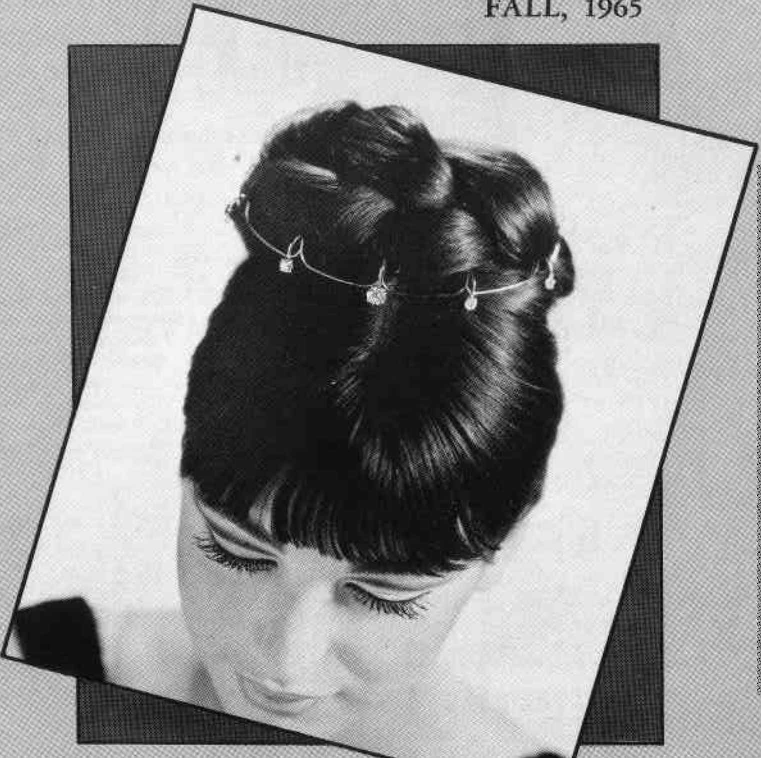
Gems and Gemology

FALL, 1965



Gems & Gemology

VOLUME XI FALL, 1965 NUMBER 11

IN THIS ISSUE

On the Cover

This striking necklace, shown here in the hair, was designed and executed by Carl Schmieder of Otto Schmieder and Son, Phoenix, Arizona. It was one of the winners in the Diamonds-International Awards for 1965. The diamonds, suspended from delicate arcs, rise from a slender circle of white gold. Mr. Schmieder is a GIA Jewelry Design Class Student.

Photo Courtesy
N. W. Ayer & Son, Inc.
New York City

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Marlborough Creek Chrysoprase Deposits

by J. H. Brooks, B.Sc.

Note: Reprinted from the Queensland Government Mining Journal's Geological Survey Reports (March, 1964).

Abstract

Chrysoprase occurs as veins, usually less than four inches wide, in a laterite profile developed on serpentinite. The serpentinite belt extends over an area of more than 200 square miles, but only remnants of the laterite profile remain. Mineralogically, the chrysoprase consists of microgranular quartz, rather than chalcedony. A sample of bright-apple-green material was found to have a nickel content of 2.38%. Much colorless and white quartz, chalcedony and common opal are also present in vein and nodular form. The formation of the chrysoprase is attributed to the concentration of nickel and silica during lateritization of serpentinized ultrabasic rocks. The chrysoprase has been found over an extensive surface area. Its vertical extent is not known but may be 50 feet or more. Production in substantial amounts for overseas markets commenced in the latter part of 1963. Prospects for further production from known deposits and for the discovery of new deposits of chrysoprase are considered favorable.

Introduction

Field inspections were made on October 3 and 14, 1963. The inspection on October 3 was made in company with Mr. O. Anderson, Inspector of Mines. The assistance of Mr. C. G. Moore of Gem Rock (Aust.) Pty., Ltd., on both occasions is gratefully acknowledged.

Historical Notes

Chrysoprase from the Marlborough, Princhester and Yaamba areas was recorded by Dunstan (1913 and 1921). Consideration of the commercial possibilities of the Marlborough chrysoprase can be attributed to some extent to the fairly recent upsurge of interest in the search for minerals and rocks suitable for cutting and polishing. The first mining lease for chrysoprase (M.L. 349, Rockhampton) was applied for by R. M. Moessinger in August, 1962. However, samples from this lease are reported to have been of inferior quality.

Early in 1963 a specimen, submitted by Mrs. Price of Marlborough Station to the Geological Survey, was identified as chrysoprase. This prompted a group of local men, including Messrs. Price, Plant, Derrington and Lentz, to make a concerted search that was rewarded by the discovery of deposits of commercial-grade chrysoprase. These men arranged with Gem Rock (Aust.) Pty., Ltd., to form Capricornia Mineral Development Pty., Ltd., to exploit the deposits. Leases were taken up (M.Ls. 367 and 368) and a small Authority to Prospect was granted to Gem Rock (Aust.) Pty., Ltd., to enable a systematic search to be made of the area.

The Moessinger brothers, who were working chromite deposits in the area, also applied for chrysoprase leases (M.Ls. 369-372). These leases were not inspected.

Production and Marketing

Several quarter- and half-ton parcels of graded chrysoprase were produced in the latter half of 1963. The stone is being marketed overseas by D. A. Robinson & Co. of Brisbane. A parcel of 500 pounds sent to Germany was said to be valued at £2,500 per ton. Other overseas markets are being investigated. The indications are that in the U.S.A. first-grade chrysoprase could command a high price (possibly as much as two dollars per ounce.)

This is believed to be the first time chrysoprase has been produced in quantity in Australia. Small amounts were previously produced from a locality near Spargaville in the East Coolgardie field of Western Australia.

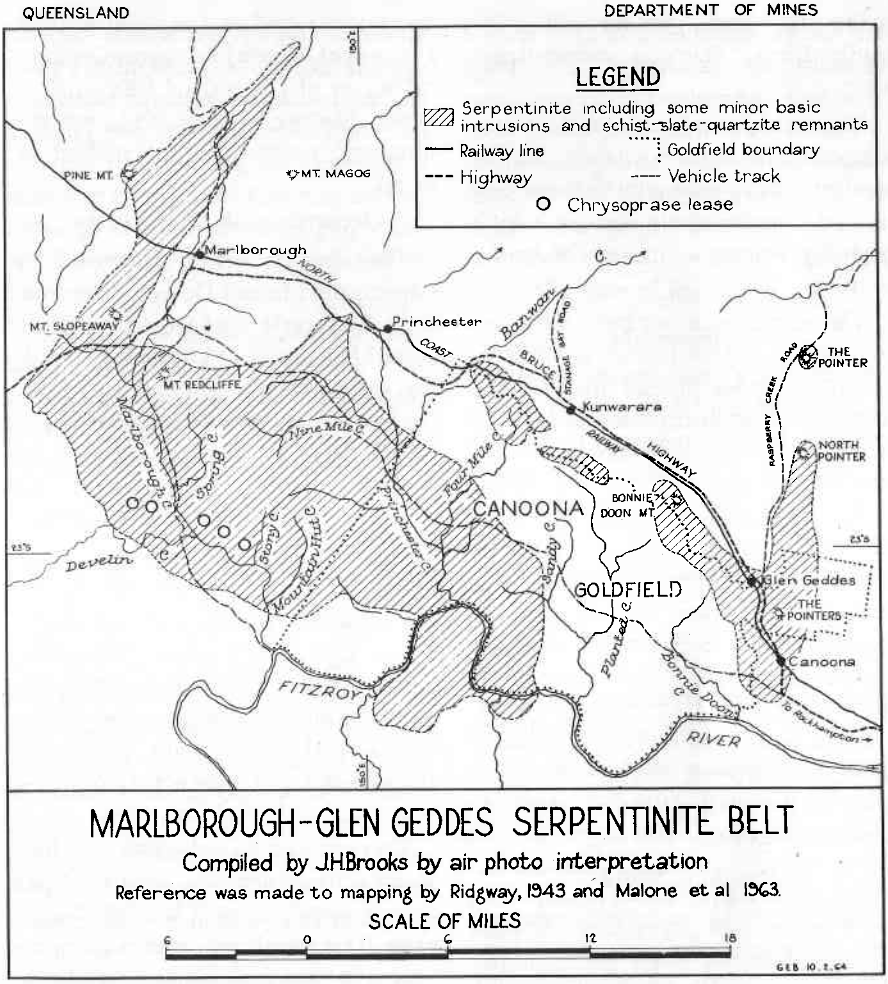
Situation and Access

The deposits inspected are situated in Marlborough Holding on the upper slopes of the divide separating the Marlborough Creek and Develin Creek watersheds. They are 10.8 miles south-southwest of Marlborough railway station and 50 miles northwest of Rockhampton. More recently, leases have been taken up on Portion 1, Parish of Ramillies, on the eastern side of Marlborough Creek.

Access is via a vehicle track that leaves the Bruce Highway on the eastern side of the Marlborough Creek crossing. This track is followed in a southerly direction for a distance of 8½ miles to near the Spring Creek crossing. A track suitable for four-wheel-drive vehicles has been bulldozed from Marlborough Creek to the deposits, a distance of 2¼ miles. Marlborough Creek, a permanently flowing stream, is 190 feet above sea level and the highest point of the divide with Develin Creek is approximately 1,500 feet above sea level.

General Geology

The chrysoprase occurrence is towards the southwestern margin of a



MARLBOROUGH-GLEN GEDDES SERPENTINITE BELT

Compiled by J.H.Brooks by air photo interpretation

Reference was made to mapping by Ridgway, 1943 and Malone et al 1963.

SCALE OF MILES

somewhat irregularly shaped mass of serpentinite with a long axis trending northwest. The serpentinite covers an area of over 200 square miles and is the largest serpentinite body in Queensland. Smaller bodies occur not far removed in the Glen Geddes-Kunwarara area. The main serpentinite body has a marked embayment on the northeastern side caused by an intrusion of granite. The serpentinite consists of massive and schistose types, and, in places, is extensively intruded by gabbro and dolerite dikes. To the west it is overlain by the Permian Lower Bowen Volcanics, Middle Bowen beds, and Tertiary sedimentary rocks; on the east it intrudes Lower Paleozoic metamorphic rocks.

The main fault directions in the area are north and north-northwest. Several small streams pursue a fairly linear east to east northeasterly course, which probably reflects a direction of strong jointing.

The serpentinite has been subjected to processes of lateritization and silicification. Remnant plateau areas on the western and southern sections indicate that a laterite-capped plateau probably covered the whole of the serpentinite at one stage. Major streams have eroded the serpentinite to depths of over a thousand feet below the old surface. For the most part, the topographic expression now consists of steepsided spiny ridges. Highly silicified serpentinite occurs as bold outcrops along the crests of some of the ridges. Elsewhere, there is a deep-red lateritic soil cover. Only in the deep gullies is fresh serpentinite exposed.

Previous Work

Ridgway (1941 and 1943) mapped part of the serpentinite area in connection with a survey of magnesite and chromite deposits. He noted that large areas of serpentinite at Mt. Slopeway and Mt. Redcliffe had been altered by surface silicification to jasper and common opal. He also noted the occurrence of veins of chalcedony. In a report on a discovery of gold at Canoona, Reid (1931) recorded the occurrence of kernels of opaline silica in decomposed serpentinite. Part of the Marlborough area was mapped on a regional scale by a Bureau of Mineral Resources-Geological Survey of Queensland field party in 1962 (Malone, *et al,* 1963), but the ultrabasic rocks were not studied in detail.

Occurrence of Chrysoprase

The deposits being developed by Capricornia Mineral Development Pty., Ltd., are largely confined to a slightly arcuate belt nearly 1½ miles long trending east-southeast. They extend from the crest of a ridge to the steep upper hill slopes; i.e., the capping zone of lateritization of the serpentinite. The east-southeast trend reflects the general direction of the ridge.

Most of the individual veins of chrysoprase either parallel this east-southeast trend or diverge from it in a south-southeasterly direction. They commonly dip vertically or steeply to the northeast. Several flatly dipping veins were also exposed, and these form a network with the steeply dipping veins.

The amount of colorless or white quartz, chalcedony and common opal present greatly exceeds that of chrysoprase. The overall ratio is difficult to estimate, but may be between 1:4 and 1:8. Flaws of various kinds occur in the chrysoprase. Vugs are commonly lined with fine quartz crystals or with infillings of limonitic material. Despite this, a considerable proportion of the chrysoprase is of marketable grade.

Chrysoprase is confined to vein form, but chalcedony and common opal also occur as nodules. Some poorly developed moss chalcedony and opal are present. Where quartz and chalcedony form a close network of veins and the serpentine minerals are leached out, the material resembles siliceous sinter. In outcrop, the color of the chrysoprase shows no very marked tendency to fade, although a "skin" of white opaque material is usually present on each side of the veins.

Magnesite veins occur near the chrysoprase deposits, and a chromite mine is located less than one mile to the northeast. Small deposits of both these minerals have been mined in the Marlborough area.

Towards the western end of the chrysoprase belt a pit had been opened up on the steep southern slope of the main ridge over a length of 20 feet and to a depth of 15 feet at the face. Chrysoprase occurs as residual veins in red and reddish-brown soil. The best exposed vein had an average width of 2 inches with bulges up to 4 inches wide. Most of the chrysoprase was strongly colored and relatively unflawed, but rapid variations in color were evident from one part of the vein to another. The material at the bottom of the pit was of similar quality to that close to the surface.

In several places, chrysoprase occurs in one comparatively wide vein and in several narrow veins that radiate into the surrounding silicified serpentinite or soil. At the "Hanging Rock" locality, the main vein is up to 8 inches wide and averages approximately 5 inches in width. Other veins, usually less than one inch wide, form a network extending up to 15 feet on either side of the main vein. Apparently, the siliceous solutions were introduced along a major fracture and some penetrated along adjacent joint planes. Most of the chrysoprase at the "Hanging Rock" is of rather poor quality, but practically no subsurface exploration had been carried out at the time of inspection.

Mineralogy

The chrysoprase being marketed consists of microgranular quartz or a mixture of microgranular and fibrous quartz. Some chalcedonic and opaline silica is present in the deposits but this is colorless, white, gray or very pale green. Material from eight specimens, representing the various forms of silica collected during the inspection, were examined under the microscope by Mr. R. M. Tucker and the determinations are set out in the Table 1.

Frondel (1962) attributes the color of chrysoprase to hydrated nickel silicate. However, no particles of any mineral to which the coloring matter could be attributed were detected in the Marlborough chrysoprase, even under high magnification. Three samples, obtained by taking chips from several specimens, were analyzed at the Government Chemical Laboratory, Brisbane. These indicate that the intensity of green color is directly related to the amount of nickel present. The nickel content of the strongly colored material is surprisingly high (Table 2). It compares with a nickel-oxide content of 0.5 to 1.0% found in chrysoprase from Silesia (Goodchild, 1908).

Table 1

Mineralogical Data

Macroscopic Description	Microscopic Description
1. Bright apple green, subtranslucent, even splintery fracture, subvitreous luster.	Micrographular quartz
2. Pale green, translucent, even splintery fracture, resinous luster.	Micrographular quartz
3. Bright apple green, translucent, hackly fracture, subvitreous luster.	Micrographular and fibrous quartz
4. Pale leek green, translucent, conchoidal fracture, resinous luster.	Fibrous chalcedony
5. Colorless, translucent, conchoidal fracture, vitreous luster.	Opaline material with fibers of chalcedony
6. Colorless to white, translucent to opaque, conchoidal fracture, vitreous luster.	Opaline material with few chalcedony fibers
7. White to pale green, opaque, even splintery fracture, dull.	Quartz mosaic
8. White with slight greenish tint in places, subtranslucent to opaque, even splintery fracture, subvitreous luster.	Micrographular quartz

Table 2

Chemical Analysis

Description	Ni%	Cr%	SiO_2%	Loss on Ignition %	Moisture %
1. Apple-green material. Representative of the chrysoprase being marketed	2.38	Nil	94.82	1.60	0.16
2. Pale-green chrysoprase of inferior quality	0.65	—	97.86	0.90	0.10
3. Colorless and white micro-granular quartz, chalcedony and opaline material.	0.16	—	95.2	2.7	1.3

Origin of the Chrysoprase

Three factors are considered to have been responsible for the formation of the chrysoprase.

(1) The presence of nickel
(2) The alteration of ultrabasic rocks
(3) Weathering conditions

(1) The amount of nickel in igneous

rocks, in general, increases with increasing basicity. Queensland ultrabasic rocks contain nickel in amounts ranging from a trace to 0.63%, the average nickel content being a little less than 0.20%. Analyses of chrysoprase (Table 2) indicate that appreciable amounts of nickel must be present to impart a green color, and the intensity of the color is directly related to the amount of nickel present.

(2) The process of serpentinization of ultrabasic rocks may lead to the production of considerable amounts of magnesia and silica (Turner and Verhoogen, 1960).

$$5Mg_2SiO_4 \quad + \quad 4H_2O \quad — \quad 2H_4Mg_3Si_2O_9 \quad + \quad 4MgO \quad + \quad SiSO_2$$

Olivine Serpentine Introduced Removed in Solution

The regional silicification of ultrabasic rocks is not an uncommon feature. Benson (1913) described the silicification of serpentinite with the development of chalcedony quartz and common opal, in the Nundle and Sheep Station Creek areas of New South Wales. This development is similar to that in the Marlborough area, except in respect of chrysoprase. The comparatively low nickel content of ultrabasic rocks from the great serpentinite belt of New South Wales may account for the absence of chrysoprase deposits. Wilkinson (1950) described the effects of silicification along the margins of the Pine Mountain serpentinite. He considered the silica was derived from late magmatic water associated with ultrabasic intrusion.

(3) Lateritic profiles may be developed on serpentinites, particularly under tropical or subtropical weather conditions. The concentration of nickel under these circumstances is illustrated by the large commercial deposits in Cuba, New Caledonia and the Celebes, where residual concentrations of nickel have been derived from serpentinite. All the analyses of Queensland ultrabasic rocks are of samples from outcrop or from shallow workings. It can be concluded that some degree of concentration has taken place in all the samples. Insufficient assay data are available to draw definite conclusions, but the above-average assays of samples from the Marlborough, Canoona and Mary Valley areas may indicate a higher overall nickel content in these serpentinite areas than in other Queensland serpentinites.

Although the concentration of silica often accompanies the process of lateritization, it is a little difficult to conceive that the very large quantities of silica in the laterite cappings in the Marlborough area could have been derived solely from the serpentinite. Some of the silica may have been introduced from the overlying Bowen beds or from the granite that intrudes the serpentinite.

It is anticipated that the chrysoprase will be limited in vertical extent by the depth of weathering of the serpentinite. In the Californian deposits (Wright, 1957) the chrysoprase graded into white chalcedony at a depth of about 20 feet. The Marlborough deposits are expected to extend to a considerably greater depth, perhaps 50 feet or more, in view of the deep lateritic profile.

Conclusions

Chrysoprase has been found over an extensive area and little doubt exists that more will be found as prospecting is intensified. Some of the chrysoprase is of high quality, and substantial quantities of marketable-grade material are available. The depth to which the chrysoprase persists is an important unknown factor.

A ready overseas market exists for chrysoprase. The demand in Australia is not great at present, but future prospects for the local market appear good.

The steep terrain poses some difficulties in the development of the deposits. However, the use of heavy earthmoving equipment should overcome these obstacles and the cost of mining, particularly where the chrysoprase occurs as residual veins in lateritic soil, should not be high. Small-scale, open-cut mining, with benching where necessary, is applicable.

The boundaries of the serpentinite define the limits of prospecting for chrysoprase. A map showing the extent of serpentinite in the Marlborough-Glen Geddes area accompanies this report. Over much of the area, particularly in the northeast, east and central areas, denudation has proceeded to the extent that only very small remnants of the overlying laterite profile remain. Although it is probable that chrysoprase will be found in these areas, the deposits are likely to be restricted in size. The most promising areas for prospecting appear to be the elevated areas towards the western and southern margin of the main Marlborough serpentinite belt.

A reconnaissance of other serpentinites, such as in the Mary Valley where above-average nickel assays have been obtained, may be worthwhile to determine if silicification, similar to that at Marlborough Creek, has taken place. Interest is also aroused in the nickel content of the laterite profile. Although the prospects of finding large commercial deposits of nickel are not particularly encouraging, it is considered that a geochemical survey of the lateritized serpentinite is warranted.

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Developments and Highlights

at the

GEM TRADE LAB

in New York

by

Robert Crowningshield

Unusual 10-Carat Montana Sapphire

We are indebted to stone dealer George Bruce of International Import Co., Stone Mt., Georgia, for allowing us to study and photograph one of the largest Montana sapphires we have encountered. Weighing in excess of 10 carats, it had the typical color of the source and the flat shape associated with many sapphires from Montana *(Figure 1)*. Internally, it offered surprises. The inclusion in the photograph consisted of several crystals, possibly spinel, and several two-phase inclusions. *Figure 2* illustrates the latter before and *Figure 3* after slight warming in the light of the Gemolite. Perhaps more surprising was the patch of needlelike inclusions in three directions *(Figure 4)*. This is unusual, especially if they were rutile needles, since star stones are virtually unknown from the Montana area.

Pre-1952 Synthetic Star Rubies

Few people are ever confused between the currently supplied synthetic star sapphires and rubies and natural star sapphires and rubies. Newcomers to the jewelry industry, and laymen alike, may not be familiar with the earliest synthetic stars, which appeared on the market between approximately 1947 and 1952. These early stones had great transparency and the stars were not as sharply defined nor as complete as in the stones offered today. As a result, early synthetic stars have been accepted in some cases as natural. *Figure*

Figure 1

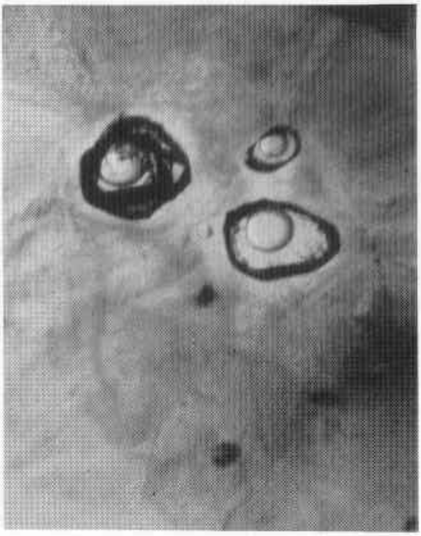


Figure 2

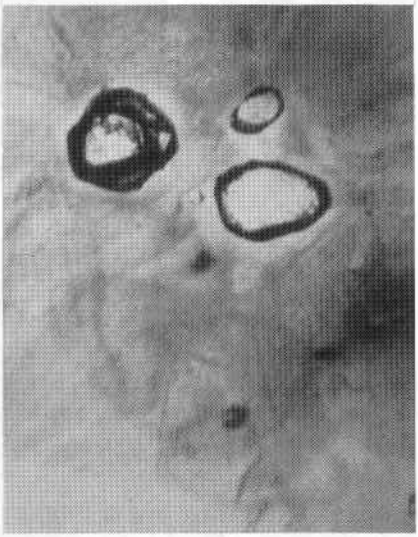


Figure 3

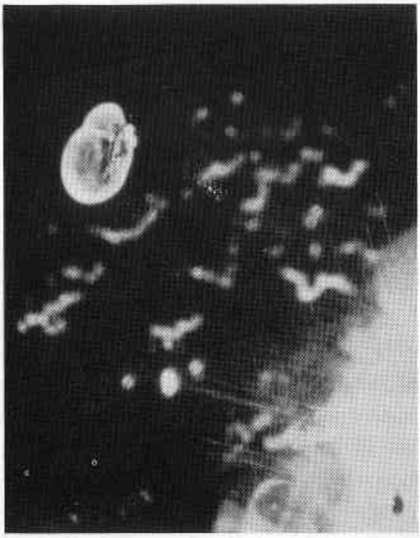


Figure 4

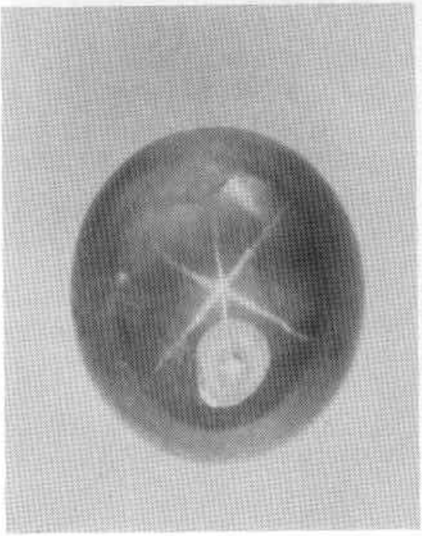


Figure 5

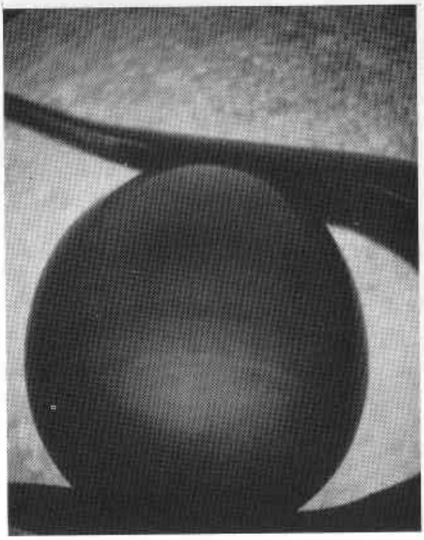


Figure 6

5 is a photograph of a beautiful blue-purple synthetic star sapphire that shows the kind of asterism these stones have. *Figure* 6 was taken in transmitted light, to show the distinct curved striae that is more obvious in these stones than in the newer opaque stones.

Red Spinel Crystal

Figure 7 is a photo of a beautiful red spinel crystal. It contains a large negative crystal, surrounded by numerous small spinel crystals.

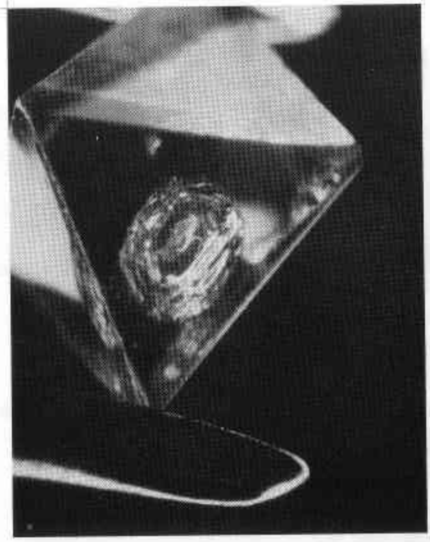


Figure 7

Button-Shaped Abalone Pearls

Recently, we had the unusual pleasure of examining and X-raying a pair of very large button-shaped abalone pearls of approximately 16 millimeters in diameter. One was from the green abalone and one from the red. Since regular shapes in these pearls are rare, how much rarer to find a pair of almost button shapes?

Figure 8

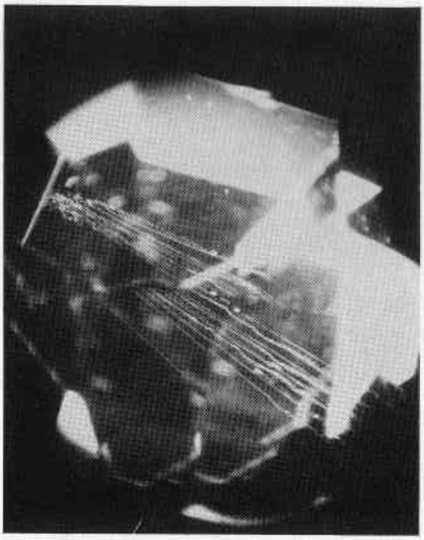


Figure 9

Reddish-Chalcedony Cameo

An unusual chalcedony cameo of a peculiar reddish color owed that color to bright-red, oddly formed inclusions *(Figure 8)*.

Natural-Appearing Synthetic Sapphire

A 10.75-carat blue synthetic sapphire had been sold in the trade as a natural stone many years ago and the present owner, feeling that the market was right to sell at a profit, offered it again in the trade. With a loupe, it was easy to see why it would be thought to be natural. Long streamers, unlike anything seen in the usual synthetics, were accompanied by very small gas bubbles *(Figure 9)*.

Cleaning a Hazard to Cultured Pearls?

Figure 10 illustrates a pair of cultured pearls left in a nonammonia-base jewelry cleaner for a period of two weeks. The nacre softened into a jelly-like mass, here shown pushed up into a ridge. When allowed to dry, the nacre returned to its original position, but all luster was gone and the surface became powdery.

Enstenite!

Figure 11 is the absorption spectrum of a dark-green, 10.83-carat, chrome-bearing enstatite-hypersthene, reportedly from Arizona. Dana once proposed the name *enstenite* for such stones.

Unusual Treated-Diamond Spectrum

A dark, yellow-green, nonfluorescent treated diamond gave us the rather unusual absorption spectrum illustrated in *Figure 12*. Instead of absorption lines at 4080 Å and 5040 Å, lines at approximately 5050 Å and 5150 Å, with the former the stronger, together with two very faint lines just under 5200 Å, were visible. The dark color of the stone prevented us from seeing any of the "cape" lines, other than the 4780 Å.

Metamict Zircon

A dark-green crystal fragment with a brown "skin" proved to be metamict zircon and was reportedly from Brazil. The stone showed intense strain colors in the polariscope in all directions but did show distinct dichroism. The absorption spectrum, *Figure 13,* is unusual and heretofore reported by Anderson as occurring rarely in green Ceylon zirçons.

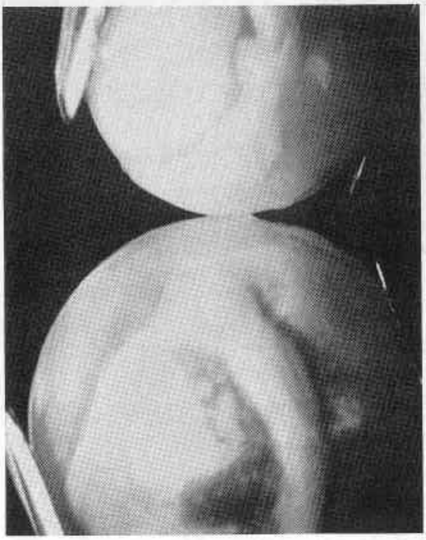


Figure 10

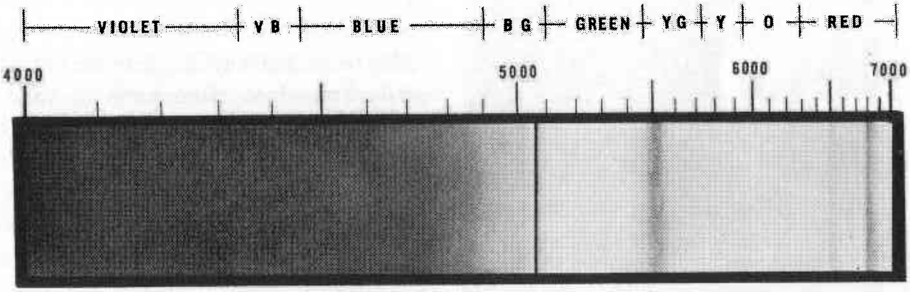


Figure 11

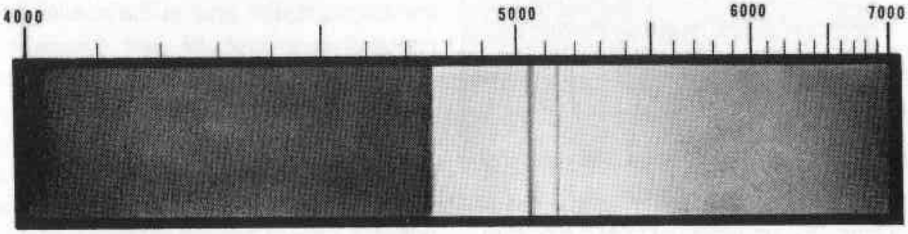


Figure 12

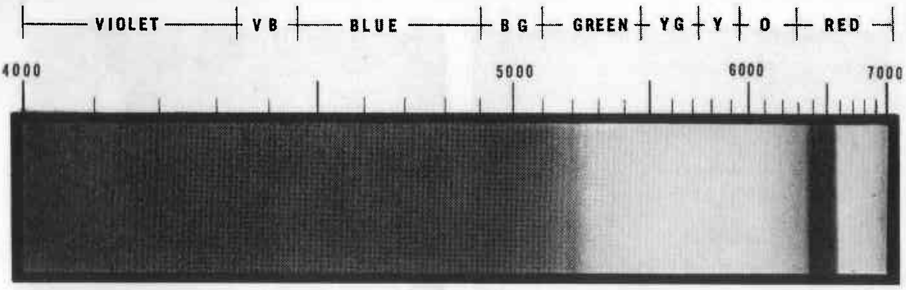


Figure 13

Synthetic Emeralds Exposed to High Temperature

Several good-quality Chatham synthetic emeralds were submitted to us to determine the source of their peculiar surface appearance. All the stones exhibited a "melted" appearance on the surface *(Figure 14)* and most showed numerous parallel etch lines, some of which made angles of 60° and 90° *(Figure 15)*. One stone showed what we felt was an exaggeration of polishing lines *(Figure 16)*, where drag lines had pulled away from an inherent crack. None of the stones showed iridescence in fractures caused by quench crackling, and we could only conclude that the stones had undergone a period of exposure to high temperature.

Californite

The jadelike idocrase called californite has not been particularly available in its native California. Recently, we have seen several lots of stones reportedly from Pakistan, a source listed in Dana. We are indebted to Mr. I. Nishio, President of Associated Merchandise Co., Inc., Tokyo, for a very nice selection of three qualities of the material. With the increased demand for jade, together with import restrictions, efforts are being made to locate suitable substitutes or sources of jade itself. This would seem to account for the number of items purporting to be jade that we have examined lately.

Type II Diamonds

Electroconductivity in diamonds is usually limited to blue stones of the Type II classification. We tested a dark yellow-green laminated stone recently and found it conductive as well as phosphorescent following exposure to shortwave ultraviolet.

Jade-Albite versus Chrome-Albite

The general ignorance of the public, and the confusion even in the minds of jewelers, regarding the jade minerals suggests to us that the use of the term *jade-albite* for the material first introduced in this magazine as *Maw-sit-sit* is not a wise one. Since it has been found and reported to be principally albite feldspar colored by a very fine-grained chrome-bearing pyroxene (chrome jadeite), Dr. Gubelin has proposed the

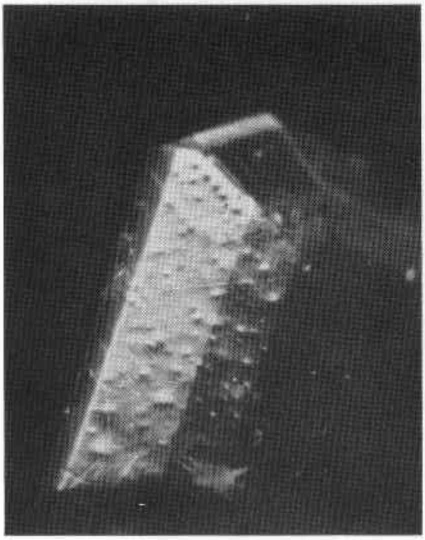


Figure 14

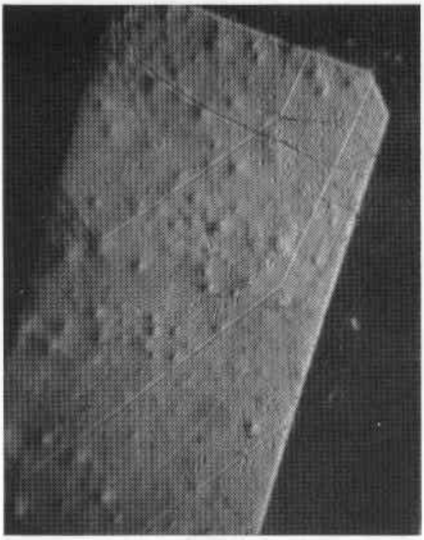


Figure 15

name. Our objection stems from trying to clarify such a term to jewelers, one of whom said, "Oh, then it is jade, isn't it?" We feel the term *chrome-albite* is much less apt to lead to confusion and mislabelling. In the past few months, we have had several occasions to see articles of this mineral, principally graduated beads.

Notes on Lapis-Lazuli

The stone that may be slated to fill the fashion-color slot long filled by turquois is lapis-lazuli. Dealers report increased interest and sales of this intense, dark-blue mineral. Although supplies of turquois have become so scarce that all sorts of treatment and imitations have been devised to supply the demand, it is doubtful if similar activities will be successful with lapis. For one thing, the material is not homog-

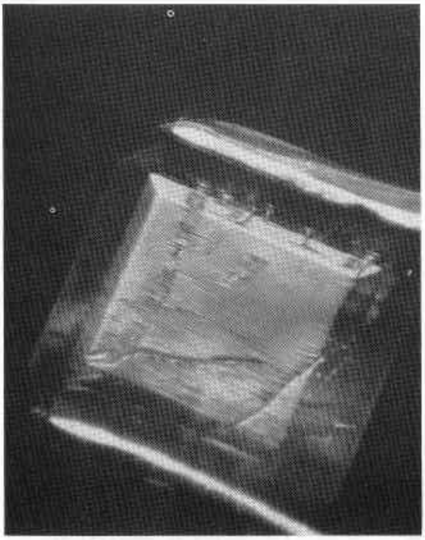


Figure 16

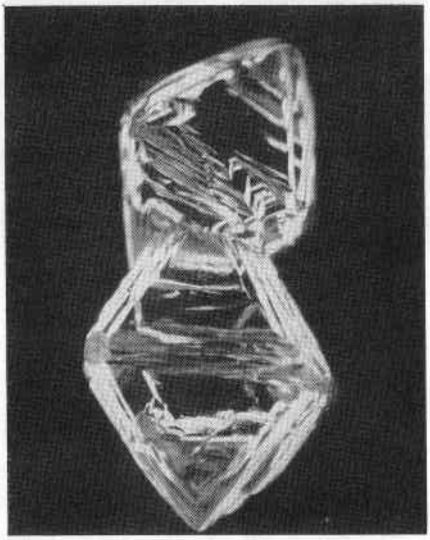


Figure 17

eneous and will not therefore take dye readily nor respond as turquois does to oils and waxes, though aniline dyes have been reported. However, we do occasionally encounter lapis in which cracks and whitish areas have been disguised with what would appear to be a blue wax. One informant suggested that certain blue shoe pastes work well. If carefully done, the process seems relatively permanent. Rarely have we been informed of customer complaints about lapis fading or staining white fabrics – unlike the case of turquois.

Acknowledgements

We were very happy to receive from **Lazare Kaplan & Sons,** diamond cutters, New York City, a 2.13-carat unusual twin crystal. It will be put to good use in Diamond Appraisal Classes *(Figure 17).*

We thank Bogota lapidary **Luis H. Hernandez** for an unusual variation of *trapiche* beryl crystallization. The stone weighs more than 65 carats and is a very pale watery green. It shows very little chromium in the spectroscope, and it is doubtful if a cut stone could be termed emerald.

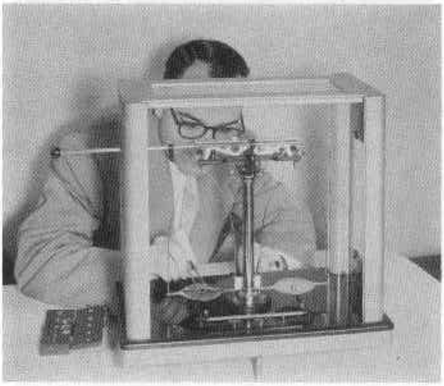
We wish to thank **Mr. Robert Dunnigan,** GIA student of Hempstead, N.Y., for two rare books for our library. One is *Workshop Notes for Jewelers and Watchmakers,* published in 1892 by the Jewelers Circular Publishing Co. The other is *Treatise on Gems,* by Dr. Lewis Feuchtwanger and published in 1838. The book illustrates the confused state of gem-mineral knowledge in the U.S. 127 years ago.

We are very much indebted to the following firms and individuals for responding to our requests for stones to be used for correspondence-student study: **Mr. Bill Mazza,** B fu C. Mazza, New York City; **Mr. Baer,** of Amber Guild, Ltd., Baden & Foss, New York City; **Mr. Melvin Strump,** Superior Gem Co., New York City; **Italo de Vivo,** emerald dealer, New York City; and **Joe Rothstein** of the New York Lapidary and Mineral Society for a specimen of garnet in mica-schist from an excavation at 28th Street and 6th Avenue, New York City.

The Institute acknowledges with appreciation a special award for the most educational display at the Eastern Fed-

Continued on page 351

Developments and Highlights



at the GEM TRADE LAB in Los Angeles

by
Richard T. Liddicoat, Jr.

Dyed Quartz

A bracelet of crystalline quartz (probably quartzite) dyed to a deep violetish red, reminiscent of rubellite more than ruby, showed a broad absorption band in the spectroscope from 5500 Å to 5900 Å. The dye was very obviously concentrated in cracks, as is common in dyed quartz, but rare in the more porous chalcedony. A portion of one of the beads is illustrated in *Figure 1.*

Color Banding in Diamond

A very interesting brown diamond was sent in for identification. Under magnification, it showed strong color zoning, as illustrated in *Figure 2.* It was so unusually strong that we photographed it to show the pattern. Color banding in diamond is not highly unusual, but banding of this strength we do not recall.

Slag Glass

An identification was sent to us from a desert community near Los Angeles, the sender believing that the lump was a natural glass. It was a dark-green material enclosed in a white crust. The appearance under magnification was so roiled that we took a photograph of it *(Figure 3).* Its properties were those of a slag, rather than of natural glass, as the owner had hoped it would be.

Puzzling Arclike Scratches on Diamonds

Recently, we have encountered a number of diamonds with scratches on the table that are circles or arcs of cir-

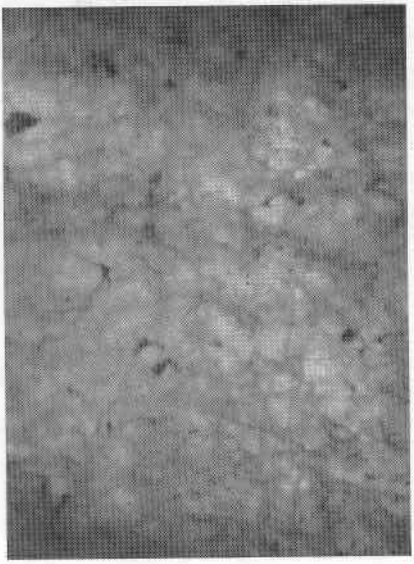


Figure 1

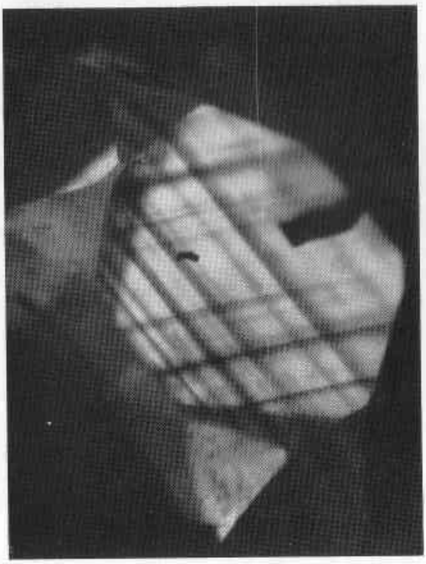


Figure 2

cles. An example is shown in *Figure 4*, wherein it is most readily visible on the right side of the table. Our first impression was that these had been caused during a girdle-polishing operation by the holder used in a girdle-polishing machine. However, the same scratches were encountered on stones without polished or faceted girdles, so it has to be something else. Probably, they are caused by a mechanical dop that holds the stone for polishing the pavilion. We have seen a number of circular scratches of this type recently, and do not recall any of this nature in the past, so someone may have introduced a new dop, or a careless operator has failed to remove diamond powder from the stone or allowed the dop to become contaminated.

An Understanding Customer

We examined a large emerald-cut diamond that had been in a platinum ring. It had been taken to a jeweler's shop to be cleaned, when a workman dropped it and stepped on it, breaking the mounting and forcing out the diamond. Fortunately, the jeweler had an unbelievably understanding customer, who said that if an examination by the Laboratory showed no damage that she would be perfectly satisfied. When the examination showed nothing that could have been traced to the accident, the jeweler was obligated only for new mounting.

Emerald-Green Tourmaline

We had the opportunity of seeing a magnificent green tourmaline — one of

Figure 3

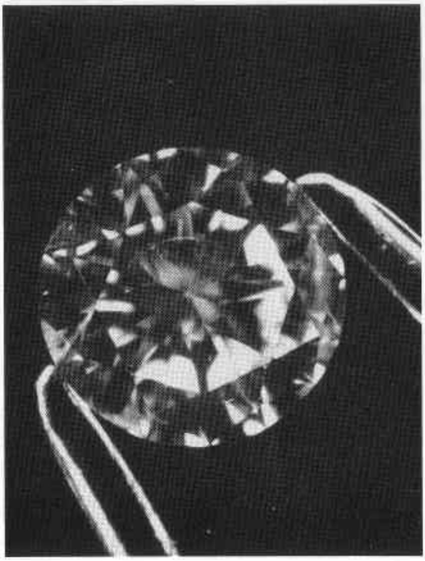


Figure 4

the rare ones found in a color that is reminiscent of a good emerald, rather than tourmaline. Although at best, such a tourmaline does not closely resemble the finest emerald, it is an exceptionally lovely green stone. Even in the darker dichroic direction, the stone was clear and attractive in color.

Acknowledgements

We are very grateful to **George Houston**, Los Angeles colored-stone dealer, who gave us hundreds of doublets when our supply for the Gem Identification Course was exhausted. He also gave GIA a large supply of faceted glass.

The Siberian Diamond Deposits

by

Dr. N. Polutoff, Frankfurt a.M.

Translated from the German by
R. W. Stolz, Hudson Falls, N. Y.

The Discovery

The discovery of the rich diamond fields in the western part of Yakutia (eastern Siberia) doubtless belongs to the great achievements of Soviet geologists in the postwar era. This important event did not occur by accident, but was the result of twenty years of research. It is a brilliant example of scientific prognosis and the result of deductive reasoning and thorough research in the field. West German literature reported very little about this story.

The significance of industrial diamonds to modern industry does not require further discussion. It is known that diamond tools speed up production processes and raise substantially the quality of industrial products. It is therefore understandable that the demand for industrial diamonds in the Soviet Union grew from year to year with progressing industrialization of the country. The distinct shortage of these diamonds, which the Soviet Union had had to import, mostly from England, delayed the development of Soviet industry. The position of the industry grew more difficult when diamond was declared a strategically important product, and export to the Soviet Union was prohibited. On the other hand this circumstance contributed materially to the acceleration of prospect work in their own country.

Long ago (1898 and 1937), industrial-diamond deposits on the mid-Siberian Plateau were known. They were located between the Lena and Jenissei Rivers and the northern Siberian depression and in the north and east Sajan Mountains, in the south. After profound consideration, the focal point of the renewed search for diamonds was confined to this Plateau. The knowledge of the principal diamond provinces of the world (South Africa, India and Brazil) pointed to the old table. The mid-Siberian Plateau represents one of such tables, about four million square kilometers in area, which is known as the Siberian Table.

In 1936, Prof. W. S. Sobolew, in his great monograph about the widely distributed melaphyres on the Siberian Table, recognized that they were similar to the South African dolorites of the Karoo formation. The discovery of picritic porphyries and rocks similar to melilite basalt in the Kotui-Maimetscha district caused Sobolew to speculate that true kimberlite might also be present in Siberia. World War II put an end to further research.

After the War, prospecting was done under extreme difficulties. Equipment for expeditions was poor, and to provide geologists with supplies in the barely accessible Taiga was difficult. The so-called Tunguska Expedition of the Irkutsker Geological Institution, under the leadership of M. Odinzow in 1947, was abandoned in the upper and lower Tunguska with unsuccessful results. At the end of 1947, the so-called Amaka Expedition of the Ministry of Geology and Mines took over the prospecting work on the mid-Siberian Plateau. Eventually, the Amaka Expedition developed into a large research organization, with the principal seat in the village of Njurba, on the middle course of the Wilui River. In 1958, it had three steamers, forty speedboats and a number of airplanes in operation, as well as a well-equipped laboratory.

The first useful diamond placers were proved in 1949, and the primary deposits only in 1954-55.

The discovery of the first kimberlite pipes in 1954 is credited to the young mineralogist L. Popugaewa. One year earlier, she found in the Daldyn-Alakit district, gravels that contained garnet and that, on examination, proved to be pyrope, not unlike that from the South African kimberlites. Earlier geologists concentrated on the diamond itself, with the hope of discovering primary deposits with the help of diamond-bearing alluvium. L. Popugaewa proved that with the help of pyrope-bearing gravel, the target can be reached faster and more surely, since she discovered on August 21, 1954, in the Daldyn-Alakit district the first kimberlite pipe on the Siberian Plateau, which she called *Sarniza*. By this discovery, she dealt a death blow to the previously mistaken conception that primary diamond deposits were not present on the Table, but that the diamond crystals previously found were alluvial, having originated in the neighboring fold mountains, thereby directing prospect work into a new and fruitful direction.

The pyrope method of L. Popugaewa was confirmed during the following years. On June 13, 1955, the rich kimberlite pipe *Mir* (Peace) in the Malaja Batoubija district, and on June 15 the pipe called *Udatschnaja* (Successful One) in the Daldyn-Alakit district were discovered. These two pipes are the foundations of the young Soviet diamond-mining industry. In 1957, another was found on the northeastern rim of the Plateau. By the end of 1958, there had been 120 pipes discovered, some diamond bearing, some diamond free. On January 26, 1960, a new one was discovered on the Sochsolooch River in the Daldyn-Alakit district named *Aichal* (Glory). According to early reports, it is supposed to surpass the famous *Mir* pipe in diamond content.

The Siberian Diamond Province

At present, the borders of the Siberian diamond province are as follows: On the north, the coast of the northern Polar Sea; on the south, the north slope of the east Sajan Mountains; on the west, the Jenissey River; and on the east, the Lena and Aldan Rivers. The primary deposits are concentrated in the northeastern part of the province, in the basins of the Wilui, Muna, Olen and Ek Rivers. The northernmost point of distribution of the Siberian kimberlite pipes at present is the Koujka River, a tributary of the Olenek (with the pipes *Obnashennaja* and *Olivinovaja)*, and the southernmost point is the Malaja Batoubja River (*Mir* pipe).

Prospecting for diamonds took place in the extraordinarily severe climatic conditions in the difficult-to-penetrate marshy primeval woods (Taiga), often in areas totally unexplored. With toughness, ready sacrifice and inflexible will, geologists mastered their many difficult problems. Special praise goes to the women, who, as scientists or with scientific-technical powers, were present in almost all the prospecting parties. Many were in leading positions and took a decisive part in the battle for the Siberian diamonds. The pilots deserve commendation for proving their skill in this little-known Taiga. Also worthy of mention was the valuable help of the native Eweski and Jaktes in their role as transport workers and, above all, as excellent guides through the primeval woods.

The Siberian Plateau

The Siberian diamond province presently covers the eastern half of the mid-Siberian Plateau of the Siberian Table. The Plateau represents a very flattened highland, which is divided by rivers into a system of 500- to 1000-meter-high watersheds (Table Mountains). The Plateau is heavily wooded. In the high north, the wooded zone changes into tundra. The climate is decidedly continental. In the same latitude, it is colder here than in neighboring West Siberia or in the far east. The winter lasts six to seven months. Starting in November, the temperature usually is under —40°F., sinking in mid-winter to —58°F. and sometimes to —76°F. Dry air and lack of wind make it easier to withstand these temperatures. The coldest month is January and the warmest month is July, with temperatures of over +54°F. and sometimes even +72°F. A great disadvantage here is the everlasting frozen ground, which, north of the Wilui River, reaches a depth of 200 meters, making the construction of railroads, watermains, buildings, etc., extremely difficult.

Transportation in the diamond province is scarcely opened. Larger rivers are the only transport routes. Except for reindeer, airplanes are the principal means of transportation.

Tectonic

The mid-Siberian Plateau is typically Precambrian. It consists of dislocated and metamorphosed Archeozoic and Proterozoic rocks. On top of the eroded mountains lie a number of epicontinental marine deposits of Lower and Upper Paleozoic ages. On top of this are layers of mostly continental deposits, including volcanic materials; also, deposits of Permian, Triassic, Jurassic, Cretaceous and Cenozoic ages.

Magmatism

The magmatic activity on the Siberian Table during the Precambrian period has a geosynclinal character. The ensuing magmatic cycles show the features that characterize the magmatic history of the tableland.

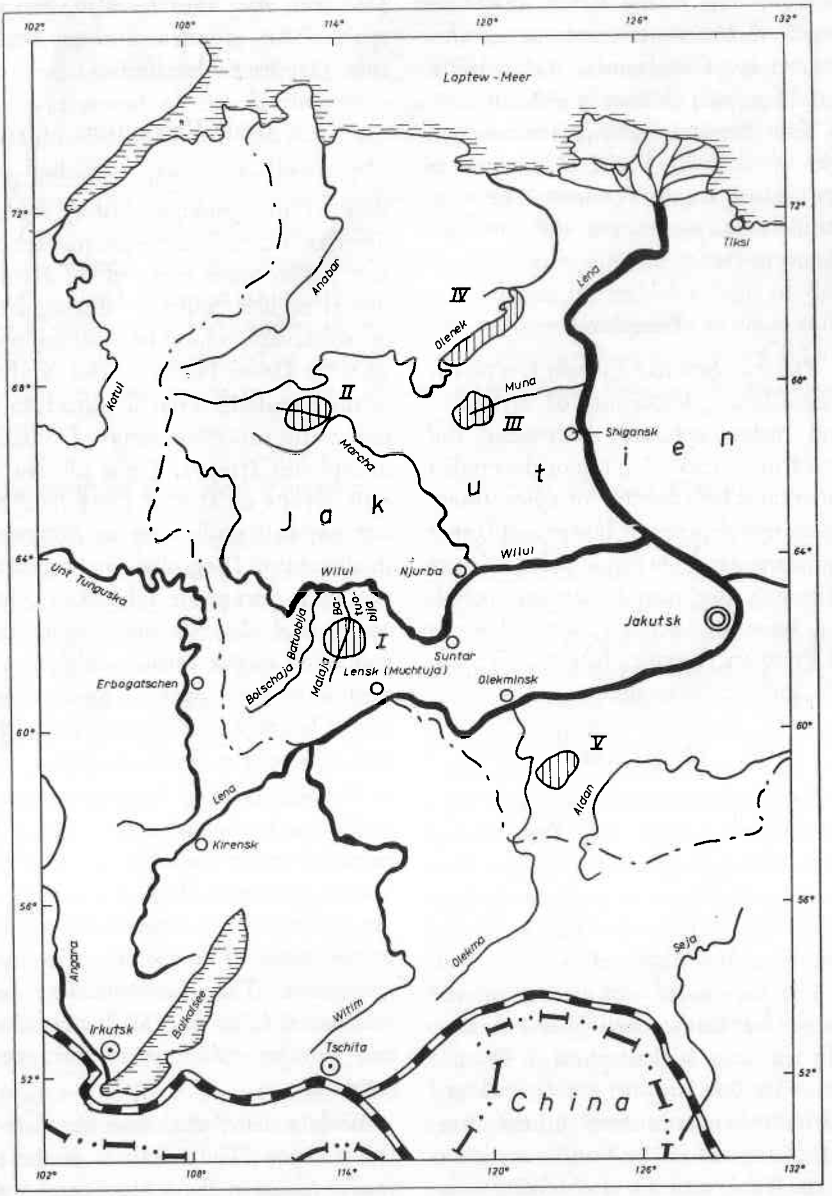
The periods of magmatism on the Table start first in the Upper Paleozoic and reach the highest point in Triassic time. To this magmatic cycle belongs the melaphyre formation and the ultrabasic complex in the northern portion of the Table and the kimberlite formation in the eastern half of the Table. A correct time demarcation of these magmatic formations is not yet known. However, they are related in time and space. They formed during Jurassic time (Upper Carboniferous).

Basic Volcanism

The Triassic occupies a specific position in the geologic history of the Siberian Table. The epicontinental marine basins were replaced by a continental regime, which is distinguished by volcanism, whose beginnings reach into the Lower Permian. The products of the essentially Triassic volcanism are under the collective name of Siberian melaphyres (traps). These plateau basalts occupy an area of more than one and one-half million square kilometers in the entire Tunguska syncline in the northwest part of the Table. In richness and spread, they are the largest basalt formation in the world, perhaps comparable to the Upper Paleozoic dolorites in South Africa and the Paleogene trap rocks of the Deccan in India.

The Siberian trap formation consists of intrusive and extrusive rocks. The intrusive traps form veins, sills and blocks and are widely distributed, especially in the rim areas of the syncline in the zones of the strongest tectonic movement. The sills sometimes are multilayered, up to 250 meters thick and can be followed several dozen kilometers.

Widely distributed also are the extrusive traps. The thickness of the extrusive series in the central part of the Putorana Plateau, in the northwest of the table, reaches 1800 to 2000 meters. The traps appear in some places in the



The Siberian Diamond Province

I: Malaja Batuobija District.
II: Daldyn-Alakit District.
III: Ober-Muna District.
IV: Olenek District.
V: Aldan District.

form of cylindrical tubes, but these are filled with trap meterial, which differs sharply from the fillings of the kimberlite pipes. Trap volcanism appears most strongly inside of the Tunguska syncline. East of the syncline, the traps reach close to the Siberian diamond province.

Ultrabasic Volcanism

In 1937-39, a peculiar petrographic province of ultrabasic and alkalic rock, created by repeated eruptions, was found to cover an area of 30,000 kilometers on the north rim of the Siberian Table in the area of the Maimetscha and Kotui Rivers, which belong to the Chatanga River system. These rocks differ from the trap-rock formation by specific mineralogical and chemical characteristics. An extrusive layer 300 to 2000 meters thick covers the Permian here; it includes nepheline basalts and other alkalic basaltoids. The younger flows of the extrusive series are maimetschites (picroporphyries), which are similar to the typical kimberlites. On the Maimetscha River, the rocks form a homogenous layer 1500 meters thick.

Related to the extrusions are some ultrabasic massifs composed of dunite and peridotite, which are closely related to alkalic rocks.

By today's conceptions, the kimberlites belong to the group of alkalic basaltoids and stand chemically and mineralogically nearest to the melilith basalts, as in the classical area of South Africa. For this reason, the Siberian kimberlites with alkalic basaltoids of the Maimetscha-Kotui area, where lately melilith basalts also were found, are genetically related.

It has to be mentioned that the age of the Siberian kimberlites has not yet been established definitely. It is accepted that the ultrabasic rocks of the Maimetscha-Kotui area formed at the end of Permian time, but predominantly in Triassic time. The formation of the kimberlite itself probably occurred during the relatively short period of the Triassic period, until the start of the Jurassic. After later investigations, the kimberlite volcanism is supposed to have appeared before as well as after.

The Kimberlite Pipes & Lodes

The primary diamond deposits of the Siberian Table are represented by the kimberlite pipes and veins. The point about the pipes is that they consist mostly of rock bodies of cylindrical shape, which in cross section may be oval, round or irregular. In the vertical cross section, many are funnel shaped; e.g., the *Mir* pipe. Others, in comparison, have at depth the same shape as on the surface. The diameter of the pipes is very different, ranging from 20 to 700 meters.

The well-defined vertical zonality (yellow ground, blueground, hardebank) commonly developed on kimberlite deposits is, on the Siberian pipes, scarcely developed. Because of the severe climatic conditions, the surface changes of the kimberlite is in-significant, and the weathering products, such as blueground and yellow ground, are hardly known on the Table.

One part of the pipes has a near-western orientation; e.g., the great Elenek trap dike may be followed more than 100 kilometers, as well as the *Maljutka* and *Jarutskaja* pipes and others. The penetration of the kimberlite magma into this fault system is related to the rejuvenation of the faults during the tectonic movement at the beginning of the Mesozoic period. Many of the kimberlite pipes (e.g., *Sarniza*) have an isometric shape and probably developed at the crossing of several fault systems.

As a rule, the kimberlite pipes appear in groups, forming so-called kimberlite fields in the areas of the near-horizontal carbonate strata of Cambrian and Ordovician age. The pipes are located outside of the compact distribution of trap rocks. The trap magma, which was extruded mainly before the kimberlite magma, changed the surrounding rocks into monolithic blocks. The upward force of the magma used, as supply routes, faults on the border of these monolithic blocks against the surrounding rocks.

The Siberian kimberlite veins originated as did the South African, by repeated eruptions. The *Mir* pipe is built up of two kimberlite columns of different ages. The double-lode *Udatschnaja* is filled by two petrographically and, relative to age, different kinds of kimberlites.

The Siberian pipes contain breccia of fine to coarse fragments, mainly different shades of gray and green. In spite of seeming multiplicity, the kimberlites can be summed up in the following five main types, which in structure, textural and mineralogical composition, differ distinctly from each other:

1. Kimberlite tuffs (*Mir* pipe).
2. Kimberlite breccias (*Sarniza* pipe).
3. Kimberlite of basaltic habit (*Udatschnaja* pipe).
4. Mica kimberlites (*Sagadotschnada* pipe).
5. Kimberlites of transition types (*Nowinka* and *Legkaja* pipes).

The first three types (especially the third) are poor in mica and similar to the basaltic varieties of South Africa.

Among the zenoliths of the Siberian kimberlites, the following kinds of rocks have been traceable:

1. Xenolith of ultrabasic rocks (pyroxenite, amphibole, peridotite, dunite, serpentinite, mica). The characteristic for these rocks is the presence of pyrope garnet.
2. Xenolith of basic rocks (traps: heavily changed gabbro-diabase and diabase).
3. Xenolith of the crystalline slates (with eclogite facies).

There is not enough space for a detailed description of the kimberlite types and the xenolith variations. Also, as in South Africa, the Siberian kimberlites play an important part in the relationship of garnet to the species pyrope. The most widely distributed xenoliths are Siberian basement fragments, which contain garnet and monoclinic pyroxenes and usually plagioclase in considerable quantities. These could not be designated as typical eclogite; rather, one observes all transitions from plagioclase-rich to plagioclase-poor eclogites to those consisting essentially of garnet and pyroxenes only.

Small deposits of typical eclogite have been observed in the *Sarniza, Mir, Udatschnaja* and *Obnashennaja* pipes. To the eclogite facies also belong some peculiar rocks with grossularite, monoclinic pyroxenes and sphene for which the name *grospydite* has been proposed. The mineral paragenesis of this rock may well suggest that it originated under high pressure and therefore under conditions that formed the eclogites.

The geological conditions of formation of eclogites are complicated and, as yet, insufficiently understood. It is only known that the procedure of eclogitization is not related to the effects of the magmas on the xenoliths enclosed. The appearance of eclogite rocks and pyrope is ordinarily characteristic of kimberlites and harmonizes with the formation of diamonds, which, as is well known, originate also as those of eclogites, under very high pressure.

The above-mentioned five principal types of Siberian kimberlites distinguish themselves by the unusually stable mineralogical composition. The quantity of individual minerals in the different types of kimberlite and kimberlite deposits varies widely. In all kimberlites, olivine, ilmenite and magnetite are widely distributed, and in most of them pyrope, too, is abundant. Commonly, pyrite is an important mineral. Chrome diopside, enstatite, chromite, apatite, zircon, hornblende, perovskite and other minerals appear as individual grains.

Sobolew deserves the credit for first recognizing the similarity of the Siberian diamond province with the one of South Africa and of promoting the prospecting for diamonds in Siberia. This similarity has, according to the latest investigations, surmounted all expectations, so that it is simpler and easier today, not by similar indications, to establish the existence of similarities between the two provinces. The age of the South African diamond deposits is seemingly Cretaceous, whereas the age of the Siberian is essentially pre-Jurassic. Also, the Siberian trap formation is older than the dolorites of the Karoo formation. In comparison between the two provinces, there exists a great similarity in the composition of the kimberlite deposits and in their linear arrangement. The Siberian kimberlites are less altered than the South African, so that the fresh kimberlite in Siberia reaches close to the surface. In Siberia, the

Continued on page 351

Book Review

THE BOOK OF DIAMONDS by Joan Younger Dickinson. Published by Crown Publishers, Inc., New York. 226 pages, glossary and bibliography. Numerous black-and-white illustrations. Price: $5.95.

Joan Younger Dickinson has filled an obvious gap in the literature in the diamond field by writing *The Book of Diamonds,* a popular, thoroughly entertaining account of this fascinating gem from ancient to modern times.

Beginning her story with the discovery of diamonds in India's Golconda Mines, the author traces the history, lore and romance of diamonds, through the Brazilian diggings to the South African diamond rush and the development of De Beers Consolidated Mines, Ltd., to their present control of eighty percent of the world's gem-diamond production. This section is followed by a rather full coverage of the intricacies of cutting and polishing.

Mrs. Dickinson continues with an interesting account of the more celebrated diamonds of the world. Included are stories of such notable stones as the *Koh-i-Noor, Orloff, Cullinan, Regent, Hope, Sancy, Florentine, Vargas, Tiffany, Excelsior, Jubilee and Jonker,* as well as some of the larger diamonds found in this country. Omitted, unfortunately, are descriptions of the *Nassak, Great Mogul, Polar Star, Star of Este, Empress Eugénie, English Dresden, Dresden Green* and a few others that are notable from viewpoints of history or drama. Each story is interestingly written, with an emphasis on human-interest content.

Another chapter discusses the role that diamonds have played in American fashions among the wealthy and the working girl alike. This story starts with the earliest jewelry stores of New York City in the 1700's and concludes with the plush present-day establishments along Fifth Avenue.

The last chapter is intended as a guide to the selection and purchase of diamonds. She points out that fully 50% of engagement diamonds are chosen with the aid of the bride-to-be. The stone should be chosen with a clear eye and a clear head is her message — not in "a fog of sentiment." For the uninitiated, Mrs. Dickinson explains and illustrates the various cutting styles, the meaning of the word carat, and how to buy diamonds for beauty, show, flawlessness, investment, or even for sentiment. The accepted etiquette, as well as practical advice for buying the engagement ring is offered. Answers to questions most likely to be asked by the prospective bridegroom and his fiancée, including how to clean and care for a ring, are also answered. For the more gemologically minded reader, here is an abbreviated but informative glossary of diamond terms.

The Book of Diamonds is illustrated with old engravings of diamond mining and reproductions of museum paintings, plus photographs of cutting, mining, famous diamonds, and award-winning traditional and modern diamond pieces. Everyone who has an appreciation for the diamond should find this book an enjoyable and valuable reading experience. Many jewelers will consider it a worthwhile gift for good customers.

Continued from 349

mica kimberlites are seemingly less well distributed, as in South Africa. The basaltoid kimberlites are more significant. Contrary to South Africa, perovskite is poorly distributed in the kimberlites. The two provinces are distinguished for their noteworthy distribution of pyrope. Siberia is also remarkable for the presence of moissanite (silicon carbide) and the plagioclase eclogites.

(To be continued)

NEW YORK LAB NOTES

Continued from page 338

eration of Mineralogical and Lapidary Societies meeting and exhibition in New York City in July. A handsome golden loving cup attests to the award.

We are very much indebted to **Advanced Ring Manufacturing Company** for making available to Bert Krashes for his Design Classes a selection of parts and findings that enable students to visualize ring construction.

A very large vote of thanks is due **Mr. Ed Purcell** of Baumgold Bros., diamond cutters of New York City, for making available to Eastern Headquarters a fine selection of fancy-shape diamonds for use in Diamond Appraisal Classes.

Continued from page 330

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