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and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN
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GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

(Originally founded in 1908 *as the Education Committee of the National Association of Goldsmiths, reconstituted in* 1931 *as the Gemmological Association)*

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TRAPICHE EMERALD

By M. J. O'DONOGHUE M.A., F.G.A.

ALTHOUGH this type of emerald has been known since 1963 it has so far not been published in a British gemmological journal. The present article, therefore, attempts to summarize the research already carried out and to illustrate it with some specimens from the author's collection.

Trapiche emeralds (the word in Spanish means cane-crushing gear) have been found so far only in Colombia. The majority of the specimens described are up to 1″ long and ½″ in diameter. Most contain a central core of green emerald from which sprout six arms of the same material, in hexagonal form. The interstices of the arms are filled with a whitish-grey material. Other examples have no central core at one end and yet display it at the other. In some pieces the material of the interstices is very thin so that the stone as a whole resembles a normal hexagonal emerald crystal with white or black inclusions following the hexagonal axes. Most of the existing research has been carried out with a view to ascertaining the nature of the white material and to establish the mode of growth.

Nassau and Jackson[1] found that two stages of emerald growth are found in stones from the Peña Blanca Mine, near Muzo. The stones are found in pockets in the Cretaceous shales and clays of the area. The first stage was the growth of the central prism which is hexagonal and slightly tapered while the second stage was the simultaneous growth of beryl and albite with the beryl growing parallel to the original prism faces and the albite at the corners. Striations parallel and perpendicular to the faces of the prisms seem to indicate that the lateral faces grew with a plane interface which moved out parallel to the original faces of the prism. The authors postulate on this basis that the two-phase growth at the corners was simultaneous with the growth of the central area, since if the reverse were true the growth markings would have been out from the corners rather than parallel to the original prism faces. Growth occurred from a hydrothermal solution containing albite.

The growth of the two-phase material at the corners rather than at the faces of the prism was thought to have been due to the rapid lateral growth of new layers on the side faces of the prisms, suppressing the growth there of the second phase, whereas at the corners the difficulty of starting new layers allowed the continuing presence of the second phase.

By powder X-ray diffraction the material in the central core and the side arms has been shown to be beryl. The white material as shown in Fig. 1 no. 1 is a mixture of beryl and albite. A Laue diffraction pattern showed that the central core and the six arms had the same orientation with the c axis along the hexagonal symmetry axes of the crystal.

It was also found that the white material gave a single crystal pattern in the same orientation as the rest of the crystal, which forced the conclusion that the trapiche emerald is in fact a single crystal with varying amounts of albite as inclusion. The infra-red spectrum of water was found in both the central core and the side arms, the latter containing about 10% more.

The same results from X-ray diffraction were obtained from some specimens from the Muzo mine where the central prism was black (the shale at Muzo has a high carbon content) and the outer sections of clear emerald separated by sheets of dark material. Laue patterns again showed that these stones are single crystals. It is suggested by Nassau and Jackson that the change in composition and colour results from an abrupt reduction in the growth rate which was rapid in the central core, trapping carbonaceous material, and much slower in the arms which are clear emerald, with the impurities diffusing away from the flat faces and being trapped only at the corners. It was also thought possible that the composition of growth medium suddenly changed to one with a much lower carbon content.

Top left: Institute of Geological Sciences (MI 33267).

Top right and centre: Author's collection.

Bottom left (B.M. 1967, 40) and *bottom right* (B.M. 1967, 402), British Museum (Natural History).

Institute of Geological Sciences photograph reproduced by permission of the Director.

Some optical values are shown in the table given by the same authors in another publication:

	nω	DR
Peña Blanca trapiche	1·575–580	0·006–0·007
Muzo trapiche	1·572	0·008
Chivor ordinary	1·577	0·006
Muzo ordinary	1·584	0·006

Schiffmann[2] has described the process of cutting trapiche emerald. In order to get rid of the non-emerald material, the stones are sawn across at 120° in the plane of the axes of the star. The black or white material then falls away, leaving the emerald which may then be cut. Another method of cutting is described by Tripp and Hernandez[3]. Using a thin slitting diamond blade two cuts are made in the stone perpendicular to the centre crystal on each side of the outer pieces. By exerting pressure with a thin knife blade in the cuts the piece of emerald will come away cleanly. The authors also found that the centre crystal was nearly always cracked or broken, although it was more transparent than the outer pieces which however are the better colour. A stone measuring 2″ × 4½″ and weighing about 167 ct has been seen and a stone 20mm in diameter with no apparent centre crystal was cut to produce six fine quality stones each averaging 3 ct.

Schiffmann described some cut emeralds which had a clouded appearance and which were transparent to translucent due to the structure rather than to inclusions. As the constants were similar to other emeralds from the area and as inclusions of albite and carbonaceous matter were found, Nassau and Jackson suggested that they were probably trapiche emeralds and perhaps cut from a crystal 3″ long seen by G. R. Crowningshield, as most other trapiches known were much too small to yield cut stones of the size examined by Schiffmann, which averaged 1 ct and 8mm.

The writer is indebted to Mr. E. A. Jobbins of the Geological Museum for photographing the emeralds and for assistance with source material.

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ANTARCTIC PERIDOT

By A. M. TAYLOR

WHAT appears to be the first discovery of gem material from the Antarctic continent has been made by Professor A. T. Wilson, now of Waikato University, Hamilton, New Zealand. Samples of peridot were recovered during a recent Victoria University of Wellington expedition to the ice-free areas of Ross Island in McMurdo Sound. Two separate deposits were found on opposite sides of the island, near Cape Bird and Cape Crozier. In both areas the material occurred as angular nodules on the surface of loose volcanic debris. In size the pieces ranged from 0·5 to 4 grams. Large phenocrysts of granular olivine 3 to 5 cm across are of fairly common occurrence in a dense black basaltic rock in the general area but no gem quality crystals were found in the solid rock. The deposits are rather similar to other known peridot localities such as at Buell Park, Arizona.

Examination of the material from the two localities revealed that they had practically identical physical properties, which are in the normal range for peridot, viz., specific gravity 3·34–3·35; refractive index $\alpha = 1{\cdot}653$, $\gamma = 1{\cdot}689$, D.R. 0·036. The colour of the cut stones is a pleasant yellow-green without appreciable olive tint. The material so far recovered has yielded slightly flawed but acceptable cut stones up to 2 carats weight and flawless stones of 0·5 carat are possible. The principal flaws consist of veils of two-phase inclusions and minute brown mica plates arranged in parallel orientation.

The discovery is not considered to be of any economic or scientific importance but purely of gemmological interest. The localities are not readily accessible from the McMurdo Sound bases except by helicopter during the summer months. Supply of material at present is limited to that picked up by personnel on official scientific expeditions. Considering the extensive volcanic nature of the terrain we may hope that future geological expeditions will encounter new and better deposits now that an awareness to gemstones prevails.

PENHALONGA AND NOITGEDACHT

By SANDRA YEO

IN the Spring of 1968, my parents uprooted themselves for the second time in their lives and took themselves off to Rhodesia. This time I did not follow, but current involvements very easily led to an interest in their particular roosting place.

R. W. Yeo (Associated Companies) Ltd., in conjunction with a Charitable Trust, run a Technical Centre at Exeter, for the purpose of training jewellers in all aspects of the trade, which, with a magnificent gem museum and adjoining laboratory, is open for study to any interested outside persons. A trip to Africa could well produce some interesting film and material for this Centre, and so in January 1970 Mr. R. W. Yeo and myself set off for a nine week tour around Rhodesia and South Africa.

Arrangements had been made in advance with the Gem and Mineral Society of Rhodesia, and De Beers in South Africa, but the first three weeks were to be spent with my parents in Penhalonga, where we made an unexpected and quite delightful discovery.

The Penhalonga valley is in the Eastern highlands, above Umtali, which is the third largest town in Rhodesia, and about five miles from the Moçambique border. Rhodes himself first entered the country at a spot just above Penhalonga, which goes by the quaint but obvious name of "Divide". The mountain pass over the border is not accessible except on foot, and thus gives exclusive use to the rural Africans whose private interests are dissected by the arbitrary line of the border. The movement to and fro is very casual, and I am not even sure if it is all official. Penhalonga is a delightful spot with an equable climate, caused by the fact that although the whole of Rhodesia is well within the tropics, it lies between 2,000 feet and 6,000 feet above sea level, and Penhalonga itself at around 4,000 feet. However, its scenic beauty was not the attraction to Rhodes, but its gold. The Rezende mine was the first in the country and along with others in the valley enjoyed a boom time, until eventually lodes proved unprofitable and the town was left to decay. The shaft-head buildings still stand on the Rezende site. All around are the waste hills, but somehow—perhaps it is the sunshine and/or the multi-coloration—gold waste-heaps look less depressing than piles of slag under a drizzly Derbyshire sky.

Recently, with the aid of modern scientific equipment, prospecting has again begun in earnest in the area, but so far no significant finds have been made. However, mining interests seem confident of the possibilities, and some of the miners' houses are now being bought up by Europeans and renovated, obviously in the hope of a resuscitation of prosperity. The Mutari Exploration Co. has flooded one shaft that they had re-opened, but they are continuing diamond-drilling around the hills, and look for a successful strike in the near future.

It was with a view to having a look at some old workings, that we set off one day down a dirt road in the north of the valley, off the main road. At the side of the track, not far along, we came upon a small crudely made board, declaring in hastily written red letters, "Ponderosa Syndicate, Private", with an arrow pointing along the way in which we were going. We passed more arrows and eventually arrived at half a fence with a larger notice, this time giving timely warning to trespassers. Nothing daunted, we decided to investigate, and threaded our way down a track through the Brobdignagian grasses. Quite suddenly, the growth gave way to a clearing, and a sight that seemed straight out of a story book. On our right was an untidy vegetable patch in front of an odd-shaped building made entirely of off-cuts of logs; in front, the path spread itself around a beaten-up Ford Popular, and the entrails of various other cars, and several other buildings, made of the same material as the first, which looked as though they might be living accommodation. A lean, grizzled old man, wearing boots, baggy khaki trousers held up with braces, bush shirt and broad brimmed hat, ambled out to meet us, and, far from being annoyed at us for trespassing, he seemed delighted to have some company. He introduced himself as Fred Green, one half of Messrs. Perhat & Green of the Ponderosa Syndicate.

Paul Perhat is a railwayman five days a week, and a miner at weekends. His father died a poor man after years of prospecting success and failure, and he suffers from the same disease as he calls it; it could more accurately be called an obsession. Fred Green is retired, and spends all his time on the site, supervising the African labour and generally keeping house: one of the buildings was confirmed as a two-storey log cabin, with living quarters downstairs and Perhat's bedroom upstairs. Modern amenities such as a cooker and fridge are in evidence, though both are of suitable age to fit in with the general backwoods atmosphere. Green has his sleeping quarters in another building. Apart from visitors, they are alone; Perhat does have a family—somewhere.

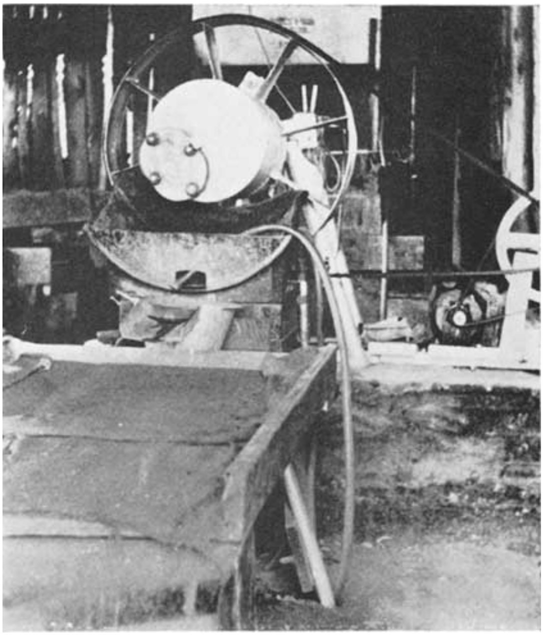
All the machinery and buildings are of home construction, which explained the presence of the old cars outside. The claim stands on 150 acres of land, and here we saw prospecting at its most raw and fascinating.

Fresh water comes from the municipal supply, but the water for use in the machinery is pumped from a river 1,000 feet away. Perhat has erected a small dam and built a water wheel to run the pump which sends the water, with the ground rising 70 feet in the 1,000 feet, to a reservoir beside the house.

The main workings at present are open-cast, though they do have one shaft sunk, but up till now it has proved too expensive to work. I did climb down to have a look, and climb is the operative word. The sides of the entrance shaft are re-inforced with wooden slats, and foot-rests have been added to these, so that you climb down hand over hand. By the light of Perhat's helmet lamp, I was able to follow the seam of gold bearing rock as it wound through the short narrow galleries, which apparently do not need any re-inforcement, and which for the time being have been left to the bats and the frogs, of which there are many.

Above ground, four Africans do the digging, and the soil and rock is carted by hand to the Crusher, where it is smashed before going into the Mill. The Mill pounds it all to a powder, and the resulting amalgam washes slowly down to the James table. Some of this is collected in a bucket and is used to analyse the gold content of the rock they are treating. Perhat takes a sample in a coffee tin, and one of his men carefully pans this sample until only the heavier substances including the gold, are left. This is then worked around the edge of the pan, and the gold forms into a "tail" behind the other material. According to the length of this "tail", the amount of gold yield per ton of soil can be estimated; if an inch, then the yield will be 1 ounce per ton.

The James Table is a long low oblong table, with slats running diagonally across it. It is mechanically shaken at a steady pace, with the result that the heavier substances are pushed to the back, and eventually wash into a channel at the bottom of the table, while the waste washes off the side.



Amalgam drum.

The gold-bearing material is now put into an amalgam drum, which is a rotating cylinder with rods inside, that further pound the materials. It rotates at about 35 revolutions per minute, and this goes on for eight hours, after which time a small quantity of nitric acid and three pounds of mercury are added and the drum is rotated for a further four hours. The gold adheres to the mercury, and after the requisite time the drum is opened and the process of finally washing off the last waste begins. Perhat is allergic to mercury, and this is therefore the job of his senior boy, who could be 16 or 60 and has been with Perhat long enough to have learnt everything from cooking to stripping down intricate machinery. The washing is carried out in a series of bowls (would you believe pudding basins?) with the aid of a hose, so that the lighter stuff washes down a sloping table into a collecting well, and the semi-liquid mercury and gold gob is left behind. This is kept in water to avoid evaporation of the mercury. The waste, expecially in the case of poor-yielding rock, will go through the amalgam drum again. Finally the mercury is distilled off the gold and kept for use again.

At the time we were there, and for some time prior, the yield was under 5 pennyweights per ton, which indicates a lot of hard work for little return. However, as Perhat says, it is a disease. He and Green and their Africans have little material needs; he is his own boss, and there is always the possibility of making a fortune. In the red of the evening, with a sundowner slipping coolly down the throat, and all around the mysterious, incessant African hum, it is easy to see the attractions of such a life, and it is refreshing to know that romance still exists in this high-speed world of ours.

Unlike Penhalonga, almost everyone has heard of Kimberley. Kimberley of the Big Hole belongs to the World, but there is more to the place than what is shown in the tourist blurbs.

De Beers had again laid excellent plans for us. We were to be taken down a mine, on to the treatment plant and of course to the Big Hole and adjoining museum, but the P.R. people were not sure if we would want to go out to the "diggings". In fact one female guide tried to put us off, which quite naturally decided us to go.

We took off in the car in a south-west direction out of town, and along a road which looked as if it went for a 1,000 miles. In the far distance there was a faint blue line of higher broken ground, but alongside the road was just flat dry scrub, with occasionally a building of sorts, indicating some human purpose to which the inhospitable earth had been put. At some point along this road, we turned off right into the scrub, and threaded and bounced our way along in what seemed to be a series of semi-circles. I have said the scrub was flat, and so it appears until you get amongst it, when it becomes a mass of fuzzy-growthed hillocks, which, though very small, always manage to have their summits just above eye-level.

Suddenly we lurched round a sandy mound and came upon a flat area which actually had two full-grown trees to give some welcome shade. There were also several corrugated iron buildings, one of them being quite obviously a supply store. Thus was our abrupt arrival at the Noitgedacht alluvial diggings. The store is run by an old coloured fellow and his African wife, and has small living quarters at the back. The storekeeper looked an eminently cheerful man, riding out to his own claim on his donkey and cart, and it was touching to see, amidst what can only be described as squalor, his tiny parlour-walls festooned with several formal Victorian style family portraits.

De Beers started this digging project in 1949, mainly to satisfy the individual prospectors, whose fathers and sometimes grandfathers had scratched a living from the ground around Kimberley, and who now found their rights eroded by the expanding uniquitous Anglo-American Corporation. Each claim is 45 feet by 45 feet, and no one person is allowed to have more than four claims running at the same time. Fifty cents is paid per claim and the leases are renewed each month. De Beers are the main buyers of the diamonds found, and they also take a small percentage on the sales. Every Friday the diggers come to the site office and register their finds and obtain a permit to sell. The office is run by a retired electrical engineer from the mines, and the building had once been intended for habitation. All that remains now is a very dirty-looking bathroom and an antediluvian kitchen.

Whilst we were in the office talking to the Manager, Mr. Humphreys, an old Afrikaaner ambled in with two stones he wanted weighed. He spoke little English, but Humphreys spoke Afrikaans, and so conversation was possible. The two stones together weighed 1·30 carats and were of poor quality. However the Afrikaaner intimated, and Humphreys confirmed, that he could expect about £10 a carat. This astounded us, and we were unable to obtain a satisfactory explanation for this apparent high price at ground level. However, it is pretty safe to surmise that these prices are to discourage any illegal sales. From the records, we noted that in the month of January 43 stones weighing 35 carats were registered, realizing R.1,178.

Humphreys took us out to visit one claim, which had been selected because the owner could speak English, apparently a rarity among the diggers. This is one place where race classification is of no consequence, and a Bantu will work a claim alongside a European. Our site was run by a coloured named Toburn, and his four African labourers. Toburn is a little wiry fellow of indeterminate age with the unruffled air of a man of infinite patience, which he needs must be in his sort of occupation.

The ground, which has already been excavated in the past, is hacked and shovelled by the labourers, and then smashed by hand under a huge sledge hammer. The treatment plant consists of a rotary pan, similar in principle to the sophisticated series of density tanks used at De Beers, and a series of sieves. The pan has a diametrical arm which is rotated by hand through the contents at a slow steady pace. The excavated material is poured into this pan, which already contains the thick muddy water known as "puddle". The viscosity of this puddle is of paramount importance, and is something Toburn appears to have learnt by sheer experience.

Toburn's Gravity Tank.

The theory is that at a certain viscosity the puddle will support all but the heavier materials (including diamond) which sink to the bottom. When Toburn considers enough time has elapsed, he opens a small door in the side of the pan and allows some of the contents to fall into a bucket. The largest of the sieves is then pushed to the bottom of the bucket, gravitated, and brought to the top again. The contents are then upturned onto a table, and the diamonds, if there are any, being the heaviest material will appear on the top. This process is repeated right down through to the smallest sieve. Toburn works over the stones with a tiny spatula, and at an amazing speed, but it seems he doesn't miss anything. Amongst the smallest grit were some dark brown cubes, of varying sizes, but all of perfect shape. Toburn had no idea what they were, and just termed them "blockies". We took them to a geologist later at De Beers head office, and much to his chagrin, he could not identify them, though the discussion did conclude that they might be some form of pseudomorph. So in fact they proved to be: pseudomorphs of limonite in pyrite.

We did not bring Toburn any luck during the time we were with him, and, like the photographs on the storekeeper's wall, he is an anachronism that will soon be smothered under the march of progress. The Government is not issuing any more licences to individual diggers, and originally this Noitgedacht project had not been intended for a long duration. However, the men kept turning up enough stones to make it worthwhile, though by now this particular area must be pretty nearly worked out. In 1951, a man named Venter found the largest stone recorded here, a perfect octohedron weighing 511 carats, and, of the 483 diggers who have had claims since the scheme started, 391 have made finds. In 1966, Toburn found a stone of 21·75 carats, for which he received £200 a carat, so as he says with a grin, "I have to go on". There are now only 26 diggers left, but each one will no doubt go on searching for that elusive fortune until they finally become part of the ground they are now so busy excavating.

HEAT-TREATMENT OF PALE BLUE SAPPHIRE FROM MALAWI

By E. A. JOBBINS

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A SERIES of pale greenish-blue circular, step-cut, sapphires (ranging from 0·44 to 0·69 carats in weight) from Chimwadzulu Hill, Malawi, was submitted for examination to the Institute of Geological Sciences by Messrs. Gunson (Exports) Ltd.

The heat treatment of gem material is widely practised, but detailed information on the temperature and duration of heating is not commonly released. Since suitable stones were available, and the owners were agreeable, it was decided to carry out a series of carefully controlled heating experiments in air. In order to evaluate possible colour changes, the stones were divided into eight closely matched colour groups of three stones each; one stone of each group being retained as a standard and the other two heated, the first for one hour at the set temperature and the second for five hours. Stepwise heating was carried out over the range of 500°–1200°C at 100° intervals the stone being placed in an unglazed porcelain boat in an electric muffle furnace. The time to reach the set temperature varied from about 40 minutes to reach 500°C to about 2 hours to 1200°C. The stones were allowed to cool overnight in the furnace after heating, and removed about 09.15 hours next morning when the next run started, then usually from about 100°C rather than room temperature.

General visual examination of the whole series showed that heating over the 500° to 700°C range or for one hour at 800°C had no obvious effect on the stones. Heating for five hours at 800°C caused the general blue colour to become paler. In the higher heating range 900°–1200°C all residual blue colour was eliminated and the stones changed to a very pale green colour.

To evaluate the colour changes in more detail the pleochroism schemes for untreated and heated stones were examined. The scheme for the unheated stones is very distinct—from a pale ("commercial") aquamarine-blue for the ordinary ray (ω) to a very pale green for the extraordinary ray (ε). No change in the pleochroism was apparent in the stone heated for one hour at 800°C (or in stones heated at lower temperatures) but heating at 800°C for five hours caused the colour of the ordinary ray to become paler blue, although there was no discernible change in the colour of the extraordinary ray. Heating to 900°C and above virtually eliminates the blue in the ordinary ray which then appears as a very pale slightly greyish-green, and only a very slight colour change is discernible between the ordinary ray and extraordinary ray (which appears as a very pale, slightly yellowish green). There appears to be little, if any, change in colour of the extraordinary ray between heated and unheated material.

The absorption spectrum of unheated stones exhibits a well-defined narrow band at 4500Å in the blue and a faint but perceptible line at 4600Å with some general absorption between these two bands; a very faint line at 4710Å was also distinguished; the spectrum was seen more clearly in the direction of the darker colour (ordinary ray). It was not possible to detect any change in this spectrum in the heated stones.

The refractive indices of the series were constant at 1·761 (ε) and 1·769 (ω) and no change was recorded on heating. There was no change in weight as a result of the heating.

The heating of pale greenish-blue sapphires from Malawi does not increase the blue colour, which is in contrast to the heat-treatment of aquamarine where the blue colour is often enhanced.

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GEM AND DECORATIVE MINERALS AT HASLEMERE MUSEUM

By EDGAR J. BURBAGE

WHAT does one expect of a Museum? Ideally, that it shall display exhibits of interest and beauty, and also that it shall advance the study of a subject by assembling appropriate material to this end. Few museums other than the national collections at South Kensington and elsewhere manage to attain both objectives, and in far too many provincial museums the dusty exhibits are hopelessly random in character, and are completely useless for study purposes. It is, therefore, a welcome exception to find at Haslemere in Surrey, a museum which, although having much to interest the casual visitor, is also geared to the needs of the more serious enquirer.

The Haslemere Educational Museum is also exceptional in being a self-supporting unendowed private venture. It is arguable that the "Educational" qualification in its title might well be jettisoned, carrying as it does undertones of earnest endeavour alien to many potential visitors, but it results from the circumstances of the foundation of the Museum. An eminent Victorian surgeon, Sir Jonathan Hutchinson, a Quaker and an enthusiast for education, started a small museum in his home at Inval, outside Haslemere, in 1888, and used his collections to illustrate talks which he gave to local people. The growth of the collections and increasing public interest resulted in the re-siting of the Museum at a more convenient position in the town, and, later, in 1926, its removal to its present central position in the High Street. Essentially, the ideals of the founder have been retained but some degree of specialization has developed over the intervening years, and today the Museum is concerned primarily with the study of natural history and biology, the excellent collections of local interest, "Folk" craftsmanship, "bygones", and so forth, being to some extent peripheral to this main theme. To this end, the Museum is splendidly equipped, with its well-arranged gallery exhibits, lecture hall, and recently-opened Arthur Jewell Laboratory, and extensive grounds. These facilities are used by colleges, schools, and societies up and down the country, including the University of London and its constituent colleges, the Mycological Society, The Quekett Club, teachers' training colleges, and societies interested in entomology, bryology, zoology, botany, ecology, bee-keeping, and so forth.

In the field of geology, the founder had very definite ideas, and his schematic arrangement of the appropriate gallery into divisions corresponding to epochs, with characteristic fossils and relevant illustrations is still maintained. The Museum had for many years as its geological mentor the famous geologist Sir Archibald Geikie, who was a member of the Governing Body during and after the First World War, and whose work is still apparent in the collections. (Some of his notebooks, sketches, and field-work impedimenta are displayed there).

The geology gallery includes good exhibits of minerals, both economic and ornamental. Of special interest to gemmologists will be the handsome mineral groups presented by Dr. F. Percival, including quartz and amethyst. Dr. Percival was responsible in 1951 for the assemblage of a special exhibition of gem and ornamental minerals, which aroused much interest, and in subsequent years it has been possible to arrange a small, but representative, collection of gemstones. Although the display is not large, it fulfils its function in providing an "eye-catcher" for the casual visitor, and a focus of interest for the serious enquirer.

Having regard to the fact that quartz is the one mineral abundantly present in Surrey in the form of sand in the Lower Greensand deposits, and as chalcedony in the Hythe Beds rocks and elsewhere, it was considered worthwhile to devote a showcase to it, variously illustrating its applications in (for instance) glass-making at Redhill, the production of figurines, faceted gemstones, crystal spheres for decoration and clairvoyance, oscillators for electronics, and so on. In another showcase, a revolving table permits the varying reactions of a set of radioactive minerals to be assessed by a geiger counter, and there is also a section devoted to the display of fluorescence of minerals in ultra-violet light.

Occasional special exhibitions of gemmological interest have been arranged from time to time, as for instance in 1956, when on the theme of colour in gemstones a display of gemstones illustrating dichroism, colour-temperature changes, schiller, heat-treatment, etc. was assembled, augmented by a case of irradiated gemstones, together with their untreated counterparts. The latter was shown by courtesy of the Atomic Energy Authority at Harwell, through the good offices of Mr. Thorold Jones, well-known to many past gemmology students at Chelsea Polytechnic and a good friend to the Museum in many ways. On a later occasion, Harwell contributed a further display based on an extra-mural enquiry into the curious "thunderbolt" concretions of sulphide of iron occurring in the chalk, which in years past one would describe as "marcasite" before later research had undermined such confident dogmatism.

In addition to the public displays, there are considerable reserve collections of minerals and rock-sections available for study in the Arthur Jewell Laboratory, and there is a small but useful selection of books on gemstones and minerals in the Library. In an unostentatious fashion, the Haslemere Museum is doing an excellent job in introducing gemstones and minerals to the layman.

INCLUSIONS IN NATURAL TOPAZ CRYSTALS

By M. S. JOSHI and R. K. TAKU

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Abstract

Inclusions, like channels, isolated oriented square shaped, tree-like, etc., in natural topaz crystals are illustrated and described. It is shown that some of them are trapped at dislocation sites. Correlation of etch-pits on (001) cleavages of topaz crystals with some of the inclusions underneath is analysed. Observations on matched cleavages and on two opposite surfaces of thin flakes are briefly described.

Introduction

Solid, liquid or gaseous material is almost always found included in both natural and synthetic crystals. Study of such inclusions often becomes a tool to derive valuable information of the material (substance) from which crystals grow. Such inclusions vary in size and are normally found in a haphazard manner in the crystal. However, crystallographically strictly oriented inclusions are not uncommon. In some rare cases their walls are parallel to a growing face. A variety of parameters, like variation in the supersaturation of mother-liquor, composition of solution, minor fluctuations in temperature, size of the crystal, etc., govern the formation of inclusions in crystals grown from solutions. Consequently different types of inclusions observed in different crystals may be listed as follows:

1. Relatively large layers of solution whose lateral size substantially exceeds the thickness.
2. Thin, continuous channels or chains of separate inclusions.
3. Distinct small isolated inclusions.

Buckley (1952), Amelinckx (1958), Chernov and Budurov (1964), Joshi and Vagh (1965), Brooks *et al.* (1968), Belyustin and Fridman (1968), and Gross (1970) have observed inclusions in different crystals.

According to Gross (loc. cit.) liquid inclusions in RDX crystals involve the trapping of solvent either interstitially followed by its migration to dislocations or even directly along dislocation lines.

Natural topaz crystals often contain many microscopic liquid inclusions and this report deals with the study made on them.

Experimental

Fairly good transparent crystals of natural topaz were parted along (001) cleavage planes by giving a gentle blow to the flat head of the chisel with a small hammer, the sharp edge of the chisel being held in a curve almost parallel to the basal plane. By a similar operation thin flakes of topaz crystals were also obtained. Such cleaved surfaces and such thin flakes were then etched in KOH at 440°C for 10 seconds. The cleaved crystal to be etched was held by a nickel hook and with the help of a fork, the hook with the crystal was dropped into the etchant in a nickel crucible placed in the furnace maintained at a constant desired temperature. At the end of etching time the crystal was removed from the etchant and subsequently cleaned with concentrated nitric acid, hydrogen peroxide and distilled water. They were then examined under an optical microscope.

In order to remove the etch-figures produced on a cleaved surface, the etched crystal was dipped for 15 seconds into sodium peroxide melt in a crucible in a furnace maintained at a constant temperature of 510°C.

Observations and Discussion

A variety of inclusions were observed in natural topaz crystals in the present investigation. Such inclusions were observed through unsilvered basal cleavages by slightly racking down the objective of the microscope focused on the cleaved surface under examination. In most of the natural topaz crystals thin as well as thick channels of liquid inclusions were commonly observed. One such case is illustrated in a photomicrograph in Fig. 1. Fluctuations in the conditions of growth may lead to the aggregation of thin channels of liquid inclusions forming thereby bigger channels of imprisoned mother liquor. Some of the cleaved match-surfaces revealed slightly below them presence of small liquid inclusions aligned along curved lines which have exact matching on the two surfaces as illustrated in Figs. 2a and 2b. On etching these matched cleavages etch-patterns were

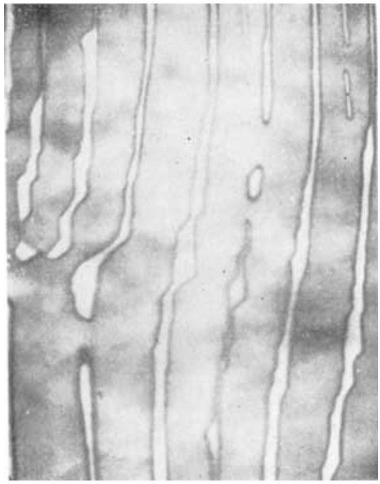
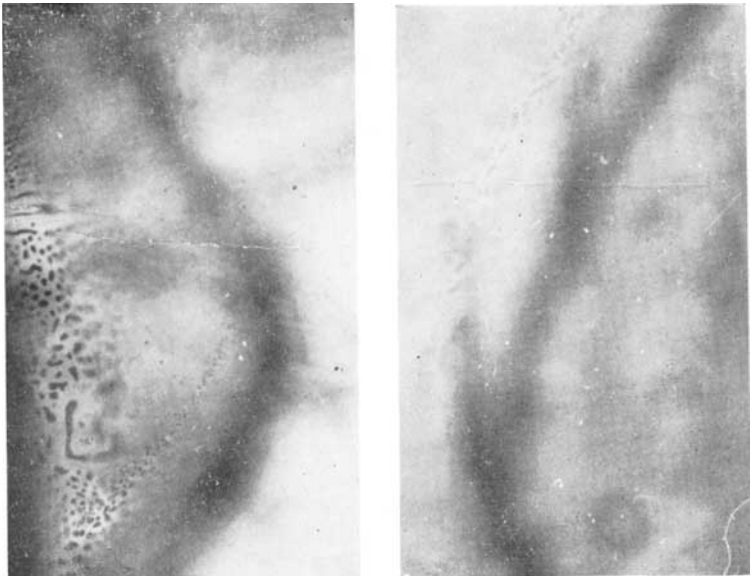
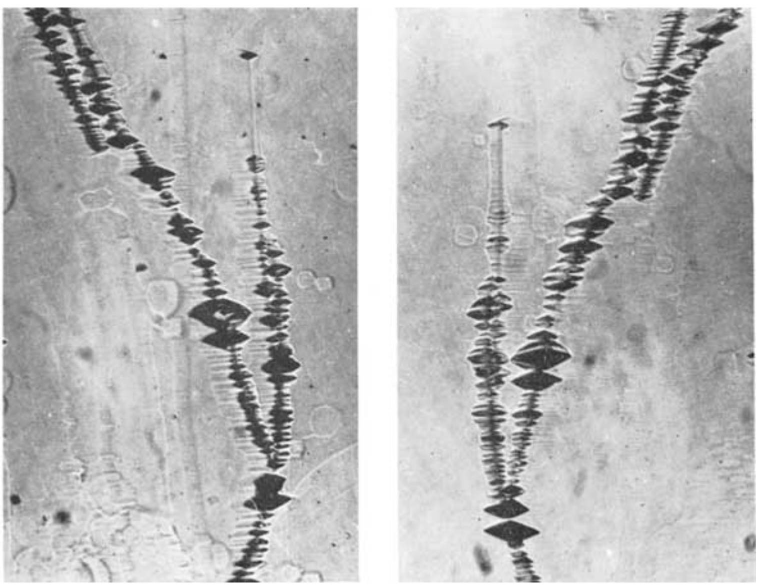


FIG. 1. Channels of liquid inclusions. 350 ×.

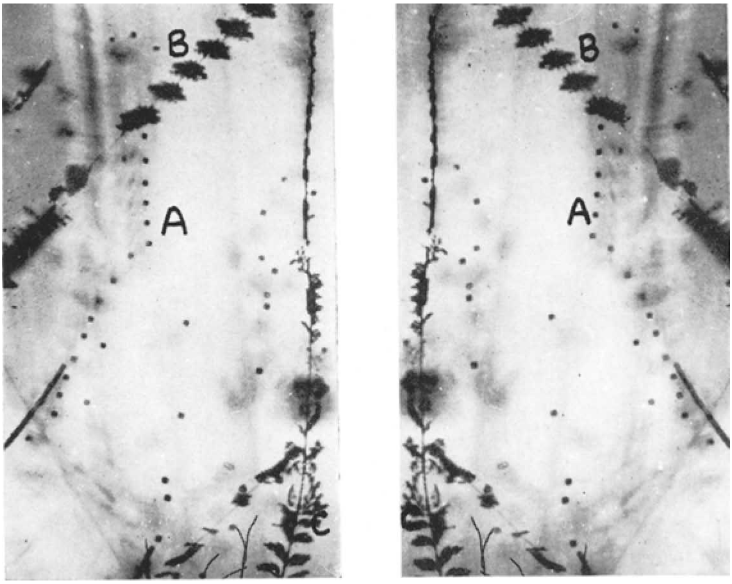
obtained having perfect matching on the two cleaved match surfaces as is shown in Figs. 3a and 3b. These pits were observed on the matched surfaces themselves. On racking down the objective of the microscope below the surfaces the same inclusions as shown in Figs. 2a and 2b are observed. On further etching these pits on the matched surfaces grew bigger in size, as was to be expected. By slightly racking the microscope objective up and down it was ascertained that the pits are on the surface and the inclusions are in the body of the crystal right below the pits. All pits are not of the same size on the surface, though the corresponding pits on the two matched halves are identical in regard to their size, shape and position. The exact correspondence of pits on the two matched halves, Figs. 3a and 3b indicates presence of dislocations along these boundaries. From the correspondence between rows of pits and the rows of inclusions as seen from Figs. 3a and 2a or Figs. 3b and 2b, we are inclined to suggest that some, if not all, inclusions occur at dislocation sites. A number of thin flakes, each about 500 microns thick, were obtained, whose both surfaces were basal cleavages. Observations on one such flake showed the presence of inclusions. These inclusions could be seen from either side of the flake. Figure 4a illustrates inclusions in one such flake when seen through one unsilvered surface of the



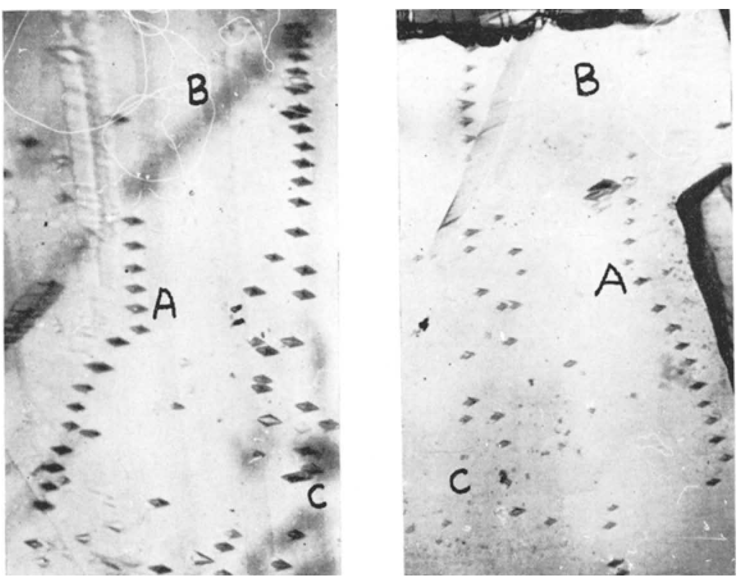
Figs. 2a and 2b. Small inclusions aligned along curved lines. 350 ×.



Figs. 3a and 3b. Etch patterns on regions of Figs. 2a and 2b. 350 ×.



Figs. 4a and 4b. Inclusions observed through opposite surfaces of a thin flake. 350 ×.

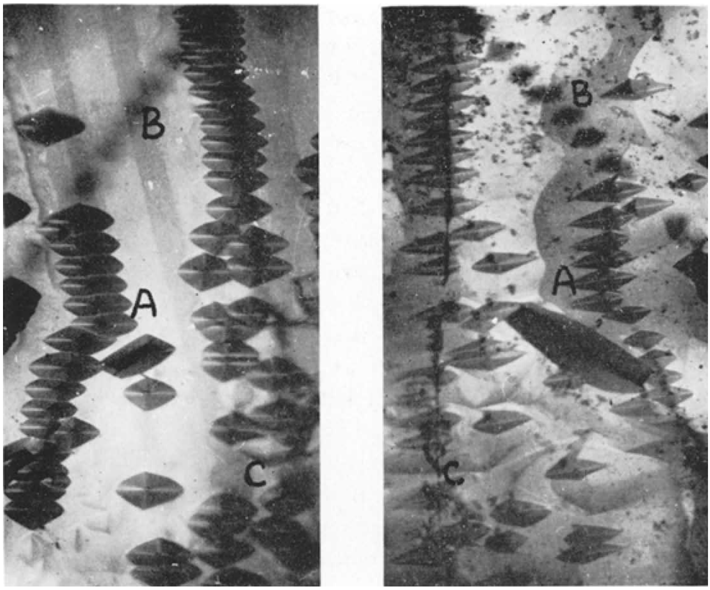


Figs. 5a and 5b. Etch patterns on the opposite surfaces of the thin flake. 350 ×.

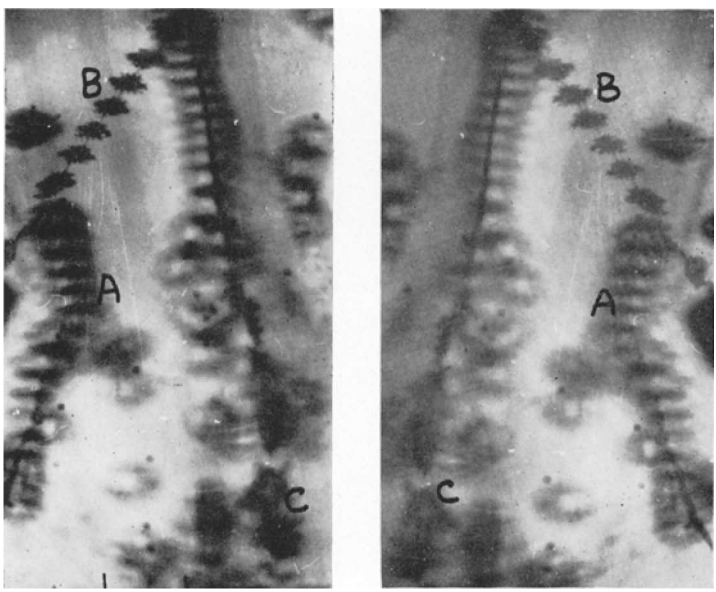
flake, while Fig. 4b shows the same inclusions when seen through the other unsilvered surface of the flake. It is interesting to note three distinct types of inclusions in this case. In the region marked A in Fig. 4a one sees tiny square inclusions, all of almost equal size. They are strictly oriented, are almost equally spaced and are aligned along a curved line. In region B in the same figure there is a row of bead-shaped inclusions. In region C in the right bottom corner of Fig. 4a inclusions having a tree-like structure are observed. All these are seen a little below the surface of the flake facing the objective of the microscope. This flake was then etched as mentioned above. The resulting etch-patterns, as observed through the two surfaces of the flake, are illustrated in Figs. 5a and 5b. Pits in regions A in Fig 5a strictly correspond to the above cited square inclusions illustrated in regions A in the Fig. 4a. It may be noted that there is exact correspondence between pits in regions A on the opposite faces of the flake as seen in Figs. 5a and 5b. Such a correspondence is indicative of formation of these pits at dislocation lines threading through the flake and cut by the opposite surfaces of the flake. Further, the correspondence between the pits in region A in Fig. 5a with the square tiny inclusions in region A of Fig. 4a is indicative of trapping of these inclusions at dislocation sites.

The flake was then chemically polished in sodium peroxide, as explained above, until all the pits on both its surfaces were completely washed off. It was then re-examined. All the three types of inclusions in the regions A, B and C of Fig. 4a and of Fig. 4b were observed through its two surfaces as before. The flake was then etched again as stated earlier, and the etch-patterns on its two opposite surfaces were examined. The pits obtained were found to be identical to those in regions A in Figs. 5a and 5b and also correspond to square tiny inclusions in region A in Figs. 4a and 4b. Such a correspondence indicates nucleation of etch-pits at dislocation sites, and the latter suggests trapping of these inclusions at dislocation sites.

The flake was again polished as mentioned earlier, and then etched for 40 seconds more. The etch-patterns thus obtained on the opposite faces of the flake are illustrated in Figs. 6a and 6b respectively. There is perfect correspondence of pits in region A of Fig. 6a with those in regions A of Fig. 5a and with square inclusions in region A of Fig. 4a. Of course, these pits are bigger



FIGS. 6a and 6b. Etch patterns on regions of Figs. 5a and 5b obtained after polishing and re-etching for 40 seconds. 350 ×.



FIGS. 7a and 7b. Same inclusions observed below regions of Figs. 6a and 6b. 350 ×.

in size and are also deeper. Correspondence is also observed in Figs. 6a and 6b, particularly in region A. It is very interesting to note square tiny dots at the centre of pits in regions A of Figs. 6a and 6b, which are the square inclusions below the etched surface. On slightly racking down the microscope objective these inclusions are clearly visible as shown in Figs. 7a and 7b. In these Figs. inclusions in regions B are very much more marked than in other figures reported here. These observations endorse our suggestion that at least the square inclusions are trapped at dislocation sites.

From the observations reported here, and the evidences given thereof, one can safely conclude that since for each pit there is a corresponding inclusion although each inclusion is not necessarily associated with a pit, at least some, if not all, inclusions are certainly trapped at or associated with dislocations.

All etch-pits reported here are not all of the same size. In a particular case the inequality in the size of pits may be attributed to the different strain energies around dislocations or alternatively to the inequality in the size of inclusions if the latter are trapped at dislocation sites.

Conclusion

From the above given observation and discussion it may be concluded as follows:

1. Liquid inclusions are very common in natural topaz crystals.
2. Different forms of such inclusions are present in topaz crystals, some of which are strictly crystallographically oriented.
3. Some inclusions are trapped at dislocation sites.
4. Etching technique is useful for proving the possibility of trapping of inclusions at dislocation sites.

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Gemmological Abstracts

ANDERSON (B. W.). *Some problems and a few solutions in the field of gem testing with the spectroscope.* Gems & Gemology, 1970/71. XIII, 8, 238-244.

A resume of the address given by the Author to the 13th Gemmological Conference. The absorption spectra of chromium coloured minerals, the spectra due to cobalt and due to rare-earths are discussed. The difference between the absorption spectra of the chrome chalcedony and green stained chalcedony is mentioned, the natural chrome material showing a single band at 6790Å while the stained chalcedony shows three blurred bands at 6340Å, 6650Å and a strong band beyond 7000Å. True chrysoprase shows an ill-defined line in the orange which is presumed to be due to nickel. Cobalt spectra betoken a stone which is not natural. The reason why cobalt produces a blue colour in these stones and a pink colour in natural stones is explained. Of the rare-earth spectra the didymium spectra are mainly described and those seen in the synthetic "garnets" and in the scheelites are mentioned—in the latter case, it being hoped that the examination of the absorption spectra would enable distinction between the natural and the synthetic material to be made. The hoped for success was not completely achieved.

7 illustrations R.W.

BANK (H.). *Transparenter weiss-farbloser Grossular aus Tansania.* Transparent white to colourless grossular from Tanzania. Zeitschr. d. deutsch. Gesellschaft, 1971, 20, 1, 22-25.

The white to colourless transparent grossular from Tanzania was first thought to be a synthetic colourless spinel, but on examination was found to be a grossular, although this particular type had not been found in that country before. Some of its characteristics are described. The author fears that it might offer yet another diamond imitation, but by its low R.I. can easily be recognised as non-diamond material.

E.S.

CROWNINGSHIELD (R.). *A rare alexandrite garnet from Tanzania.* Gems & Gemology, 1970, XIII, 6, 174-177.

The report of an examination of a dark dull rolled pebble, weighing approximately 3½ carats, which appeared green in daylight and red in artificial light. X-ray diffraction tests proved the stone to be a garnet and a chemical analysis showed that apart from the usual constituents of garnet there was 0·54% of chromium, 0·324% of vanadium and 0·1418% of titanium present. It was considered that the vanadium content was the cause of the colour change. The stone, which was cut into a 1·70 carat oval stone was found to have a density of 3·88, a refractive index of 1·765 and a hardness of 7 to 7½. 5 illustrations R.W.

CROWNINGSHIELD (R.). *Developments & highlights at G.I.A.'s Lab. in New York.* Gems & Gemology, 1970/71, XIII, 6, 7 & 8, 192-201, 221-229, 249-254.

Examination has been made of a new diamond simulant to which the trade name YTTRALOX has been applied. The material is an optical ceramic consisting of a specially sintered polycrystalline product containing 90% yttrium oxide and 10% thorium oxide. A cut stone from this material gave a refractive index of 1·92, a dispersion of 0·039, a density of 5·30 and a hardness of 6 to 6½. White star-quartz, a large faceted Trapiche emerald, the inclusions in a green grossular garnet, the spectra of Tanzanian spessarite and of monazite, transparent lazulite and green andalusite are reported upon. There is a discussion of the use of laser beams to reduce dark inclusions in diamonds. The fluorescence of certain diamonds and the use of ultra-violet light in separating green zircons from a parcel of demantoid garnets are mentioned. Difficulties of amber identification, a zincian staurolite and transparent colourless grossularite are other items noted. There are discussions on the staining of ironstone matrix of opal and on the so-called "synthetic jade", "meta jade" or "Iimori stone" which emanates from Japan. It is suggested that the material is a glass with refractive index of 1·53 to 1·55 and density of 2·65 and may show anomalous double refraction due to devitrification. One type was so devitrified as to produce radiating fibres so that the stone when cabochon cut showed a cat's-eye effect. Such stones have been sold under the misnomer "Synthetic cat's-eyes". 40 illustrations R.W.

CROWNINGSHIELD (R.). *World's largest phenakite.* Gems & Gemology 1970/71, XIII, 6, 178-181.

A report on what may be the largest phenakite known. Originally a partially polished rolled pebble, the specimen was cut into a 569 carat oval stone and three others, of which one weighed 36 carats and another 12 carats. The original rough stone was seen to be filled with thin reflective needles, which it was anticipated would make the cut stones appear "sleepy". Much of this was overcome in the cutting by making the table facet at right angles to the optic axis so to a great extent getting rid of the strong double refraction (0·016) causing doubling of the needles. The stone is probably destined for the Smithsonian Museum.

5 illustrations R.W.

ELBE (M.). *Der geschliffene Diamant*—The cut diamond. Zeitschr. d. deutsch. Gemmologischen Gesellschaft, 1971, 20, 2, pp. 57-90.

The author of this article, which is illustrated with many diagrams and some photographs, proposes a theory that, if a diamond were to be cut asymetrically, the "fire" would increase dramatically.

The conventional brillant-cut is based on an even number of symmetrical facets placed in such a fashion that the main facets of the crown and pavillion match exactly. The author has developed three new cuts: a new brilliant, a prismant and a colorant. He suggests that the "fire" is improved by 247% in the case of the new brilliant-cut and by 426% in the case of the other two cuts, for the latter two cause the cutting loss to be decreased by as much as 20%.

The physical and optical properties of diamond are discussed in detail and so are the relevant physiological processes of the human sight and the sensitivity of the eye. Based on these data, the author developed a cut with various objectives in view: to increase the number of reflections, to make the high-lights of the table appear as a single white reflection, to make the light rays which enter the stone appear as coloured reflections by making them enter at an angle of 4°–7°, to improve the "purity" of the spectrum by a perfect polish of the facets and by choosing the entering light rays in such a way that only a small number of facets are of utmost importance, and also to keep the loss in cutting to a minimum. Not all these objectives were reached.

In the new brilliant-cut the number of reflections has been doubled and the resulting spectrum is much wider: the conventional cut has 57 facets with 8 main facets yielding 100 reflection of 570 light units, the new cut has 78 facets with 11 main facets yielding 182 reflection of 1,063 light units. The exact angles to be used are given.

The prismant is a completely new type of cut, especially suitable for cleaved triangular rough stones. The advantage of this cut, apart from the "fire" and the small cutting loss, is the ratio of the height of the prismant to its diameter, which is only 7%.

The colorant is a completely transparent stone which can be viewed from any side (the cut stone is roughly spherical). The produced spectrum is very "pure" even in dull light. The facets in this cut can be even- or odd-numbered. A diagram illustrates a colorant with 9-cornered facets. A table comparing the "fire" and the light loss in cutting of a brilliant style and a colorant seems impressive. Bibliography.

E.S.

EPPLER (W. F.). *Synthetischer Rubin, nach dem Hydrothermal-Verfahren und aus der Schmelze hergestellt.* Synthetic ruby produced by the hydro-thermal method and grown from a melt. Zeitsch. d. deutsch. Gemmol. Gesellschaft, 1971, 20, 1, 1-5, 5 photomicrographs.

The author describes the history and development of the synthesis of the ruby. He first describes the Verneuil process and then the improved hydro-thermal method by Ballman and others in 1957, when they used a sodium carbonate solution, aluminium oxide and a ruby seed. In 1959 Chatham publicised his synthesis. The next synthesis was by E. A. D. White, who used lead fluorite as a melt. The firm "Ardon Associates" also produced rubies from a melt, and lastly the author describes synthetic rubies marketed by a US firm called "Designer Jewels Ltd." in Houston, Texas, under the name of "Rubies grown by Kashan"—not mentioning explicitly that these stones are synthetics. The colour of these stones reminds one a little of almandine. Various typical characteristics of the various synthetic products are mentioned.

E.S.

LIDDICOAT (R. T.). *The Russian diamond industry.* Gems & Gemology, 1970/71, XIII, 8, 259-265.

A brief history of the recovery of diamond in Siberia since the end of the war. Against some 25,000 persons employed in the United States of America on geological investigation, it is said that the Russian geological strength is nearer 500,000 persons, but numbers are not considered to be the answer to the phenomenal results obtained with diamond finds and other geological surveys, but as much to the fact that the Russian geologist is very well trained and capable. A number of "pipes" have been discovered as well as alluvial deposits, the latter being said to supply fine colour gem material. In 1969 six recovery plants were in operation. Yields per cubic metre of rock mined are not revealed, and the commercial operation differs greatly from that in the free world; costs may to a great extent be disregarded. Marketing of some of the rough is still through the Diamond Trading Company. The Russiams cut much of their gem quality stones. It is reported that the melee sizes are very well cut but the larger sizes have not the make of Western standards. Some of their cut stones are marketed through certain Western importers. The latest claim is that Russia is the second largest producer, by weight, of diamonds in the world

7 illustrations R.W.

LIDDICOAT (R. T.). *Developments & highlights at G.I.A.'s Lab. in Los Angeles.* Gems & Gemology, 1970/71, XIII, 6 & 7, 182-191, 230-235.

Interesting items recorded during the work in this laboratory include some pyrite inclusions in fluorite looking very like table-cut stones and horn carvings which had a refractive index of 1·55 and a density of 1·31. The carvings were stained but gave off an odour of burnt hair when touched with a hot needle and they are said to have shown slight effervescence when using dilute hydrochloric acid. Other items examined were a bi-coloured diamond, a chrysoberyl cat's-eye with high properties, another type of synthetic emerald, a lapis-lazuli *pietre dura* lavalliere, a spessartite garnet with unusual inclusions and iron carbonate (siderite) nodules. A brownish-pink faceted stone with refractive indices of 1·640–1·668, biaxial negative, and a density near 3·06 was identified as the manganese-aluminium phosphate orthorhombic mineral known as eosphorite. Sinhalite, Mexican treated-opals and chrome fluorite are other items mentioned. There is more information on Linde hydrothermal and Chatham flux-melt rubies.

24 illustrations R.W.

MORTLEY (H. A.). *Measuring wavelengths without a built-in scale.* The Australian Gemmologist, 1971 11, 1, 3-4 & 27.

It is suggested that the wavelengths of the absorption lines seen in a gemstone by the aid of a simple spectroscope not fitted with a wavelength scale can be measured by superimposing a spectrum having lines of known wavelength over the spectrum of the stone under test. A number of media producing suitable "wavelength scales" are suggested, such as the Fraunhofer lines, the lines from a fluorescent lighting tube, different gelatine filters, a dilute solution of potassium dichromate and a synthetic ruby. Methods of using these superimposed spectra are explained.

R.W.

NASSAU (K.). *Synthetic garnets.* Lapidary Journal, 1971, XXV, I, 100-112.

Pre-eminent in the world of crystal growth, Dr. Nassau deals with the relationship of the structure of the synthetic or rare-earth garnets with the structure of the natural garnets. The question of the nomenclature is discussed and reasons given for the use of the name *garnet* for the rare-earth synthetically produced stones. The rare-earth garnets are generally grown by the Czochralski "pulling" technique from a melt at about 1,980°C in an iridium crucible with a high-powered radio-frequency generator. Boules 1″ or more in diameter and many inches in length are grown at 2–6 mm per hour. Small well formed crystals are grown by the flux growth method; the solvent (flux) may contain PbO, PbF_2 and B_2O_3. The growth is at a lower temperature, about 1,300°C cooling to 950°C over a three week period. The uses made of these rare-earth garnets fall into three groups. When "doped" with impurities, such as neodymium, holmium, erbium, thulium or ytterbium the stones show fluorescence and can then be used for crystal lasers. The second group uses the magnetic properties of iron containing rare-earth garnets and an example given is that a tiny sphere machined from a flux-grown yttrium iron garnet was an essential part of the radio-amplifier in the TELSTAR satelite. The third use is in the gemstone possibilities. The colourless material is said to provide a convincing diamond simulant and cut stones are marketed under various trade names. The hardness is 8½, the refractive index 1·833 and the dispersion is 0·028. Inclusions are faint curved growth rings in the "pulled" material, and straight growth lines and variable amounts of flux inclusions in flux-grown material. Coloured material can be produced by "doping" with various trace elements. A purple colour is produced by neodymium, a green by chromium, a yellow by titanium and pink to red by manganese, and blue, a colour never seen in natural garnets, by silicon and cobalt.

8 illustrations (5 in colour) R.W.

NASSAU (K.) and (J.). *Dr. A. V. L. Verneuil and the synthesis of ruby and sapphire.* Lapid. Journ., 1971, Jan., Feb. and Mar., 1971, 24, 10, 1284, 1442, 1524.

A detailed investigation into the life and work of Dr. A. V. L. Verneuil. The authors' account is based only on reliable primary data which they have been able to verify themselves. Consequently their biographical contribution is extremely valuable.

S.P.

OTTEMANN (J.), BERDESINSKI (W.), BANK (H.). *Die Elektronen-Mikrosonde und ihre Anwendung in der Gemmologie.* The micro-electro-scanner and its use in gemmology. Zeitsch. d. deutsch. Gemmol. Gesellschaft, 1971, 20, 1, 6-13.

The micro-electro-scanner is one of the most sensitive intruments for the chemical analysis of small objects and therefore particularly useful for gemmology. The construction of this instrument and its working methods are described. It can be used to determine the content of a chemical element and its percentage, i.e. it was shown that an olivine from Norway consisted of 90% forsterite and 10% fayalite. The instrument can also be used to find qualitatively the chemical composition of minimal inclusions. Lastly, it can be used for the quantitative determination of a mineral; this is illustrated by the examination of a diopside.

E.S.

POIROT (J-P.). *Application de la radiographie en bijouterie joaillerie.* Dépôt légal Kodak-Pathé, 1970, 4th quarter, No. 152, 1-7 (in French).

A short well-illustrated article on the use of x-rays in the Paris laboratory of the Paris Chamber of Commerce. The article deals solely with pearl testing. The text is short but concise and much information is given by the captions to the x-ray pictures and the line drawings accompaning them. The pictures are "negative" prints showing the structures as would be seen by an operator viewing the negative as is normally done. The x-ray machine used operates at 50–90 kV according to the size of the pearl and a three minute exposure is given using Kodak film Type M.

12 illustrations R.W.

ANON. *The facts about diamond imitations.* Gems & Gemology, 1970/71, XIII, 8, 245-248.

A general survey of the diamond simulants encountered since World War II. A list of the trade names applied to these man-made stones is given and there is a table of their constants.

R.W.

BOOK REVIEWS

ANDERSON (B. W.). *Gem Testing.* Butterworths, London, 1971, 8th edition. 384 pages, 5 coloured plates, 127 illustrations. £7.

The seventh edition of this important book came out during 1964 and was then considerably revised. That a new edition should be called for after only seven years, or rather five to six years as the seventh edition had been "out of print" for some time, is a sound indication of the worth of the book to the jeweller and student.

The new edition follows the same general lines as the earlier editions, but one great improvement is the bringing of the chapter on "fluorescence as an aid to identification" to a position in the book where it is more in keeping, that is the actual testing methods, instead of at the end of the book which implied that this important method was put in as an afterthought. New sections are on the "direct measurement" method of refractive index measurement, and on the method of minimum deviation. Both of these are clearly written up, but the method of minimum deviation is placed in the chapter on "Double refraction and dispersion" and not in the chapter dealing with refractive index measurement. It is quite logical, for the method is the only exact method for the measurement of dispersion, but a student might not look for it there and the index is no help as neither "Minimum deviation method" nor "Table spectrometer" is in the index.

The timely comment is made that observation of the double refraction by the doubling of the back facets breaks down when the observation is made in a direction at right angles to the optic axis in uniaxial stones as the rays are then directly in line, either before or behind one another and hence cannot be seen. This is the first time that the reviewer has seen this effect mentioned in a text book; however, is not the same effect valid with biaxial stones? According to Professor R. M. Denning (*Gems and Gemology* XI, 10, 299-301) this effect also occurs with biaxial stones and he cites topaz as an example.

The chapter on "Synthetic stones" has been brought up to date and modern problems of identification are discussed. The newer synthetics are mentioned, but the existence of synthetic colourless scheelite seems to have been omitted. There is a welcome insertion detailing the various methods now used to grow crystals. A fuller description is given of the fluorescence of diamond, a subject on which the author has carried out much research. The final chapter on dispersion makes reference to graphs which shows the curves to become "infinitely steep when approaching the wavelength at which a *fundamental absorption edge* for the material in question begins" (reviewer's italics). Would it not be as well in future editions to explain—say in the glossary—what is meant by a fundamental absorption edge? It seems to the reviewer that the definitions for *iridescence* and *opalescence* are to some extent contradictory and could with advantage be clarified. There is a change to the seven crystal systems, in keeping with the Gemmological Association's teaching syllabus. With all alterations of this nature it is always difficult not to overlook a correction, and such an oversight is apparent in the entry for benitoite in the alphabetical summary. It should read "trigonal", not "hexagonal". There is a good index.

Gem Testing is a volume no gemmologist or jeweller can afford to be without. It is written by an expert who has the student and layman in mind and writes accordingly. The vast majority of the errors in the seventh edition have been corrected and the book is to-day the most up-to-date volume on gemmology.

The book is well bound and is finished in a hard-back black leatherette covered case. The title is in gold and on the spine only and not on the face of the book. By using a smaller type face the new publishers, for the publishers of the 7th edition have now merged with the firm of Butterworths who have produced "Gem Testing" under their own name, have produced a volume only seven pages larger than the earlier edition. A welcome change is the dispensing with any advertising pages, which never do enhance a book. A choice of thinner paper has produced a slimmer volume which weighs 1 lb. 8 oz. as against 2 lbs. 1 oz. for the 7th edition. While accepting that there are four more illustrations, four more colour plates and no advertising, that the book needed to be completely reset, and that the cost of printing has advanced enormously, a price increase of 125% seems rather steep.

R.W.

Beck (R. J.), Reed (A. H.) and Reed (A. W.). *New Zealand Jade: the story of greenstone.* Wellington, 1970, pp. 106. £1·90.

The apparent inconsistency between title and subtitle is explained by the author in the first (unnumbered) chapter, in which he concludes that greenstone is nephrite but that New Zealand usage often employs the term for bowenite. However, New Zealand greenstone and true greenstone are only used for nephrite.

Later chapters deal with the world location of the jades and the New Zealand locations are described in detail. A separate chapter deals with bowenite locations in New Zealand. A brief review of gem testing methods precedes a list of minerals found in New Zealand and likely to be confused with nephrite. The remainder of the book describes lapidary work including that of the Maoris and there are a number of useful diagrams and photographs illustrating various stages of jade carving. There is a general glossary and an index which omits specific gravity and density.

Altogether this is a useful and long-wanted book in which the coloured illustrations are particularly meritorious.

M.O'D.

DANEU (A.). *L'Arte Trapanese del Corallo.* Fondazione Ignazio Mormino of the Banco di Sicilia, Palermo, 1964. 176 pages, 39 coloured plates and 32 black and white plates. L.18,000.

Although this is in no sense a scientific or gemmological work, books on coral are relatively scarce and in this case the standard of the illustrations is so high that gemmologists who are interested in organic materials will be pleased to know that this book is on the market.

The book is essentially a study of the fishing and working of coral in the Sicilian province and town of Trapani. Some inventories are reproduced from the fifteenth and sixteenth centuries and the remainder of the book is given over to the fine series of coloured and black and white plates, each of which is described in detail. The artefacts range in date from 1590 to the end of the eighteenth century.

M.O'D.

TESCIONE (G.). *Italiani alla Pesca del Corallo ed Egemonie Marittime nel Mediterraneo.* Second edition, Fausto Fiorentino, Naples, 1968. 506 pages, coloured plates. (Probably limited distribution).

Originally published in 1940, this is the first attempt to reconstruct the history of the Italian coral-fishing industry. The whole course of the coral trade is pursued and footnotes which follow each chapter lead the reader to a large number of additional sources of information. The fine coloured plates illustrate coral artefacts from all periods. The reader has to rely, in the absence of an index, on summaries placed before each chapter. None-theless this is an essential book for both the collector of coral and the student of Italian applied art.

M.O'D.

THE SIGNIFICANCE OF GEMS IN ASTROLOGY

By S. NALLIAH, F.G.A. Dip. Gemmology (Ceylon).

THE cardinal virtues of a gem are beauty, durability and rarity. The beauty acts in various ways in different gems, e.g. in blue sapphire and ruby through the depth of colour and transparency, in diamond through fire, colourlessness and clarity, in opal through a play of colour.

For ages ancient Kings and Queens adorned themselves with ornaments studded with expensive and rare gems. Very often we find that people wear gemstones not because of their beauty but because it is believed they will ward off evil effects or the influence of the ruling planets which affect them most. It is said that there are principally two remedies in astrology to ward off planetary evil. One way is to propitiate the Deities ruling the relevant planets in the manner prescribed. The other is to wear a gemstone correspondent to the planet concerned. When wearing a gem, one side of the stone should be exposed to space and the other side touch the skin of the wearer. The general belief is that the rays of the planet will be absorbed by the gem because it has the power of reflection and refraction of rays of light which, transmitted to the body, resist the evil influence of the particular planet. Thus we find that gems have an additional virtue for people who believe in astrology.

In the matter of selecting gemstones for different planets the Western and the Eastern systems of astrology differ. The Western system of astrology allocates different gems for each month. And each month is ruled by a different planet and the person who is born in that month will have to wear the gem relevant to the planet related to that month in order to derive benefit from the planet. According to the Eastern system the person will have to wear gems in accordance with his ruling planet to ward off the ill-effect.

For instance, if a person is born in Sinha lagna with its lord, the Sun, in prominent position he should wear a gem related to or ruled by the sun and so absorb more of the protective rays of the sun to build up enough resistance to planetary evil. Again some astrologers maintain that stones akin to the planet ruling the current period should be worn to ward off the evils of that planet. That is to say, if one is suffering from the evil effects of Saturn's directions (dasa) one should wear the gemstone pertaining to Saturn. One may, therefore, select either the stone relevant to his dasa planet or one relevant to his ruling planet of birth, whichever may have the better appeal. Red is the colour for the Sun and for Mars as well, but for the Sun it should be strong and must have a good lustre. Therefore, ruby, star-ruby and sunstone have been allocated to the Sun. For Mars, as the colour is not so strong and the lustre is dull or greasy, garnet, coral and red jasper have been allocated to it. The different gems relevant to the planets according to both systems of astrology are given below. Those who follow the western system of astrology should select a stone according to the month of their birth. As far as the Eastern system is concerned selection should be according to the ruling planets.

Allocation of gems according to the Western system of astrology.

January — Garnet or alexandrite
February — Amethyst
March — Bloodstone or tourmaline
April — Diamond
May — Emerald
June — Cat's-eye
July — Ruby
August — Zircon or aquamarine
September — Sapphire
October — Opal
November — Topaz
December — Turquoise or star-sapphire.

Allocation of gems according to the Eastern system of astrology.

Gems for Sun — Star-ruby, sunstone or ruby.
Gems for Moon — Moonstone, white sapphire or white pearl.
Gems for Mars — Garnet, coral or red jasper.
Gems for Mercury — Aquamarine, green zircon, emerald or turquoise.
Gems for Jupiter — Yellow pearl, golden topaz or yellow sapphire.
Gems for Venus — White zircon or diamond.
Gems for Saturn — Amethyst or lapis-lazuli.
Gems for shadows of the earth
Rahu — Hessonite garnet.
Kethu — Cat's-eye or tiger's-eye.

ASSOCIATION NOTICES

MEMBERS' MEETINGS

On the 20th June, members of the Scottish Branch of the Association enjoyed a very successful day prospecting for agate at Dunure on the Ayrshire coast. Although great difficulty was found in removing the agate intact from the hard rock matrix, some quite good specimens were obtained.

Owing to popular demand a repeated visit was made by the Midlands Branch of the Association on the 26th September, 1971, to the Blue John Mine near Castleton in Derbyshire, and to Chatsworth House, the Derbyshire home of the Dukes of Devonshire, which is one of the most charming stately homes in England.

ASSOCIATIONS OVERSEAS

The Association has been advised that the following organizations have recently been formed:

Gemmological Association of Rhodesia, P.O. Box 8277, Belmont, Bulawayo, Rhodesia. Chairman: Mr. Ian C. C. Campbell, F.G.A.

Gemmologists Association of Ceylon, P.O. Box 1371, Colombo, Ceylon. President: Prof. K. Kularatnam, M.A., Ph.D.(Lond.), Dr.Sc.(Paris).

The Association recently had the pleasure of receiving visits of parties from the Gemological Institute of America and the Norwegian Gemmological Association.

STELLENBOSCH UNIVERSITY

The University of Stellenbosch and De Beers Consolidated Mines have arranged for a lectureship in gemmology to be established at the University—the first of its kind in South Africa.

A diploma course in gemmology will start in 1972 and it is hoped that diamond grading courses, as well as short introductory lectures in gemmology, will be held in various centres throughout the country from next year onwards. Mr. H. S. Pienaar, senior technical officer in the Department of Geology at Stellenbosch University, has been appointed lecturer in the course.

OBITUARY

Mr. Hugh N. Leiper, for many years editor of the Lapidary Journal, San Diego, California, died on the 13th July, 1971. He was largely responsible for making the Lapidary Journal an internationally respected publication. He qualified as a Fellow of the Association in 1956.

A. C. D. Pain of Exmouth, who discovered and gave his name to the mineral Painite found in the gem gravels at Mogok, Burma, died in August 1971. Painite was identified as an unusual mineral and its nature was recorded in the Journal of Gemmology in October 1957, in an abstract from the Mineral Magazine of March 1957.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to the following:

The Gemmological Association of All Japan for a Japanese translation of the *Scandinavian Diamond Nomenclature and Grading Standards*.

The Banco di Sicilia for a copy of *L'Arte Trapanese del Corallo*.

Mr. K. Ambar, Djakarta, Indonesia, for uncut hydrophane (common opal) from West Java, Bantam area.

The Union Carbide Corporation for samples of Linde created emeralds for use in teaching.

E. P. Joseph Ltd., London, for an agate and quartz slice on a gilt stand.

Dimitri Paraskevopulos, San Paulo, Brazil, for specimens of Brazilian sapphire, emerald and brazilianite.

COUNCIL MEETING

At a meeting of the Council of the Association held on the 1st September, 1971, it was decided to adopt the clarity and colour chapters of the Scandinavian Diamond Nomenclature for inclusion in the Association's Gem Diamond Examination syllabus.

The following were elected to membership:

Fellowship

Aye, Daw Swae Swae, Rangoon, Burma. D.1970
Brown, Jonathan Philip, Derby. D.1971
Ferrer Tor, Maria Luisa, Gerona, Spain. D.1970
Hazelden, John Norman, Worthing, Sussex. D.1971
Sharp, Charles S., New York. N.Y., U.S.A. D.1961

Ordinary

Aalbers, K. J. J., Velp, Holland
Anderson, Neil, Walmer, Kent
Arambulo, Belen Luna, Quezon City, Philippines
Arnold, Alan Price, New Orleans, La., U.S.A.
Barham, Richard Findlay, Freeport, Grand Bahama Island
Barr, Stephen Ponsford, Porirua, New Zealand
Bellucci, Francesco, Bari, Italy
Boghossian, René, Beirut, Lebanon
Brom, Frederick Willibrord, Johannesburg, S. Africa
Brooks, Julius C., West Chester, Pa., U.S.A.
Brown, Stanley Arthur, Tynemouth, Northumberland
Brunner, Claude, Carouge, Switzerland
Buck, Philip Frederick, Stoke-on-Trent, Staffs.
Buckley, Peter Ross, Halifax, Yorks.
Caspart, Peter, Mainz, W. Germany
Cheung, Lap Poon, Norwich, Norfolk
Chew, Handman, Bangkok, Thailand
Chung, Kwang-Yong, Seoul, Korea
Cooras, George, East London, S. Africa
Cox, Edward Charles, Auckland, New Zealand
Cummins, Barry William, Hataitai, Wellington, New Zealand
Da Silva, Jose Pinho Bento, Johannesburg, S. Africa
De Silva, G. Chandrakanthi Ida, Singapore
Donkin, Arthur, Assam, India
Farah, Georges A., Tripoli, Lebanon
Farrell, James John, Tonyrefail, Glam.
Feather, John Robert, Fairfax, Virginia, U.S.A.
Fernando, Modarage Wijayapala, Colombo, Ceylon
Fuchs, Alexander Wilfred, Brisbane, Queensland, Australia
Furuya, Kenji, Kunitachi-City, Japan
Gerrand, Ian McAra, Hawera, New Zealand
Green, Roger, Leicester
Haile, Neville Seymour, Kuala Lumpur, Malaysia
Horovitz, Herbert, Geneva, Switzerland
Humphreys, Martin John, Heaton, Yorks.
Inoue, Shuichi, Fukuoka City, Japan
Irwin, Alan, Menlo Park, Calif., U.S.A.
Jain, Subhash Chand, Jaipur, India
Jaliwala, Mansoor Abdurahim, Bombay, India
Jones, Michael Noel, Tredegar, Mon.
Kaku, Baikei, Kobe, Japan
Kano, Toshikazu, Tokyo, Japan
Kapp, Hans R., Basel, Switzerland
Kawashima, Kouhei, Tokyo, Japan
Kelso, Roger Joseph, Christchurch, New Zealand
Kechurim, David, Yokohama-City, Japan

Knoske, Gene E.,
Milwaukee, Wisconsin, U.S.A.
Knowles-Brown, Andrew,
Chesham, Bucks.
Kumarasamy, Velupillai,
Colombo, Ceylon
Lahiri, P. K., Panna, India
Lee, Terrence John,
Armidale, N.S.W., Australia
Leung, Danny K. C.,
Kowloon, Hong Kong
Lujwangana, John Raphael,
Dares Salaam, Tanzania
Macdonald, Rosemary,
Guildford, Surrey
Malhas, Naiel A. F., Amman, Jordan
Malone, Ben D.,
Port Charlotte, Florida, U.S.A.
Maury, Robert Lee,
Port Charlotte, Florida, U.S.A.
Mehta, Burjor F., Bombay, India
Milner, David John,
Bexhill-on-Sea, Sussex
Mistry alias Chowhan, Mehendra
Narottam, Bombay, India
Morris, Harold Harding,
Lower Hutt, New Zealand.
Nazeel, Mohamed Zuhair Mohamed,
Dharga Town, Ceylon
Oliver, Graham Denis,
Wellington, New Zealand.
Olstein, Sumner L.,
New London, Conn., U.S.A.
Ohtsu, Shigeo, Fujisawa City, Japan
Palmieri, Donald Anthony,
Pittsburgh, Pa., U.S.A.
Paskoff, Philip Howard,
Royal Oak, Michigan, U.S.A.
Patni, Lalitkumar Jayantilal,
Bombay, India
Pavitt, John Anthony Leighton,
Bangkok, Thailand
Peterson, David L.,
Spokane, Washington, U.S.A.
Puri, Harbans Lal, New Delhi, India
Ratnayake, Senaka Banda,
Colombo, Ceylon
Robinson, Bruce Steven,
Bexleyheath, Kent
Roffey, Arthur David,
Blackheath, N.S.W., Australia
Ross, Henry C., Buffalo, N.Y., U.S.A.
Rudge, John Charlton,
George Town, Tas., Australia
Ruplinger, Peter K.,
San Diego, Calif., U.S.A.
Sapieha, Teresa Jadwiga,
Nairobi, Kenya
Savin, Richard Ernest, London
Scharf, Walter (Dr.),
New York, N.Y., U.S.A.
Shah, Bearry, Norbury, London
Sheng, Alec Ee Kim, Singapore
Sockolof, Arthur,
New Brunswick, N.J., U.S.A.
Stenson, Ann P. Sabina,
Ottawa, Ont., Canada
Stevens, Eric Leslie,
Sydney, N.S.W., Australia
Tate, Robert Brydon,
Bandar Seri Begawan, Brunei
Trickey, Stevan, Bristol
Turner, Alan Harold,
Ramsgate, Kent
Ueda, Makoto,
Ichikawa-City, Chiba, Japan
Veera, Geerdurlall Govindass,
Port Louis, Mauritius
Wells, David Andrew Hester,
Eastbourne, Sussex
Westmoreland, Don Lee,
Winnemucca, Nevada, U.S.A.
Widess, David,
Los Angeles, Calif., U.S.A.
Witherup, Sylvan,
Cincinnati, Ohio, U.S.A.
Yap, Peter J. (Dr.),
Honolulu, Hawaii
Yoshida, Kunihide, Kukuoka, Japan
Yoshimura, Shosuhe,
Tokushima City, Japan

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