the microscopic examination (p. 338 [1])
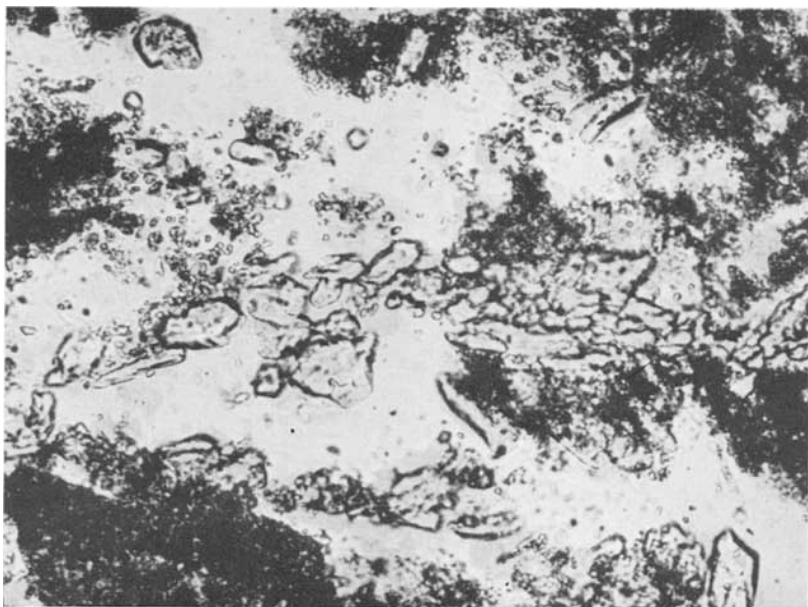

FIG. 2.   *Strong magnification of green pigment grains irregularly disseminated in the white albite rock.*   250 ×

which clearly showed that the green colour of the stone was induced by the irregularly interspersed green grains of an alien mineral (Fig. 2).

Unfortunately, the single crystals of the pigment material proved to be still too tiny to enable a quantitative analysis with the electron microprobe analyser, and it became imperative to find still another method of recovery and concentration. However, the scope of speculation grew considerably narrower, because the examination with the electron microprobe had confirmed beyond any doubt that the colouring pigment in the Maw-sit-sit was a chromiferous mineral of the pyroxene group and akin to the jadeite (Na Al Si_2O_6) or to the aegirine (Na Fe Si_2O_6).

As far as the author is informed, such a mineral has not yet been described, as all analyses published up to date do not mention higher contents than 0.01% of Cr_2O_3—even for imperial jade. Hence one might have expected a new species at this stage of the research: however, as long as the results of this investigation did not yield definitely clear results, it was preferable to wait until possibly proclaiming a new species, especially as the direct proof of sodium in the pigment-mineral was still missing.

So far the solution of the problem was frustrated by the difficulty of precipitating a sufficient concentration of the pigment-mineral, and consequently the attempt of another new procedure became necessary, which eventually proved to be successful. A fragment of rough Maw-sit-sit was pulverized in a vibration-mill, until a grain size of less than 10μ was obtained, while the concentration of the pigment (whose specific gravity on account of the chromium content was heavier than the albitic ground-mass of the rock) became possible by centrifugence of a mixture of methylene-iodide and tetrabromo-ethane. The mixture had a density of 2.75 (albite $= 2.61$). The accumulating sediment appeared a much more intensive green colour than the primary material and the floating fraction.

The sequel of the following examinations now proceeded in the reverse succession of events as against the previous phase and first another X-ray examination was carried out.

X-ray examination

With a Vernier-Guinier camera new powder diagrams of the concentrated pigment fraction, of ordinary augite, of diopside, of

aegirine and of jadeite were established after the method of de Wolff (Cu Kα—irradiation, exposure 12 hours) (Fig. 3). The distribution of lines thus obtained doubtlessly indicate a mineral of the group of the alkalipyroxenes (to which jadeite and spodumene also belong) (Fig. 4). Additional lines which are also present mainly belong to the albite, which could not be entirely removed quantitatively. A comparison of the diagrams of aegirine, jadeite and the pigment-mineral revealed that the colouring agent must lie between jadeite and aegirine. Contrary to aegirine at least two of the three lattice distances are somewhat shorter, because considerable quantities of iron are substituted by aluminium. On the other hand, the replacement of Fe ··· by Cr ··· would hardly show by the line intervals of the X-ray diagram, since both types of atoms have practically equal ion radii.

(The X-ray diagrams were made by Mr. H. Scheel of the above-mentioned institute, and he also helped with their interpretation.)

In order to attain a clear verdict and to establish a definite
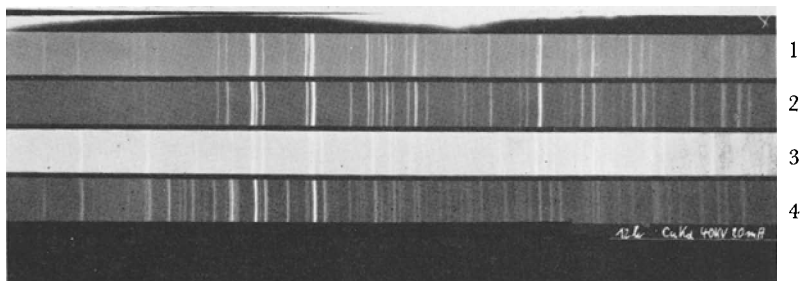
FIG. 3. *Comparison of X-ray powder diagrams after de Wolff of alkali-pyroxene minerals.*
    Diagram 1 = Augite
            2 = Diopside
            3 = Aegirine
            4 = Chrome-jadeite, i.e. pigment-mineral in the Maw-sit-sit.
The coincidence of most of the lines proves that the pigment-mineral belongs to the same isomorphous group of alkali-pyroxenes. (12h CuKα 40 KV 20 mA Al-foil)
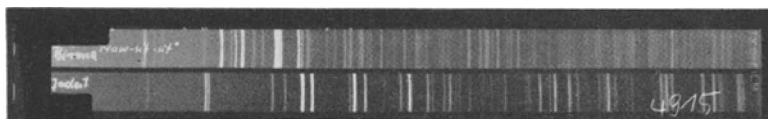
FIG. 4. *Comparison of X-ray powder diagrams after de Wolff of Maw-sit-sit and Jadeite.*
The difference of the line positions offers clear evidence that Maw-sit-sit is not Jadeite.

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chemical formula the chemical analysis of the concentrated pigment fraction obtruded itself at this phase of the examination. Since the pigment was not present in absolutely pure state, merely a partial analysis was carried out, which supplied the following result:

Molecules	Pigment concentrated to 70%	Maw-sit-sit (p. 339 [1])
Na_2O	10%	11·1%
Cr_2O_3	7%	2·6%
Fe_2O_3	4%	·8%

In face of the fact that the content of sodium has hardly changed as against the first analysis (p. 339 [1]), the pigment must be a mineral with approximately 10% Na_2O, and the following impure alkali-augite minerals may be considered: jadeite or aegirine. Pure jadeite contains 15% Na_2O and pure $NaCrSi_2O_6$ (hypothetical chromium alkaliaugite) 13.5% Na_2O. The amount of chromium is about three times greater than in the primary material. Consequently one may conclude, that the pigment-mineral comprises about 10% of Cr_2O_3 while its share in the Maw-sit-sit amounts approximately to 20 to 25%. The portion of iron is somewhat higher than what the concentration factor of three times would justify: presumably because the analyte became contaminated by iron in the course of the various operations.

Chemical formula

The exact chemical composition of the pigment-mineral could not be determined, because a sufficiently accurate separation of the accompanying minerals (particularly albite) was not possible on account of the ultra-minute size and the intimate aggregation of the crystals. However, the present investigation shows that the examined composition stems from the alkali-pyroxene jadeite ($NaAlSi_2O_6$), in which considerable quantities of aluminium are substituted by chromium and iron. Sodium is only slightly replaced. Thus the slightly idealized chemical formula of the influential pigment-mineral in the Maw-sit-sit may be expressed as: Na (Al, Cr, Fe) Si_2O_6, whose chromium content reaches approximately 10% Cr_2O_3. Pyroxene minerals with chromium are rather rare in nature. Chromium-diopside of the formula (Ca, Na) (Mg, Fe, Cr) Si_2O_6 is mentioned most often. The highest proportions of chromium which have been published so far, amount to

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2% Cr_2O_3, e.g. five times less than the chromium content in the Maw-sit-sit[2, 3, 4].

The pigment-mineral in the Maw-sit-sit represents a new, hitherto unknown member of the alkali-pyroxenes, for which the mineralogical name *chrome-jadeite* seems appropriate. A completely new name would only be justified for the more or less pure mineral at the end of the isomorphous series or, if the molecular ratio of the chromium compound:jadeite exceeded at least the proportion of 50:50. In the pigment-mineral of the Maw-sit-sit the chromium content totals *ca* 10% only, whereas the pure end member chrome-jadeite $NaCrSi_2O_6$ would have a chromium portion of 33.5%. The molecular-ratio chromium compound: jadeite in the pigment mineral of the Maw-sit-sit reaches about 30:70.

Nomenclature

In view of the fact that the present investigation has established that the new decorative gemstone from North Burma consists essentially of albite, which owes its vivid green colour to a secondary, chromiferous accessory mineral, which is irregularly and intricately disseminated through the host substance of the albite, all the names heretofore used in the trade are misleading misnomers. The rock with its native name Maw-sit-sit—described in this study—is neither jadeite (jade), nor chloromelanite, nor epidote, but definitely a fine-grained albite whose colour is induced by a pigment-mineral which has been determined to be a chrome-rich jadeite (chrome-jadeite). Consequently it is logical and imperative from a linguistic as well as scientific point of view to confer on this gemstone a name which contains the mineral name "albite"; and hence the name "Jade-albite" is suggested, which however does not exclude that the original native name Maw-sit-sit may continue to be used in future.

Summary:

After numerous unavailing attempts the optical, microscopic, chemical, spectroanalytical and X-ray examinations afforded the corroborative evidence that the decorative gemstone originating from North Burma, where it is called Maw-sit-sit, mainly consists of granular albite which owes its vivid green colour and irregular black veins and patches to a chromiferous pigment-mineral that is intricately disseminated through the albitic ground mass. The nature of the substance which is responsible for the colour could not

be determined at first, because the infinitesimally small size of the colouring crystals made the separation from the albite grains extremely difficult. Only after many tantalizing experiments was it possible, by means of modern analysing instruments, to identify the pigment-mineral as a member of the isomorphous alkali-pyroxene group which may be named "Chrome-jadeite". The tiny crystals of this chrome-jadeite reach sizes of 10μ only. It was not possible to carry out an exact chemical analysis, because the separation did not take a quantitive course. The chromium content of this chrome-jadeite amount to approximately 10% Cr_2O_3, and the chemical formula of the pigment-mineral corresponds to $Na(Fe, Cr, Al)Si_2O_6$. The portion of the pigment in the albitic ground mass was found to be 20%. No description of chrome-pyroxenes has hitherto been published which contain a similar proportion of chromium. On the basis of these data gathered from the second phase of the investigation it appears logical to call this decorative gemstone "Jade-albite".

Grateful acknowledgement is extended to Professor M. Weibel, of the Institute of Crystallography and Petrology at the Swiss Federal High School of Technology in Zurich, for his continued interest as well as the successful accomplishment of the analytical examinations and their interpretation. In addition I wish to thank Dr. Robinson and Mr. Scheel for their valuable co-operation.

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SIX CENTURIES OF DIAMOND DESIGN

By H. TILLANDER, F.G.A., C.G.

THE first authentic description of the "modern" method of diamond polishing, given by Benvenuto Cellini around 1568, is aptly supplemented by the illustration of the coat of arms of the Nuremberg diamond polishers' guild, showing clearly the dop, and two faceted diamonds. Paul Grodzinski stated, in 1953: "There were diamond polishers in Paris and Nuremberg in the 13th century, but the usual secrecy and obscurity covers their methods, which were probably quite different from those used by the ancients".

Without evidence regarding the year of execution it is not possible to draw definite conclusions, but one is perhaps not much mistaken in saying that the shaping of the earliest table-cuts in the Western World coincides with the time when women began to wear diamonds, in other words well over 600 years ago.

S. Tolansky in his "History and use of diamond" states that grinding away the tip of an octahedron was the method used by the ancients to produce the table-cut. This he believes was done at least around 1300. The earliest shaping of diamond may have been done in India some 2,000 years ago.

There are, however, two German authorities, Dr. Walter Fischer and Professor Dr. Siegfried Rösch, who both say that the earliest faceted diamonds appeared only during the second half of the 16th century, and that diamonds generally believed to have been polished before that were either natural crystals or cleaved fragments. Dr. Fischer illustrates his article with such jewellery from the period around 1500. In addition he believes that the early table-cuts were produced by sawing the rough crystal in two and not by grinding away the tip. The author has observed traces of sawing in a number of old diamonds and therefore suggests that both methods must have been used.

During mediaeval times extensive trade with the orient, appreciation of minor arts, or at least a highly luxurious life must have existed in a city, before this became a diamond centre. It remains to be discovered when trading developed into purchase of rough for subsequent cleaving and polishing before sale.

Alexander the Great was responsible for first revealing the

Fig. 1. *Coat of Arms of the Nuremberg Diamond Polishers Guild*
(*From "History of diamond polishing" by P. Grodzinski*).

wealth of diamonds in India, but only some 1,500 years after his death (in 323 B.C.) did regular trade develop between India and the West.

Early diamond centres were Alexandria, Venice, Bruges, Nuremberg and Paris. Places like Lisbon, Valencia, Barcelona, Madrid, Antwerp, Amsterdam and London became important much later.

The earliest price-list for diamonds is given by the 12th century Arab author Teifashius and in Alexandria, since 31 B.C., there was a very large trade centre which had gradually developed into an important transit place for Indian diamonds.

Quite early, around 900 A.D. Venice became a dominant centre for industry and trade and only lost importance together with other Eastern Mediterranian ports, after Vasco da Gama, in 1498, had explored the sea route around the South African coast to the far East. Venice and Florence produced famous diamond experts, such as Marco Polo, Nicolo Conti, Matteo del Nessaro, Benvenuto Cellini, Hortensio Borgius, Giulio Mazarini, Vincenzio Peruzzi, and many others.

Bruges became another large and very important commercial town and diamond centre during the 12th and 13th centuries, but lost importance to Antwerp at the end of the 15th century from where again after the Spanish Fury in 1585 the diamond cutters moved to Amsterdam.

Nuremberg, an inland town at the cross roads of travel and trade, developed equally early into a diamond centre and between

FIG. 2. *An early method of grinding away the tip of an octahedron*
(From Ars Memorativa 1480)

the 14th and the 17th century was one of Europe's most important cities for trade, art and technical inventions (modern horology, famous artists, wealthy merchants, etc.). It may thus very well have contributed to the development of diamond cutting.

Paris. In France the great passion among royalty and nobility for the minor arts dates as far back as to the 7th century, when no less than three jewellers Eloi, Alban de Fleury and Theau were canonized. But then only monasteries had workshops and almost a monopoly of craftsmen. Clotaire II established, on an isle of Paris city, a workshop of goldsmith monks, free from all cares and wars, a life in silence devoted to sacred arts. The reign of Charlemagne (771–814) was one of magnificence, goldsmith's art coming foremost. In the 12th and 13th centuries, the zenith of the curve was reached and France was the cultural centre of the continent. Secular jewellers became strongly established. In 1319 the French Queen Clemence of Hungary (King Louis the Quarreller's

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wife) is said to have worn a diamond-studded necklace and Queen Jeanne d'Evreux (wife of Charles IV) possessed rich collections of personal jewellery. This was almost a century and a half before the death of Agnes Sorel in 1450.

Small wonder if royal splendour brought diamond polishing to Paris at a very early period. Although Paris suffered an eclipse in 1415 particularly after Agincourt, this mattered little, since the Dukes of Burgundy, who also reigned over all of Flanders, made Bruges and Ghent, periodically with Paris, their residence and spent lavishly on jewels when the Kings had no means, as it happened when Charles VI became insane in 1392 and his son—with the appearance of Joan of Arc—became crowned only in 1429. There was thus no interruption as far as Paris is concerned. New and detailed information on the early evolution of diamond polishing will soon be available as a result of extensive research by a French diamond expert, M. Sirakian.

In the following analyses the universal principles for measuring diamond proportions are used—essentially the same as have within recent years also been adopted by the American gemmological organizations, but an effort has been made to introduce new signs and abbreviations, such as can be easily understood world-wide, and are easy to type or write. They have been found most practical throughout the research work.

The original brilliant-cut is the natural, perfectly developed octahedron, with a girdle of 1%, a crown height of $70\frac{3}{4}\%$, the same pavilion depth, a total height of 142·5% and with both crown- and pavilion-angles, equal to the octahedral angle of 54° 44′ 8·3″, or almost $54\frac{3}{4}°$

Eventually the octahedron was slightly improved through cleaving and primitive polishing. Together with several other regular forms of diamond crystal and cleaved fragments (the early baguettes) this "diamond-point" was used in jewellery for more than 1,500 years.

It is not known when the first attempts were made to repair broken tips of otherwise perfect octahedra.

The early diamond cutter found, probably without fully appreciating the value of his invention, the softest of all planes, the cubic. S. Tolansky believes that early workers often decided to grind away the tip until the width of the table face was 50%, involving a total loss of 1/16th or 6·25%. Other authors have
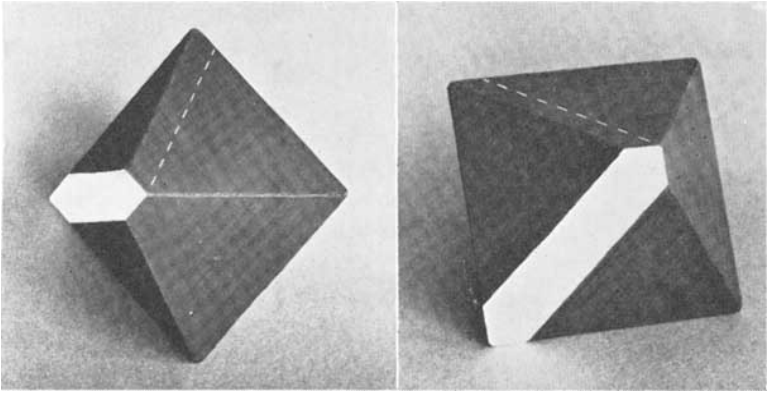
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FIG. 3. *How the earliest "Baguettes" were cleaved from a diamond octahedron.*
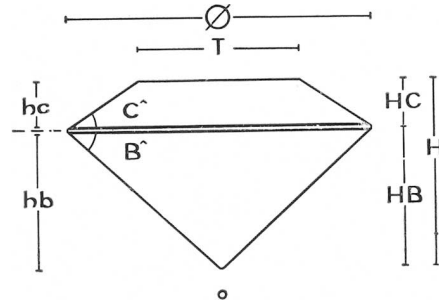

FIG. 4. *Abbreviations and signs used in proportion analyses.*

Ø	*Diameter of stone (usually the shortest)*
T	*Table size (in brilliant-cuts between opposite corners, but in certain other shapes between opposite sides)*
o	*Culet size (measured as the table size)*
hc	*Height of crown* x)
- - -	*Average girdle thickness*
hb	*Height of base (=depth of pavilion)* x)
H	*Total height (from table to culet)*
C^	*Crown angle*
B^	*Base angle (=pavilion angle)*
x)	*without girdle thickness*

quoted figures between 4 and 5 ninths. Experiments with synthetic spinels and comparisons with descriptions of fine table-cuts, old designs and photographs of authentic mediaeval jewellery show clearly that not less than 5/9th of the top pyramid had been ground or sawn off in perfect full-bodied table-cuts.
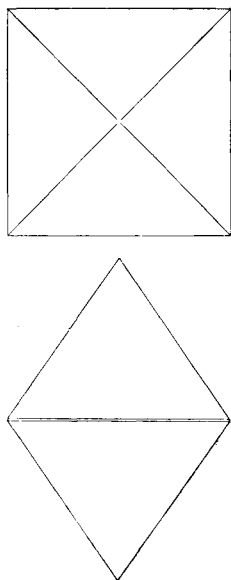
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FIG. 5. *The perfect "diamond-point* (4/4)

hc 70,75% C^ 54°44′8,3″
- - - 1,00%
hb 70,75% B^ 54°44′8,3″
H 142,50%

(*With a girdle thickness of* 1%
the "diamond-point" has a Ø
of 99,6% *compared with the
width of the perfect octahedron.
For this reason the depth figures
differ from the measures of a
crystal without "girdle"*).

The ideal table-cut has therefore been reproduced with 4/9th of the top pyramid as a crown and 8/9th as pavilion leaving a table of 56% and a culet of 11%. The magical total depth figure of 100% is not yet arrived at. These proportions remained ideal figures almost as long as the octahedral angles persisted.

Obviously the table-cut only developed very gradually into this perfect and fully symmetrical shape and few if any cutters adhered strictly to these rules, probably as few as to-day aim to produce ideal brilliant-cut stones.

From the evidence of the numerous reproductions of known jewellery in museums and private collections, no doubt remains about the dominance of the primitive table-cut up to the beginning of the 18th century, when it rapidly declined. The same applies to the "point-cut", in so far that this persisted in sizes, which to-day would be called mêlée, until they were gradually replaced by small table-cuts and then by different types of single-cuts.

Further evolution was slow and haphazard. Inspired by the results achieved in shaping softer gems and possibly also due to various shapes of rough diamond the first table-cuts with polished corners appeared. These may be termed "Octagonal table-cuts".

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FIG. 6. *Natural diamond crystals resembling table-cuts.*
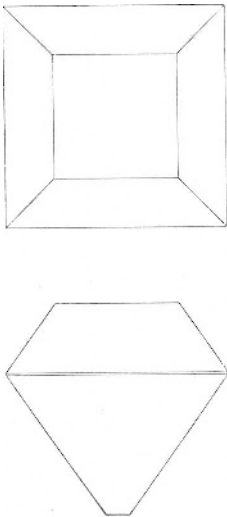*(From "Der Diamant" by Fersman u. Goldschmidt)*

FIG. 7. *The ideal full-bodied square table-*
cut (4/4)
T   56,0% *(measured between opposite sides)*
o   11,0% *(square in shape)*
hc   31,2%   CΛ   54°44′ 8,3″
- - - 1,0%
hb   62,8%   BΛ   54°44′ 8,3″
H   95,0%

This shape however never became popular or generally accepted, and must be considered merely as a repaired table-cut and a step towards the proper single-cut with 8-fold symmetry in the girdle outline as well as in the shape of the table facet.

The perfect old single-cut with 8 facets in the crown and 8 in the pavilion is thought by Professor W. Eppler, a well-known German mineralogist and gemmologist, to date as far back as to the 14th century, but in case he is right it remained a rarity for well over 200 years.

The next improvement was the rounded single-cut, the first diamond where table size should be measured, as in a modern

brilliant-cut, from corner to corner, instead of between opposite facet edges.

Diamond with richer faceting cannot be dealt with in a strict chronological order. The reasons are that techniques once learnt put no limits with regard to the number of facets that could be applied to a diamond. The rose-cut had been introduced in Europe very early in the 16th century and other richly faceted Indian diamonds, such as the "Sancy" and the "Florentine", without too much geometrical symmetry, became well known in the West.

It remained only to "invent" the final shape of the full-cut brilliant. This was achieved during the 17th century, whereas somewhat less complicated designs were created for the mêlée sizes.

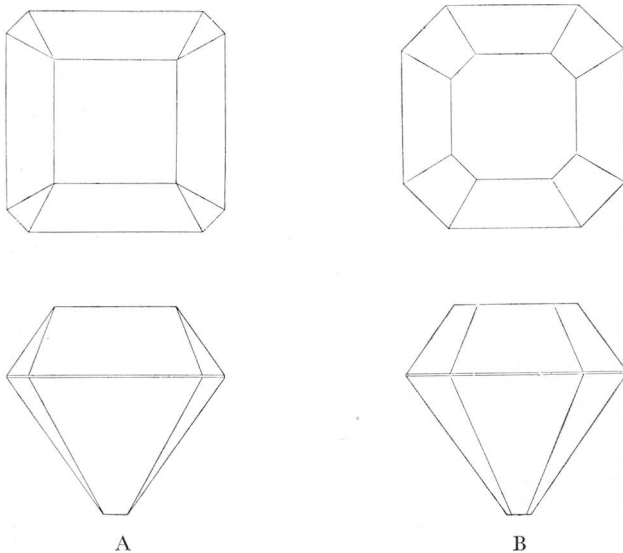The English star-cut had 16 facets in the crown and 8 in the

FIG. 8. *Ideal full-bodied octagonal table-cuts (8/8).*

A. *The first step towards the proper single-cut with a square culet and the table size measured between opposite sides. Length of outer edge of main facets is* 80% *of Ø.*

B *A shape, which persisted in mêlée sizes, with an octagonal culet and the table size measured between opposite sides. Length of outer edge of main facets is* 60% *of Ø.*

(The proportions are equal to those listed under Fig. 7)

387
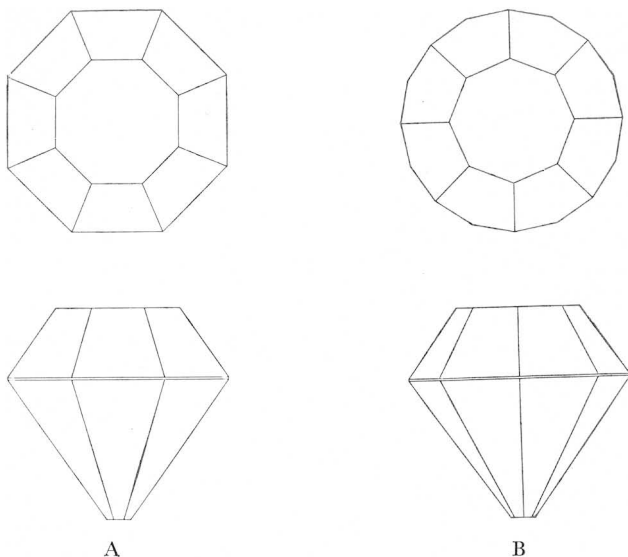
Ideal octagonal and rounded full-bodied single-cuts (8/8)
Both have octagonal culets and proportions equal to those listed under Fig. 7.

A   "T" *is measured between opposite sides*
B   "T" *is measured between opposite corners*

pavilion. The first stones in this pattern were no doubt cut with octahedron angles and the same ideal proportions as in earlier diamonds.

The English square-cut brilliant had a different girdle outline, the same amount of facets (16) in the crown, but 12 instead of 8 facets in the pavilion. Here, as in the following brilliant-cut, the table size must again be measured between opposite facet edges.

Now comes the Mazarin-cut brilliant. This was used in all sizes, also for large stones. It was in all probability older than the two previous shapes and was perhaps introduced around the year 1620, well before the era of Cardinal Mazarin.

The 17th century contributed to physics by discovering the laws of refraction and by introducing analytical geometry. There was rapid development in all fields of science. Diamonds with deliberately chosen angles and proportions no doubt appeared. Ideal proportions obviously changed. Only the table size remained 56%.
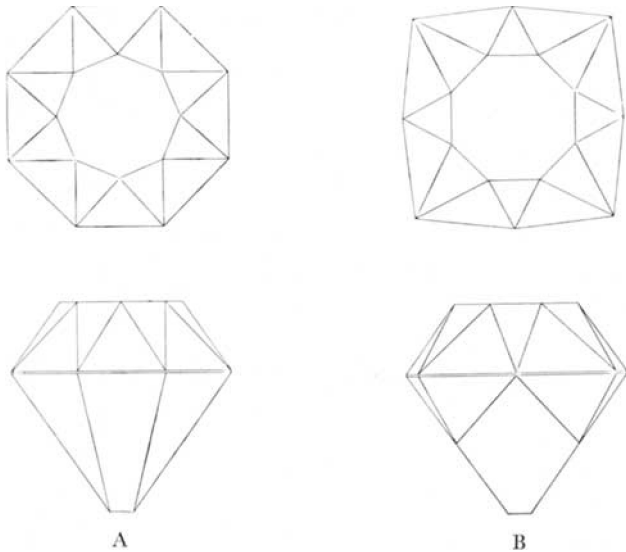
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FIG. 10

A. *The ideal full-bodied English star-cut* (16/8)
The culet is square and the proportions equal to those listed under Fig. 7.

B. *The ideal full-bodied English square-cut* (16/12)
The culet is square and the proportions equal to those listed under Fig. 7. The girdle facets in the crown and in the pavilion have the same height, but a different shape. The distance between the "corners" is 90% of Ø.

The following quotation in a letter by Marquise de Racan, a member of the French Academy, written in 1644 to Madame de Thermes, may be one reason for the wrong belief that Mazarin invented the 16/16 facet-cut: "The Cardinal has demanded a cut with 16 facets above and 16 below the girdle; he makes a triumph of this double cut".

But this cut existed, as did the rose-cut, well before 1644. 16/16 facet-cuts are mentioned in connexion with Queen Henrietta Maria who gave such diamonds in 1640 to the French Duke of Epernon as security against loans. These must have been acquired much earlier, since her husband, King Charles I, started in 1625 to dispose of his valuables; this was the first year of his reign.

The truth about Mazarin is probably that he just became a fabulous collector of large and exquisite diamonds and thus learnt more about them than others. He purchased diamonds from

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Tavernier and other merchants, he acquired the "Sancy" and the "Mirror of Portugal" and many other stones, which had belonged to royalty in distress, such as Charles I, Henrietta Maria, Queen Christina of Sweden, and many others. Almost one half of the large diamonds listed in his bequest to the French Crown were—strange as it may sound—table-cut and only subsequently, after his death, recut into new shapes. Mazarin followed the example of earlier nobles, such as Seigneur de Sancy, Henry IV and his Queen Marie de Medici, Louis XIII and his Queen Anne, Cardinal Richelieu and many others.

A few years after the death of Mazarin large full-cut brilliants appeared on the market, the earliest yet known to the author.
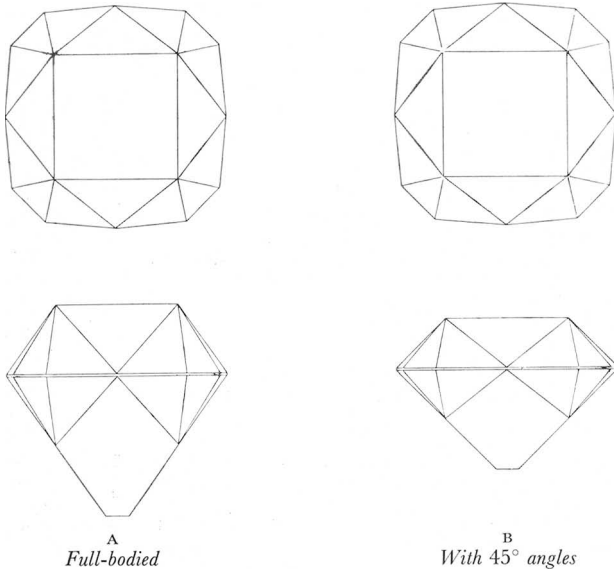

A
Full-bodied

B
With 45° angles

FIG. 11.   *The ideal Mazarin-cuts* (16/16)

The distance between the "outer corners" is 94% and between the "inner corners" 64% of Ø.   The culet is square and the girdle facets above and below the girdle are identical in size and shape.

A.   *The proportions are equal to those listed under Fig. 7*
B.   *The lower Mazarin-cut has the following proportions:*

T	56,0%		
o	10,0%		
hc	22,4%	Cᴬ	45°
- - -	1,0%		
hb	44,8%	Bᴬ	45°
H	68,2%		

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One is a 19 ct brilliant-cut stone from the Green Vaults in Dresden with a full-cut crown but a "single-cut" pavilion. The crown angle is 34°. But much more fascinating is the lately re-discovered great blue diamond of $35\frac{1}{2}$ carats, now also called "The Wittelsbacher". The appearance of this stone is particularly striking because of its unusually fine polish and the absolute flatness of the facet surfaces. It is amazing how this brilliant-cut stone can have such a deep fire and look so attractive with a total depth of only 38·6%. It has recently been studied by the author and his team. The following proportions may be of interest: Table 65·8%, Culet 31·1%, Height of crown 12·4%, Depth of pavilion 25·2%. The crown and pavilion angles are both exactly the same, 36 degrees. The size in millimeters is 24·4 × 21·46 with a depth of 8·29. The number of facets is 40/40.

All that is known of the early history of this stone is that in 1664 it was presented by the Spanish King Philip IV as part of the dowry for his daughter the Infanta Maria Teresa, who married Emperor Leopold in 1667 and that it came from "a new acquisition of precious stones from India and Portugal".

A very similar brilliant-cut stone, only without the extra facets in the crown, is a distinctly yellow diamond of 13·48 carats among the treasures of the Green Vaults. It has a table size of around 50%, a crown angle of 33° and an equally modern pavilion angle
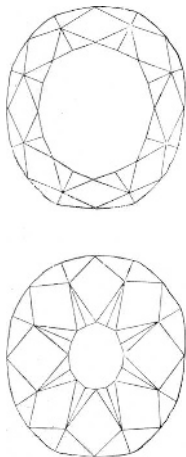

FIG. 12. *The Wittelsbach diamond* (40/40)
(*The pavilion is reproduced as if seen through the crown. The dimensions of the actual stone are* 24,5 × 21,5 *millimeters.*)

T	66,0%		
o	31,0%		
hc	12,5%	Bᴬ	36°
- - -	0,5%		
hb	30,0%	Cᴬ	42°
H	43,0%		

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of $41\frac{3}{4}°$ with a total depth of some 60%. The additional 8 facets in the pavilion are apparently applied because of the rather large size of this stone. The total amount of facets is thus 32 in the crown and 32 in the pavilion.

The famous "Regent diamond" is a 40/32 faceted brilliant-cut stone of very similar type. It was shaped between 1707-1717 with a distinctly rounded outline. The rough crystal was sawn in two, an operation which lasted almost a year. The instrument used was apparently a hand-operated saw, similar to the one described by De Boot in 1604 and to those used earlier for table-cut diamonds. There is an exceptionally even distribution of fire all over the surface of the crown. Not one of the main facets in the pavilion can be seen through the stone. This is due to an ideal pavilion angle of some $41\frac{3}{4}°$ discovered 200 years before Marcel Tolkowsky published his book on diamond design. The cutter, Harris by name, also found an ideal crown angle, near 45° which in the flickering candlelight of those days shows off the diamond's fire to perfection. In the Regent the culet is reflected in the centre of the main facets, which Mawe in 1823 described as a criterion of ideal proportions. In practically every old-miner the culet reflects either higher or lower.

The size of the culet is 10·35%, the height of the crown 25·9% and the pavilion depth 39·6% with the knife-sharp girdle giving a total depth of $65\frac{1}{2}$%. It was, may be, only a happy chance that the Regent received these beautiful proportions, since David Jeffries, although he was full of admiration for this stone in his publication of 1750 quotes 45° as ideal both for crown and pavilion. The same statements are repeated by practically every author until the introduction of the circular diamond-saw.

The three diamonds described are stones of considerable size and received for that sake alone additional facets. Smaller diamonds were certainly simultaneously polished with the classical amount of facets 32 in the crown and 24 in the pavilion as we are used to see them this very day. It has therefore been impossible to resist the temptation to reproduce a normal brilliant-cut stone with the same proportions as in the "Regent".

Contrary to the present-day taste the culet was apparently much admired. In stones which were cut in brilliant style with the octahedron angles of $54\frac{3}{4}°$ the culet acted as a mirror for a considerable amount of light entering through the crown facets.
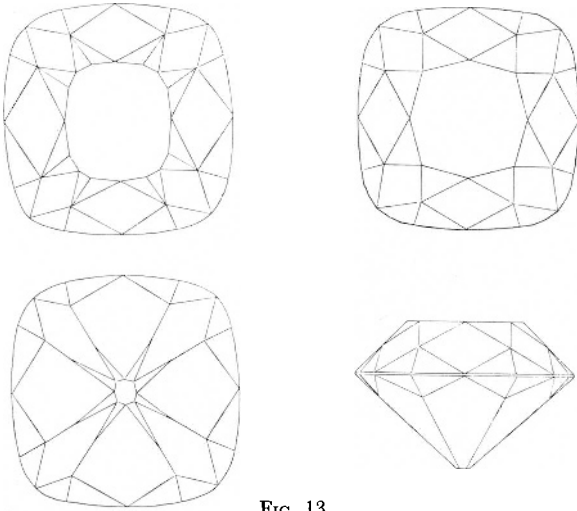
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FIG. 14

FIG. 13

FIG. 13. *The Regent diamond* (40/32)
(*The pavilion is reproduced as if seen through the crown. The dimensions of the actual stone are* 30×29 mm)

T	46,55%	(16-*sided*)	
o	10,35%	(8-*sided*)	
hc	25,90%	C^	45°
- - -	0,00%		
hb	39,60%	B^	$41\frac{3}{4}$°
H	65,50%		

FIG. 14. *The corrected "Regent-cut" with 32/24 faceting.*
This may have been the ideal shape of the earliest brilliant-cut diamonds with four-fold symmetry in the table and 150° and 120° angles. The four larger main facets are symmetrical lozenges, but the girdle facets are of a different size and shape in the crown and the pavilion; the proportion in height is around 12:10.

T	53,0%		
o	6,0%		
hc	23,5%	C^	45°
- - -	1,0%		
hb	42,0%	B^	$41\frac{3}{4}$°
H	66,5%		

The distance between the "corners" is 82% *of* Ø.

Other early brilliant-cut stones are worth mentioning, such as "Tavernier A" and "Tavernier C", 51 and 31 carats in size, and the little "Sancy Diamond", a stone of 34 carats. Their whereabouts are not known and unfortunately they can therefore not be analysed for design and proportions.

"Le Grand Condé" a pink, pear-shaped, brilliant-cut diamond weighing 50 carats, said to have been bought in India in

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1643 is, however, still on display in the Chateau de Chantilly, near Paris. It is probably even older than the Wittelsbacher and would therefore testify that full-cut brilliants existed when Mazarin still collected table-cuts and admired rose and sixteen-cuts. But definite conclusions cannot be made without further research.

Finally comes the story of Vincenzio Peruzzi, the 17th century Venetian lapidary who is credited with first employing the brilliant
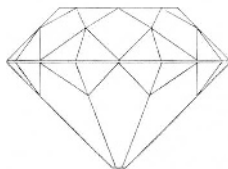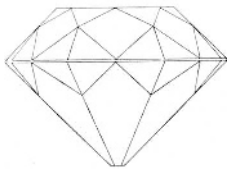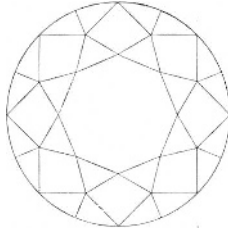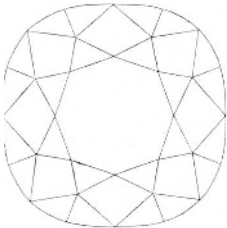

FIG. 15   FIG. 16A

FIG. 15.   *The almost round early brilliant-cut (32/24).*

This shape is mid-way between Fig. 15 and the completely round brilliant-cut, with a distance between the "corners" of 76% of Ø.   The symmetry of the table is still four-fold with angles of 127,5° and 142,5°.   The main facets in the crown are all kite shaped and proportioned to please the eye only.   The girdle facets in crown and pavilion have all a height of 15% but a slightly different shape.
The proportion figures are different from the "Regnnt-cut" since the lower pavilion angle of around 41¾° was apparently never generally accepted.

T	53,0%		
o	6,0%		
hc	23,5%	C^	45°
- - -	1,0%		
hb	47,0%	B^	45°
H	71,5%		

FIG. 16.   *The ideal perfectly round early brilliant-cut (32/24)*

A.   *The table has eight-fold symmetry with 135° angles.   The meeting points of the main facets in the crown are found by drawing a circle mid-way between the corners of the table and the girdle.   The girdle facets in crown and pavilion have all a height of 14½% and are identical also in their shape.*
The proportion figures are the same as listed under Fig. 15.
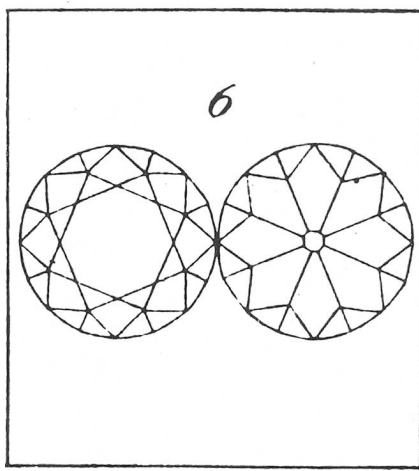
FIG. 16B

B.   *The same early brilliant-cut, as illustrated by David Jeffries in 1750, but with larger table (58%) and culet (11). Judging from this diagram the proportion figures may have been 41¾°.*

form of cutting.   This credit, which appears in prcatically every gemmological publication, cannot possibly be correct.

Investigations and research covering a period of several months have not disclosed the secrets about this legendary person.   If he ever existed is an open question.   David Jeffries did not mention Peruzzi's name in his publication of 1750.   So far his name seems to have been unknown or forgotten until 1833, when a French gemmologist A. Caire, in his book "La science des Pierres Précieuses", mentions Peruzzi as the inventor of the brilliant-design.   The Spanish author Miró repeats the statement in 1870, but such a famous author as Professor Max Bauer was not aware of his existence when, in 1896, he published the first edition of his "Edelstein-kunde".   In the second edition of 1909, however, he repeats Caire's and Miró's remarks, probably due to information given by Henri Polak, chairman of the Amsterdam Diamond Workers Union, who in several pamphlets published between 1890-1900 mentions Peruzzi, but again without giving any sources for his statements.   Genealogical researches in several European libraries gave no positive answers, except that the family Peruzzi was not of Venetian, but of Florentine origin.   This is why inquiries in Venice
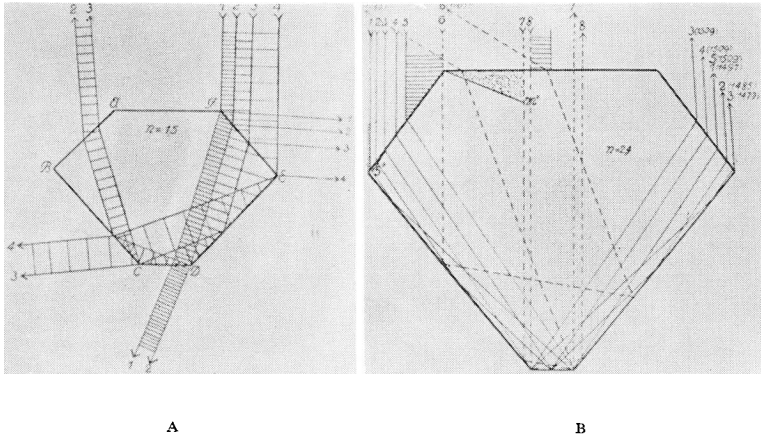
395

A   B

FIG. 17. *Leakage of light in brilliant-cut diamonds with a culet.*
A. *With 54¾° angles*   B. *With 45° angles*
(From "Brillanten und Perlen" by W. Maier)

have not led to any results. Further investigations may possibly
reveal Vincenzio Peruzzi, if not in Florence, perhaps in quite
another place. Perhaps he was one of the 75 diamond cutters
then active in Paris, perhaps one of Amsterdam's 600 diamond
workers. It is, however, quite possible that he lived in India,
where so many Italian diamond cutters worked at different periods,
and from where during the second half of the 17th century brilliant-
cut, beautifully shaped, and therefore not native-cut diamonds were
thought to have been imported into Europe.

Commenting upon the achievement attributed to Peruzzi,
Dr. Wilhelm Maier is full of admiration for the perfect geometrical
symmetry in his design. ("Brillianten und Perlen, Stuttgart, 1949").
He describes the overall-size star-design, the parallel facet edges
throughout the stone and the symmetrical facets. He believes
Peruzzi to have known earlier brilliant-cut designs, such as pre-
viously described in this paper, since his creation is actually nothing
but a definite improvement in the way of beautiful symmetry, in
fact so perfect, that nothing near to it has been achieved, earlier nor
later. It therefore remained to find out if this statement was correct
and if a shape with complete symmetry could be reconstructed.

Series of experiments with paper and pencil were carried out.

Then several pounds of transparent, pure rock crystal were consumed before it was possible to produce perfect symmetry paired with acceptable proportions.

It is not known if the Peruzzi design was executed for octahedral angles, which were at that period already practically abandoned for the then "modern" and generally accepted angles of 45°. The proportion figures with $54\frac{3}{4}°$ were: $T = 53\%$, $o = 7\%$, $hc = 33\%$, $\text{---} = 1\%$, $hb = 66\%$ and $H = 100\%$. The figures with the 45° angles were: $T = 53\%$, $o = 6\%$, $hc = 23\cdot5\%$, $\text{---} = 1\%$, $hb = 47\%$ and $H = 71\cdot5\%$. Even these figures show a surprising exactness of symmetry. No deviations from these proportions are permissible. With 8-fold symmetry in the table, its size must have been 53%—again Tolkowsky's figure. The girdle outline is equally fixed, with a distance between the corners of 94% and between the dividing edges of the girdle facets of 97%.

Now if this theory can be generally accepted as correct and the Peruzzi design thus established it remains to find actual diamonds corresponding to these rules, examine them for fire and brilliancy and make comparisons with other shapes and types. They should
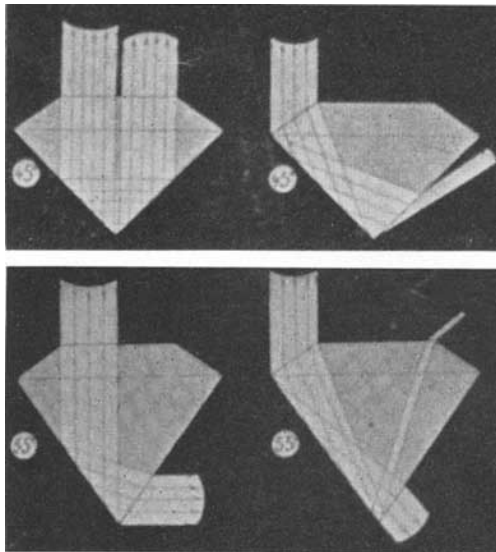

FIG. 18. *Leakage of light in brilliant-cut diamonds without a culet.*
(From Deutsche Goldschmiede-Zeitung Nr. 5-1926, pg. 48.—Mitteilungen aus dem Laboratorium fur Diamantforschung, Düsseldorf-Oberkassel, Krumbhaar & Rösch.)
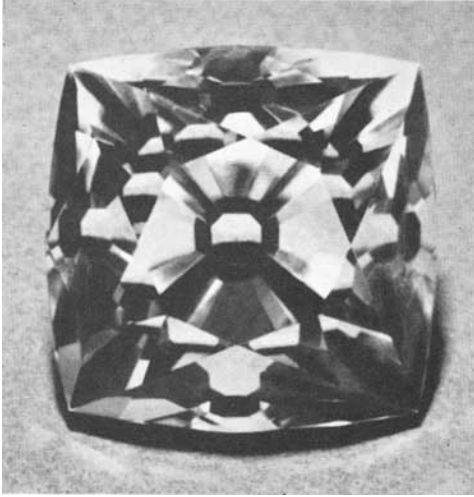
FIG. 19. *The Peruzzi design reproduced in rock crystal.*
The culet can be seen reflected in the centre of the four main facets, according to Mawe a criterion of ideal proportions.
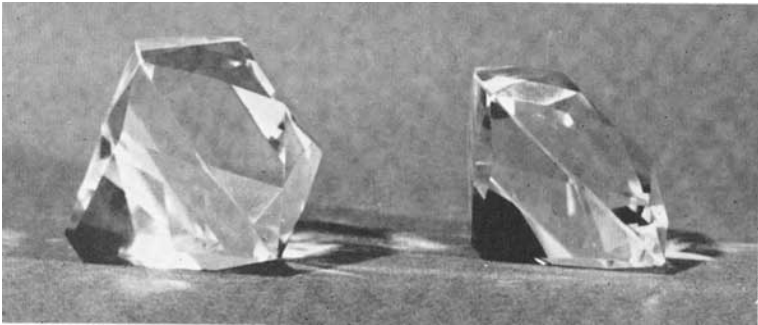

FIG. 20. *Side views of the Peruzzi design reproduced in rock crystal with 54¾° and 45° angles.*

be preserved from recutting and treasured as precious examples of a truly artistic and unique creation from the end of the 17th century.

The Peruzzi-cut must be extremely rare, since, for instance, in the Dresden Green Vault not one such diamond has been found. Although it is a very precise design and utmost accuracy is necessary to reproduce it; with the aid of a simple metal gauge, the sides of which had only to be divided into four equal parts with a pair of ordinary compasses, any patient diamond cutter should have been able to produce the perfect Peruzzi-cut.
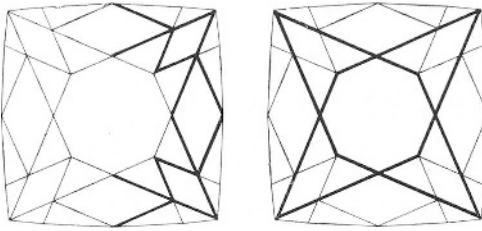
FIG. 21. *Diagrams of the Peruzzi design with the heavier lines drawn to accentuate the elements of symmetry in the crown.*
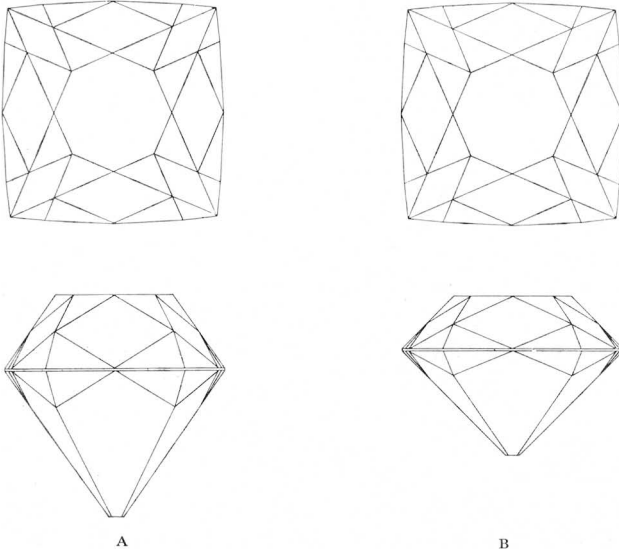

A   B

FIG. 22.   *The Peruzzi designs* (24/32)

A.					B.				
	T	53,0%				T	53,0%		
	o	7,0%				o	6,0%		
	hc	33,0%	C^	54°44′ 8,3″		hc	23,5%	C^	45°
	- - -	1,0%				- - -	1,0%		
	hb	66,0%	B^	54°44′ 8,3″		hb	47,0%	B^	45°
	H	100,0%				H	71,5%		

But in reality few cutters ever aimed to achieve perfect proportions—we recognize the situation to-day—and very inferior old-mine cuts, many of which did not even have a symmetrical girdle outline dominated the market.

This is probably one of the reasons why the older type, the nearly circular-girdle brilliant-cut remained in demand and finally outmoded the square-girdled stone.   The further development of
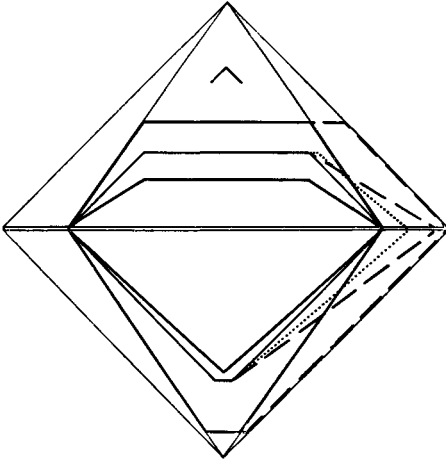
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Fig. 23. *Diagram showing the evolution from "point-cut" to modern brilliant-cut. (The octahedron, the table-cut, the early brilliant-cut, the Peruzzi cut and the modern ideal brilliant-cut.) As a simplification one table size only, 53% has been used.*

the "rounded shape" is outside the scope of this paper and therefore only suggested in a couple of diagrams.

With the invention and introduction of the bruting machine and rotary diamond saw about the end of last century the brilliant-cut became perfectly round and quickly developed into the now accepted depth proportions.

Richard Liddicoat, Jr. who inspired this work by inviting me to lecture on diamonds at the American Gem Society's Conclave in Chicago and to Gordon F. Andrews for a similar invitation to London.

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Gemmological Abstracts

FLANIGEN (E. M.), BRECK (D. W.), MUMBACH (N. R.) and TAYLOR (A. M.). *New hydrothermal emerald.* Gems and Gemology, 1965, XI, 9, p. 259.

The new synthetic emeralds made by hydrothermal process by the Linde Division of the Union Carbide Corporation, U.S.A., are reported to be comparable in quality to the finest natural emeralds from Chivor, Muzo and the Urals. Crystals as large as seventeen carats and faceted stones of three and four-carat sizes have been produced. The refractive index range of the new synthetics is $\varepsilon = 1\ 566 - 1\ 572$, $\omega = 1\ 571 - 1\ 578$, with birefringence $005 - 006$. Specific gravity is given as $2\ 67 - 2\ 69$. The new synthetic has higher refractive indices and specific gravity than those of previous synthetics. The Linde product shows a bright red fluorescence under short and long-wave ultra-violet light and a very bright red residual colour under the Chelsea colour-filter. The Linde stones are stated to be flawless macroscopically, or under 10x magnification. Because of the optical clarity the stones are quite brilliant. Under a magnification of 400x, two-phase inclusions and phenacite have been observed. The authors of the paper suggest that, although the physical properties of the synthetic resemble those of natural emerald, the bright fluorescence and residual colour under the Chelsea filter should differentiate it from most natural stones. Differences in crystal inclusions and optical clarity should provide additional means of distinction.

S.P.

DARRAGH (P. J.) and SANDERS (J. V.). *The origin of colour in opal.* Australian Gemmologist, 1965, 46, pp. 9-12.

An important article submitting reasons for the play of colour in opal. The workers used an electron microscope for this investigation. From the results it is postulated that precious opal is formed from spherical particles of amorphous opal. These are uniform in size and are packed together in a very regular manner, the basic feature of precious opal being the regularly arranged spheres and the "holes" between them. The silica spheres are themselves optically transparent but some light is scattered at the

surface of the voids because there is a change of refractive index at the interface. As these are arranged regularly in three dimensions they form a three-dimensional grating, and when the spacing is about the wavelength of visible light, Bragg diffraction of light occurs. Some explanation of the effectiveness of black backgrounds is given, and this is said to be why dyed opal and doublets are so effective. The cabochon cut provides the best form in which to cut opal in order to obtain the best play-of-colour. Potch does not show a play-of-colour owing to the irregularity of the arrangement of the spheres. The authors state that it is still not known how the regular structure occurs.

10 illus.   R.W.

BURLS (J.). *Diamonds.* Geographical Magazine, 1965, XXXVIII, 2, pp. 141-154.

A popular article on the diamond mining in Africa and elsewhere. It is an informative article and is profusely illustrated. It comprises a general discussion of the mining, recovery, sorting and marketing of diamonds. Something is told of the fashioning of diamonds and of the making of diamond jewellery. The use of diamond in industry forms the concluding part.

28 illus. (3 in colour).   R.W.

BANK (H.). *Lichtbrechung, Doppelbrechung, Dispersion, Dichte und Gitterkonstanten bei Turmalinen.* Refraction, double refraction, dispersion, density and lattice constants of tourmalines. Special number, Spring 1965, of the Zeitschrift d. deutsch. Gesell. f. Edelsteinkunde, 32 pp., 16 illustrations and bibliography.

The methods used for measuring refraction, double refraction, dispersion and density are described and their accuracy discussed. The results are published in detail and the various combinations scrutinized. The lattice constants are determined by X-rays and compared with the other results. It was shown that (*a*) there is a linear relationship between the refraction and double refraction, (*b*) between refraction, double refraction and density, (*c*) this linear relationship can also be observed between lattice constants refraction and density and (*d*) the dependance of all these phenomena on the chemical composition is obvious. For the time being the

classification of tourmalines into mixed crystal series is only possible either by chemical analysis or X-rays. For diagnostic purposes the determination of refraction, double refraction and density is suitable also in the case of cut specimens, especially using the ND-Diagram (refraction-density comparison).

<div align="right">E.S.</div>

BANK (H.). *Pegmatite Suedrhodesiens und ihre Edelsteinminerale.* The pegmatites of Southern Rhodesia and their gem materials. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964/65, 50, pp. 13-25.

The occurrence of mica pegmatites in Southern Rhodesia was known at the beginning of this century and the presence of beryl pegmatites was known in the 1920s, but only after the last war were the claims worked to any extent. In 1960 Southern Rhodesia was the second largest beryl producer in the world. The geology of the district is described and there are two maps showing the gem occurrences. Apart from chrysoberyl (with alexandrite) and emerald, there are many gem minerals found in pegmatites, the following of which, together with some of their physical and optical characteristics, are described: oxides: quartz mainly amethyst, but also some smoky quartz, citrine and rose-quartz, and spinel; silicates: beryls, including aquamarine, golden beryl, morganite and goshenite. Other minerals found include euclase, amazonite, phenakite, topaz and tourmaline.

<div align="right">E.S.</div>

SCHMIDT (P.). *Namen von Edelsteinen nach historichen Personlichkeiten.* Gems named after historical personalities. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 50, 9-10.

A number of rarer stones are called after the person who discovered them. These include kunzite, named after the American mineralogist, G. F. Kunz, and hiddenite, after W. Hidden. Other examples are chudobaite, after Professor K. Chudoba, garnierite after the Frenchman Garnier and various others. Taaffeite, named after the Irish Count Taaffe, is not mentioned.

<div align="right">E.S.</div>

THEISEN (V.). *Zur Farbbestimmung von Diamanten.* Determining the colour of diamonds. Deutsche Goldschmiedezeitung, 1965, 63, 2, pp. 142-143.

The difficulty of exact determination of the colour of a diamond is discussed and the international colour scale given. This has twelve stages from finest white to yellow. Apart from these colours there are the fancies, such as pink, blue, brown, etc. Stones should be examined in north light, from above, below and at the side. The article describes two instruments which have been developed to help to differentiate between the various colour types, the Coloriscope by Dr. E. Gübelin and the Electronic Colorimeter, developed by the American Gem Society. Both instruments are described in detail. It seems that it is difficult in Europe to obtain the American product.

E.S.

NEUE SYNTHETSEN UND IMITATIONEN. *New synthetics and imitations.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964/65, 50, pp. 30-34.

A new synthesis of sapphire has been perfected by Czochralski. The crystals grow to a height of about 2·54 cm and are up to 2·54 cm wide, and have little internal stress. The alumina is put under pressure of 10,000 lb. per sq. inch and afterwards heated for two hours at 1800°C. Australian opals, which have been dyed with carbon at a temperature of 400-450°C in oxygen, have shown to be as colour constant as natural black opals. Chrysoprase, produced in Australia, consists of chromium-coloured chalcedony. Synthetic garnets were first produced for scientific purposes, but now can be used for technical and gem purposes. There are diamonds on the market, especially in U.S.A., which are covered with an unknown material in order to improve their colour. The covering material might be fluoride. The colour is greatly improved, but the stone loses some of its brilliance and the cover itself is fairly soft and therefore has scratchmarks, which under a 10x lens can be recognized as threadlike black flaws. The cover is dissolved when the stone is boiled in concentrated sulphuric acid.

E.S.

PENSE (J.). *Elektronenmikroskopische Untersuchungen an Calcedon und Edelopal.* Examinations under the electron microscope of chalcedony and precious opal. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964/65, 50, pp. 25-27.

Extract from an article in the Fortschritte der Mineralogie published by the German Mineralogical Assoc., 1963, 41, 2. Photomicrograph of precious opal enlarged 33,000x. The opal shows a crystal lattice with an elementary distance of 2000 AE. The play of colour is explained by the refraction of the visible light by the lattice.

<div align="right">E.S.</div>

CANNAWURF (C.). *Neues vom Biwako See.* News of the Biwako lake. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964/65, 50, pp. 27-30.

In 1962 X. Saller first published details of the fresh-water cultured pearl production from the Biwako lake in Japan. This article is based on the observations of H. Hahn, from Idar-Oberstein, who saw the cultured pearl farms at the end of 1964. The lake is near the old town of Kyoto and easily reached. There are 15-20 farms many of them still being built up. The larger farms keep up to about 300,000 oysters. As the lake is sheltered the harvest is independent of any seasonal changes. The original lots are bought at an auction by "makers", who have to be admitted by the Japanese pearl association and who then "improve" the pearls. Exporters try to buy directly at the farms, but this is very difficult. All pearls, i.e. those with and those without nucleus, are creamy, grey or yellow-pink and are generally bleached by the "makers". The oysters are surprisingly large, about 15 cm long and 8 cm wide and are kept in the usual wire baskets hung on bamboo sticks in the water. The fresh-water pearl can accommodate nucleii of up to 9 mm and nearly 10% produce well formed and well coloured pearls. The oysters are fed additionally with plancton, which increases the growth of the oyster and of the pearl substance. Cultured pearls without a nucleus often reach 6-8mm after a year and a half or two years. If the oyster lives after the first harvest it is used again and sometimes even a third time.

<div align="right">E.S.</div>

ASSOCIATION
NOTICES

ANNUAL GENERAL MEETING

Mr. Norman Harper, Vice-Chairman, presided at the 35th annual general meeting of the Association, which was held at the registered offices on Wednesday, 5th May. In commenting upon the work of the year the Vice-Chairman referred to the great increase in the study of gemmology since the end of the war. In 1964 there were 412 candidates for the examinations and for 1965 there was likely to be more than 450. He hoped that it would be found possible to commence gem diamond classes in London, similar to those that had been held successfully in Birmingham for the past three years. The annual report and audited accounts for the year ended 31st December, 1964, were adopted.

Sir Lawrence Bragg, F.R.S. was re-elected as President. Mr. Harper was elected as Chairman, in place of Mr. F. H. Knowles-Brown who had resigned because of ill-health. Mr. Harper paid tribute to the work of Mr. Knowles-Brown and hoped that they they would see him at a future meeting, when they could thank him personally and make a presentation. Mr. Knowles-Brown was elected as a Vice-President of the Association. Mr. Philip Riley, a Rayner prizeman, who had also gained the highest award in the retail jewellers' examinations of the National Association of Goldsmiths, was elected Vice-Chairman and Mr. F. E. Lawson Clarke was re-elected as Treasurer.

Messrs. D. J. Ewing, W. Stern and R. Webster were re-elected to serve on the Council.

Messrs. Watson Collin & Co., chartered accountants, signified their willingness to continue as auditors to the Association.

MEMBERS' MEETINGS

A meeting of members was held at Goldsmiths' Hall, London, E.C.2. on Thursday, 11th March, 1965. It was an informal occasion at which members and others were invited to display various items of gemmological interest. One stand had a display of some of the books written by members of the Association. The range was considerable. There were books by three former Presidents, *Mineralogy* by the first President, Sir Henry Miers, F.R.S., *Concerning the Nature of Things*, by Sir William Bragg, O.M., F.R.S. and *Gemstones* by Dr. G. F. Herbert Smith. The well known books on gemmology were represented, including the second edition of *Gemmologia*, by Professor Cavenago-Bignami. Somewhat away from gemmology were *Geology for the young naturalist* by Allen White, *An Introduction to Old English*

Silver by Judith Banister, B.A., F.G.A., and a thriller by Eric Bruton, F.G.A., called *The Smithfield Slayer*. Dr. E. Gübelin's book on *Precious stones*, which is the only modern book on the subject to be published in English, French and German, was there together with J. Hammes' *Goud, Zilver, Edelstenen*, Elsie Ruff's *Jade of the Maori*, Sir James Walton's *Physical Gemmology, An Introduction to crystallography* by Professor Coles Phillips and a Finnish book on gems, *Jalokiviopin Perusteet*, by H. Tillander.

There were some outstanding gemstone exhibits including a 10·15 ct. andalusite, a danburite of 18·65 cts. a 15·50 ct. phenakite, and a magnificent star-ruby of 32 cts. Fine quality aquamarines, tourmalines and peridots were also shown. There were rare crystals of rhodonite and a collection of coloured diamond crystals. A beautiful collection of water opals was also on display, together with other items to interest gemmologists.

Some pocket refractometers, as developed by Dr. G. F. Herbert Smith, were shown, including a Bertrand type by S. Henson (1893) and Smith's experimental model made by J. H. Steward. A spectroscope by Adam Hilger (1894) and an early dichroscope by Feuss (1881) were also exhibited.

Members enjoyed themselves, meeting old friends and exchanging reminiscences. The Executive Committee of the National Association of Goldsmiths were present as guests and on display was the Arms of the National Association who, in the words of the card describing the Arms, "started it all in 1908 by proposing that courses and examinations in gemmology should be arranged".

<p style="text-align:center">*   *   *   *</p>

A meeting of members was held at Goldsmiths' Hall on Monday, 12th April 1965, when Mr. Herbert Tillander, F.G.A., Helsinki, was the guest speaker.

In welcoming Fellows and members Mr. Norman Harper, Vice-Chairman, presided and gave special mention of Mr. O. Dragsted of Copenhagen and Mr. A. Bonnebakker of Amsterdam. Other jewellers of international repute who were present were Mr. W. Meister of Zurich and Mr. Y. Chaumet of Paris.

The Vice-Chairman recalled that Mr. Tillander was a Tully Medallist in 1935 and that many would remember the charming talk he gave when he presented the awards at Goldsmiths' Hall in 1961.

Mr. Harper said "Mr. Tillander has very kindly offered to talk to us tonight on his way back from a meeting of the American Gem Society in Chicago and the title he has chosen is "Six Centuries of Diamond Design". (The lecture is reproduced as a main article on p. 380.) Mr. B. W. Anderson proposed a vote of thanks to Mr. Tillander.

OBITUARY

Ansel, William H., of Polegate, Sussex, 24th April, 1965. (Diploma 1938.)
Ramsay, Alexander M., Glasgow, March, 1965.

GIFTS TO THE ASSOCIATION

From Mrs. C. Watson, Rhodesia, a selection of Rhodesian gem minerals.
From D. Bradshaw, Esq., a sample of the jade-albite known as Maw-sit-sit.

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, 5th May, 1965. The Vice-Chairman, Mr. Norman Harper, presided.

The following were elected to membership:—

FELLOWSHIP
Cooper, Alfred, Swinton, Lancs.
D.1963
Thorne, A. R., Halesowen, Warwicks.
D.1963

ORDINARY MEMBERSHIP
Armstrong, John H., Honolulu,
Hawaii
Badenoch-Jones, Harwood G.,
St. Annes-on-Sea, Lancs.
Badshah, Mohamed Yusuf,
Birmingham, Warwicks.
Callea, Carmen J., New York, U.S.A.
Cross, Samuel S., Beckenham, Kent.
Dwumfuo, Peter K., Hanau,
W. Germany
Gaganakis, George J., Nairobi, Kenya
Hann, Alan H., Kuala Lumpur,
Malaya
Hanna, Major Joe D., Jr., St. Louis,
U.S.A.
Hardy, Alan, Hyde, Cheshire
Heys, Leonard, Poulton-Le-Fylde,
Lancs.
Igarashi, Kyoko (Miss), Tokyo, Japan
Jamieson, Sara B. (Miss), Coleraine,
N. Ireland

Kotedia, Rameshchandra, S.,
London, W.11.
Lee, Joseph I., Jr., Raleigh, U.S.A.
Lodhia, Jamnadas R., Crater, Aden
Murray, William R., York
Spink, Brian S. F., Birmingham,
Warwicks.
Tester, Robert E., Gibraltar
Vleck, Jan G., S. Pedro do Estoril,
Portugal
Yau, Mo Yin, Kobe, Japan

PROBATIONARY MEMBERSHIP
Brooks, Pauline M. (Miss), London,
N.W.7.
Clarke, John E., London, W.8.
Husselman, Lucas J., Haarlem,
Holland
Munt, Bisley J., Haverfordwest,
Wales
Reece, Gail U. (Miss), Causeway,
Rhodesia
Staub, Hugh, Salisbury, Rhodesia
Weerakoon, Ranjith L.,
Poruwedanda, Ceylon
McDowell, Peter W., Malahide,
Ireland

The Council agreed to submit the name of the retiring chairman, Mr. F. H. Knowles-Brown, for election as a Vice-President at the 35th annual general meeting. It was also decided to invite Mr. Maurice Asprey to serve as a co-opted member of the Council.

Arrangements were made for the 1965 Herbert Smith Memorial Lecture to be given at Goldsmiths' Hall (by kind permission of the Wardens) on 9th November at 7 p.m. The lecture would be given by Mr. Robert Webster.

DANISH GEMMOLOGICAL ASSOCIATION

In May, the Danish Gemmological Association invited Mr. Robert Webster, F.G.A. to Copenhagen to talk on the subject of opaque and semi-opaque stones and their identification. Black, blue and green stones were mainly considered and this brought in the difficult questions of jades and the jade-like materials, and of turquoise. Mr. Webster spoke of the difficulty of identifying those ornamental materials which consist of a mixture of minerals and are really decorative rocks. The talk was illustrated by demonstrations of chemical reactions, flame and streak tests, and by the electro-conductivity shown by some materials. Over one hundred ornamental stones were displayed to the audience. During the dinner which preceeded the talk, Mr. Webster was presented with a silver paper knife set with a piece of Danish amber containing two flies.

In May also Mr. Webster was elected a member of the British Academy of Forensic Sciences.

MIDLANDS BRANCH

By courtesy of Messrs. Steele and Dolphin, Ltd., members of the Midlands Branch of the Association were able to visit the new factory of Steele and Dolphin on 4th March 1965. Members were able to meet designers and craftsmen at work during the stages of ring manufacture, and to see the modern tools and machinery used. At the conclusion of the visit the firm kindly provided refreshments.

The annual meeting of the Branch was held on 9th April, 1965, at the Imperial Hotel, Birmingham. The following officers were elected: Chairman, Mr. Norman Harper; Deputy Chairman, Mr. J. R. Shaw; Vice-Chairman, Mr. D. N. King; Secretary, Mrs. S. E. Hiscox. Mr. Harper was elected Chairman of the Branch at the annual meeting held on 5th May, 1965.

TALKS BY MEMBERS

CAIRNCROSS, A. D., "Gemstones"; Dundee and Angus Watchmaker's and Jeweller's Association, 20th February, 1965; Forgandenny W.R.I., 17th February, 1965; Kirkfother Feus W.R.I., 18th March, 1965; Glenshee and Glenericht W.G., 19th March, 1965; Almondbank R.S.N.D. Wives' Club, 7th April, 1965; Letham Youth Fellowship, 4th April, 1965; Leven Business and Professional Women, 24th April, 1965; Scottish Milk Marketing Board Conference, 5th May, 1965.

BLYTHE, G. A., "Gemstones"; Leigh Round Table, 13th May, 1965.

COOP, NORAH (Miss). "Gemstones", Society of Walton Women, 10th December, 1964, Kew Bond (Methodist) Wives' Fellowship, Richmond, 9th March, 1965.

PARRY, GWEN (Mrs.). "Precious stones", Heath Branch of Red Cross, 8th March; Royal College of Nursing (Cardiff Branch), 10th March, 1965.

SAMPSON, E. (Mrs.). "Gemstones and jewellery", Chalfont St. Peter Women's Institute, 20th January; South Bucks. Young Conservatives, 25th January; Hornchurch Women's Institute; 6th April; American Women's Club, London, S.W.3, 21st April, 1965.

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