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and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

THE GEMMOLOGICAL ASSOCIATION
OF GREAT BRITAIN
93/94 HATTON GARDEN LONDON E.C.1

THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN (INC.)

(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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THE ATOMIC STRUCTURE OF DIAMOND

IN October last Dr. Kathleen Lonsdale gave a delightful lecture to the Gemmological Association on "The Atomic Structure of Diamond," in the rooms of the Geological Society. In welcoming the lecturer from the chair, Dr. Herbert Smith mentioned that she had returned only the day before from an extensive lecture tour of the Scandinavian countries under the auspices of the British Council. Dr. Lonsdale spoke without reference to notes and in so skilful a manner as to make the difficult subject (in which she is a specialist) understandable to all who were present. The lecture was illustrated by lantern slides and by helpful blackboard drawings. The following is a brief paraphrase of Dr. Lonsdale's talk, given as accurately as the memory of one interested listener can make it, aided by notes made at the time.

Diamond has, in past years, been the subject of investigations by many of the world's most famous scientists. The work still continues, and still there seems to be no prospect of the final word being said on the mystery of its structure and properties. It almost seems that no two diamonds are quite alike, and the problem therefore becomes in part a statistical one. This is realized by Sutherland, now working at Cambridge on the infra-red spectrum of diamond, who has sorted through many thousands of stones in the course of his investigations.

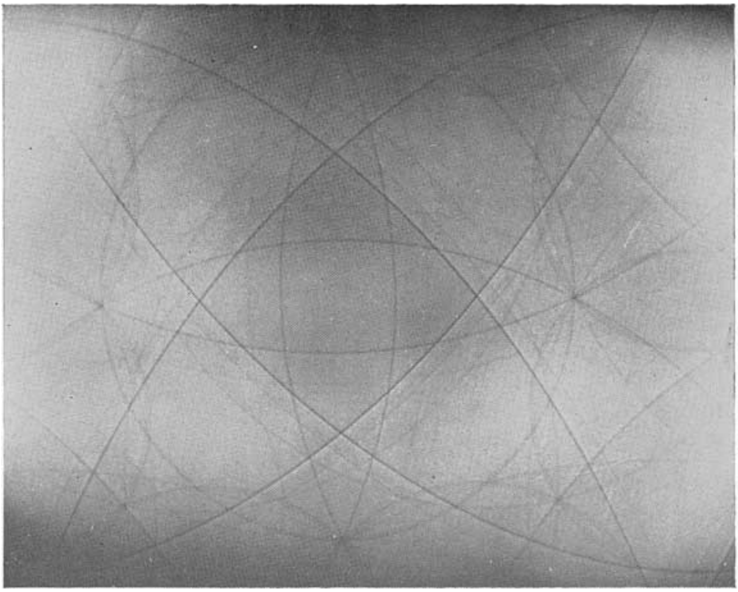
As an example of the variability of diamond may be cited the work of Chesley, who submitted 33 diamonds from 14 different localities to an elaborate spectrochemical analysis. Traces of aluminium, silicon, calcium, magnesium, copper, barium, iron, strontium, sodium, silver, titanium, chromium, and in one case lead, were found in varying amounts.

When considering the structure of a crystal in the fullest sense one has to consider the following three aspects:

1. The arrangement of the atoms,
2. The crystal texture,
3. The dynamics of the crystal lattice.

So far as the arrangement of the atoms in diamond is concerned, this was investigated by W. H. and W. L. Bragg in 1913, using the newly-discovered technique of X-ray crystal analysis. They found that in diamond there are endless chains of carbon atoms in which each carbon is linked to four others arranged tetrahedrally round it. The unit cell in such an arrangement of atoms can be described as a face-centred cube within which four further atoms are disposed at the centres of four of the eight smaller cubes enclosed by the cell. Expressed differently, the structure consists of two interpenetrating face-centred cubic lattices. Such a structure is by no means a close-packed one—were it so, the density of the mineral would be about 7.6 instead of 3.52—but it is very strong from the " engineering " point of view. Further, since in long-chain hydrocarbons the highest refractive index is found along the length of the chains, so the chains of carbon atoms which extend in all directions in diamond may account for its high refractivity. Other remarkable properties of diamond include its high thermal conductivity (higher than some metals) and low coefficient of expansion. Thanks to these properties, a diamond at red heat can be plunged into liquid nitrogen without harm, whereas almost any other non-metallic mineral would be completely shattered.

By crystal " texture " is meant the perfection or imperfection in alignment found in the minute crystallites of which the whole crystal is built. In a " perfect " crystal there is complete homogeneity, whereas in a " mosaic " crystal the tiny units are slightly " staggered " like the bricks in a badly-made wall, or may even



Photograph of a diamond, taken with a divergent beam of X-rays from a copper target. The film was perpendicular to a four-fold axis (cube edge) of the structure.

have a spiral arrangement. A model made from a stack of identical cards stitched together with elastic threads can be used to illustrate this. X-ray patterns of a crystal give information about this mosaic structure. " Perfect " crystals give feeble X-ray reflections, since interference of the rays reflected from the deeper layers of atoms prevents their contributing to the strength of the reflected beam, whereas in a mosaic structure the whole crystal can contribute and the reflected beams are thus far stronger. This is particularly true of the " divergent beam " photographs (a technique much favoured by Dr. Lonsdale) in which a small crystal is placed close to the source of a strongly diverging beam of X-rays, which then fall on to a photographic film or plate. The directions in which reflections at the atomic layers have removed certain of the rays are marked on the negative as pale lines against the darker fogged background, and the symmetry and orientation of the specimen can be gauged with extreme accuracy. Such photographs are extremely beautiful and the exposure time is extremely short. In the example reproduced in Fig. 1 the film was parallel to a cube face, and the four-fold symmetry can be clearly seen as in a stereographic projection. Copper "α" radiation was used and the exposure time was only a few seconds. This type of photograph permits very accurate measurements to be made of the mean distances between the carbon atoms. This distance averages 1.54451Å but shows a real variation between 1.54440 and 1.54465Å possibly due to the effect of a few "foreign" atoms present in the lattice.

The "dynamics" of the lattice include the study of the heat-vibrations which the atoms undergo about their mean positions. These are considerable even at room temperatures and at 1600° C. (in absence of air) are violent enough to allow the diamond structure to be converted into the more stable graphite formation.

Dr. Lonsdale alluded in passing to the strain under which some diamonds exist. Spontaneous explosions are very rare, but two authentic cases were known to the lecturer, and a slide showing the specimens concerned was shown. One stone (belonging to Prof. W. T. Gordon) was complete when placed in the safe but had exploded before the next day. This was found to contain a smaller diamond crystal enclosed within the first—possibly the cause of the strain.

The lecturer also had something to say about Hannay's artificial diamonds. It was Dr. Lonsdale who, with Dr. F. A. Bannister, subjected the tiny fragments in the British Museum collection to searching X-ray tests and proved all but one of them to be diamond. Hannay claimed some success in only three out of eighty difficult and even dangerous experiments. There are those who doubt the authenticity of Hannay's results because they have repeated his experiments without success. Dr. Lonsdale asked, cogently enough, whether any of these workers followed Hannay in attempting as many as *eighty* experiments on these lines.

In thanking Dr. Lonsdale for her most interesting lecture, Mr. F. H. Knowles-Brown said that he had experienced a shock of disappointment when she broke off her lecture on account of time, when there was so much more of the story of diamond that she could tell and we should like to hear. He hoped that Dr. Lonsdale would consent to address the Association on some future occasion.

B. W. A.

UNUSUAL INCLUSIONS *in* Almandine Garnet

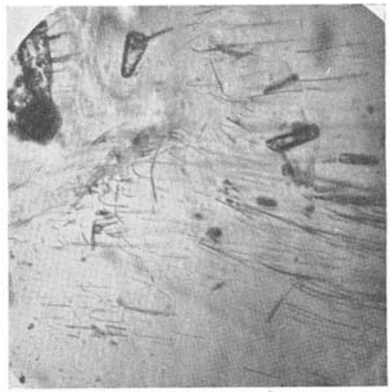


Fig. 1. Fibrous inclusions in an almandine garnet. x 25.

DURING the examination of a parcel of almandine garnets, a specimen was found which showed inclusions reminiscent of the asbestos fibres usually associated with the demantoid variety of garnet. Subsequently a similar stone from another parcel also showed rather similar inclusions.

Photomicrographs of the inclusions shown by both stones, and also one showing the asbestos fibres (byssolite fibres, according to Dr. Gübelin) in a demantoid garnet, are shown in Figs. 1-3.

Both the red stones were cut en-cabochon and were small, so that the constants of specific gravity and refractive index could not be conveniently determined ; they both showed the typical absorption spectrum of almandine garnet.

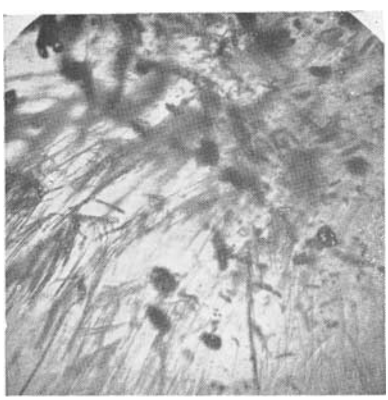


Fig. 2. The inclusions in Mr. Kino's almandine garnet. x 25.

Fig. 3. Asbestos fibre inclusions small almandine garnet. x 25.

Canadian Gems and Gem Localities

By D. S. M. FIELD

Part III
(conclusion)

GEMS OF BRITISH COLUMBIA

ALTHOUGH the gem species of Western and Northern Canada are fairly numerous, only a few deposits have yielded cutting material. Generally speaking, prospectors and engineers have been concerned only with minerals of economic importance, and no extensive search for gems has been made.

In the more accessible parts of Northern Manitoba, for instance, pegmatite dykes and sills are numerous, and some of the few examined for gemstones have yielded quite good material. Similar discoveries may be made when the rocks of other sections of this northland are carefully searched for cutting specimens.

While the writer has made every effort to list only the localities which have at one time or another yielded gem material—or those which seem to offer considerable promise—it should be borne in mind that in a country the size of Canada, thousands of miles may separate the various deposits ; and in regions such as the far north, only the most daring collector can hope to secure specimens at their source. For such reason, one must rely, for the most part, upon the word of persons often not too well qualified to judge the material by a gemmologist's standard of quality. Since many species and very many deposits mentioned in Government reports are not listed herein, the writer does not infer that this paper exhausts the known resources, let alone the unknown possibilities.

It is proposed to publish supplements to this article as further discoveries are made.

AGATE, CHALCEDONY, CORNELIAN.—Handsome specimens of these minerals occur in considerable abundance throughout British Columbia, especially in the Ashcroft, Kamloops, Nicola, Omineca and Queen Charlotte mining divisions. Some of them are found in the Miocene-Tertiary volcanics ; others are found as rolled pebbles along the shores of lakes and rivers, and on the beaches of the coastal islands. Large masses of good colour occur at Aspen Grove Camp, in the Nicola mining division. The rolled pebbles are particularly abundant on the Queen Charlotte Islands. On Vancouver Island, agate is found to a small extent in the volcanic rocks of which this island is largely composed.

In the North West Territories, olive-green chalcedony (chrysoprase) is found in small veins on Belanger Island, on the east coast of Hudson Bay.

ALMANDINE.—Fine almandine crystals ("the most beautiful in the world . . ."—Kunz) occur in mica schist, and in the gravels derived from this, on the Skeena and Stickeen Rivers, B.C. Some years ago, Mr. E. R. Flewwelling, a Vancouver manufacturing jeweller, had a cabinet containing several hundred cabochon and faceted specimens of this garnet, many of which were examined by the writer. Athough of fine colour, most of the stones—some of which weighed over ten carats—contained numerous dendritic inclusions of foreign matter. The crystals, when found imbedded in the matrix, are very nearly perfect in form and polish ; and though few of them are transparent enough to cut, they make striking cabinet specimens. The crystals are so closely spaced that a cubic foot of matrix might contain two dozen or more crystals—many over an inch across. Some of these crystals, in the matrix, are on display at the Vancouver City Museum, and at other museums in British Columbia and elsewhere.

Several specimens of gem quality almandine were collected (circa 1915) in Baffin Land on Garnet Island (Long. 78° 30′, Lat. 63° 45′) by an official of the North Lands Exploration, Limited. A few of them were cut into hollow cabochons and roses for the Royal Ontario Museum of Mineralogy Collection. This garnet is not found as individual crystals, but as rounded crystal masses, sometimes as great as four inches in diameter. Almandine also occurs in Baffin Land, at Albert Harbour ; and good crystals were brought from that locality (circa 1908) by Captain J. E. Bernier.

Almandine is of widespread occurrence throughout the West and North, but the localities described above are the only ones known to have yielded gem material.

AMBER.—This fossil resin is of frequent occurrence in the coal-fields of British Columbia. The most promising deposit (at Coalmont, B.C.) was described in some detail in a previous article (Field, D. S. M. " Canadian Amber." " Journ. Gem." October, 1947, Vol. I, No. 3). However, at none of these localities are the grains or nodules of sufficient size to furnish any but the smallest type of ornament—although many of the pieces are transparent and show a wide range of colours.

Another variety of Amber (called " Chemawinite," in allusion to a nearby Hudson Bay Post) occurs in the sand and gravel along the shore of Cedar Lake, Manitoba ; but the largest piece found was only slightly more than an inch in diameter. The beach on which the Chemawinite occurs is from eighty to one hundred and twenty feet wide and about a mile long. Mr. J. B. Tyrrell, of the Geological Survey of Canada, sank test pits to ascertain the depth of the deposit, and estimated that the upper two feet (in which the proportion of the amber is fairly uniform) contain nearly a million and a half pounds of the resin. Some of the pieces have been cut en cabochon and placed on display at the Royal Ontario Museum of Mineralogy, Toronto.

Amber also occurs in both Saskatchewan and the Yukon, but the deposits are of minor importance.

Only a few of the Canadian fossil resins contain succinic acid, but it should be borne in mind that this qualification for amber was propagated by the German Government—which controlled the mining and manufacture of their Baltic product—rather than by gemmological authority (v. " True Amber." Shipley. " Dict. Gems and Gemology," 1945).

AMETHYST.—Amethysts are known to occur in the trap rock of Dubawnt Lake, N.W.T. (quality unknown).

ANDRADITE (DEMANTOID).—This rare variety of garnet is found in pale, honey-yellow to brownish-yellow crystals ; and in yellowish-green masses, in association with a fibrous white tremolite, on Texada Island, B.C. (Malaspina Copper, Cornell and Marble Bay Mines). It also occurs quite commonly as a gangue mineral in the Alberni, Kamloops and Lillooet Mining Divisions. The Texada Island andradites are large enough to furnish gems, if any can be found clear enough for this purpose.

ANHYDRITE (SULPHATE OF CALCIUM).—This beautiful mineral occurs in large quantities north-east of Gypsumville, Manitoba. It is hard enough to take a fine polish, and shows attractive bluish-grey and red tints. It has been suggested for use as an ornamental stone.

APOPHYLLITE.—Apophyllite occurs in fine specimens of a beautiful pink colour at Le Roi Mine, Centre Star Mine, and at other mines in the Rossland area of British Columbia (Trail Creek Mining Division) (Johnston. " List of Can. Min. Occur.," Geol. Survey, 1915).

AXINITE.—Fine hair-brown crystals and crystalline masses of axinite occur on the west slope of Nickel Plate Mountain, Osoyoos Mining Division, B.C. (quality unknown).

AZURITE AND MALACHITE.—Several specimens of azurite from B.C. are on display at the Vancouver City Museum. This mineral usually occurs, in Canada, as druses, stains or coatings, seldom thick enough to cut. Malachite of fine colour is found in both the crystal and massive forms at the head of Copper Creek and Boundary Creek, Greenwood Mining Division, B.C. It also occurs as crusts and as small, radiating acicular crystal groups at several other localities in that province. Typical botryoidal specimens of malachite are on display at the B.C. Mining Building, Vancouver.

BERYL.—Transparent crystals of aquamarine, of good colour, occur in the pegmatite dykes of the Bernic Lake district of Manitoba. Dr. Goodwin (" Geol. and Min. of Man., 1929) suggests that these may prove to be of gem quality.

CALCITE (VAR. ICELAND SPAR).—A cleavage rhomb has been found on a dump at the " You-Know-Me " Claim, at Whiskey Point, Lardeau Mining Division, B.C. Good specimens are found, too, in association with the copper-bearing rocks of the province.

CHIASTOLITE.—The Chiastolite variety of Andalusite from Great Slave Lake (N.W.T.) is outstanding for size and pattern. Chiastolite also occurs on the hills west of Armstrong, B.C.

CHRYSOCOLLA (HYDROUS SILICATE OF COPPER).—Chrysocolla occurs in connection with the copper ores of both the Greenwood Mining Division and Yale District, B.C. ; and with limonite in the Whitehorse Mining Division of the Yukon.

CHRYSOPRASE.—(See Agate, etc.).

CORUNDUM.—A celandon-green, transparent corundum has been observed in the gold washings of the Pend d'Oreille River, West Kootenay District, B.C. (Geol. Survey Can. Rep't. New Series, IX-15R) ; and small rubies have been noted in the gravels of certain creeks tributary to the Tulameen River, B.C. (Johnston, op. cit.).

DIAMOND.—" Microscopic diamonds have been found in scattered groups and minute veinlets in connexion with chromite and chrompicotite occurring in dunite at two localities in the province (B.C.):

" Clinton Min. Div.—' With the chrompicotite of Scottie Creek, Bonaparte River " (Mines, G.S. Br., Sum. Rept., 1911, 360).

" Similkameen Min. Div.—' With the chromite of Olivine Mountain ' (Ibid., 1910, 112-113) " (Johnston, op. cit.).

DIOPSIDE.—Three-inch crystals of diopside, with very fresh, brilliant surfaces in the prism zone only (the ends being rounded and corroded), occur in the calcite on MacDonald Island, Baffin Land. The material is described as being olive-green in colour, and much brighter and fresher than the diopside found at Calumet Falls, P.Q. (Walker, Dr. T. L. " Min. of Baffin Land," Ottawa Naturalist, Aug.-Sept., 1915).

EPIDOTE.—This mineral is found in magnificent crystals (some of gem quality) on Prince of Wales Island, Alaska (U.S. Territory) ; and similar material occurs on the neighbouring (Canadian) islands, and in the Boundary District of B.C. It occurs, too, on the west coast of Vancouver Island. The material is rather dark in colour.

Epidote is also found at the mouth of Loon Lake, on the east side of Lake Winnipeg, Manitoba ; not of gem quality, however (although cut with the rock, it might provide an ornamental stone).

In the Whitehorse Mining Division of the Yukon, Epidote crystals occur abundantly ; and some of them might furnish gem material.

FLUORSPAR.—At Five-Mile Point, just east of Troup Junction, Nelson Mining Division, B.C., a band of bluish and purplish fluorspar, having a maximum thickness of fourteen inches, occurs along the foot of a tunnel cut in granite porphyry.

Fluorite suitable for quite large ornamental objects may also be obtained at " Rock Candy " Mountain, B.C., and crystals of fluorspar occur at the west end of Baker Lake, Dubawnt River, N.W.T.

GROSSULARITE.—This variety of garnet is found on Texada Island (Nanaimo Min. Div.) and at Lepaz Bay, Graham Island, B.C. The Lepaz Bay grossularites occur in fine trapezohedra, but there is no report as to quality.

A crystalline, massive form of grossularite—probably similar to the so-called " Transvaal Jade " of South Africa—occurs in the Whitehorse Copper Belt, Yukon.

HORNBLENDE.—A blackish-green, fibrous aggregate occurs near Foster Bar, Fraser River, B.C., and at Ash Inlet, Big Island, Baffin Land.

IOLITE.—Excellent crystals of first-grade gem iolite occur in some abundance eighty miles N.W. of Great Slave Lake, N.W.T. Some of this has yielded rich blue stones of from one to four carats or more in weight.

Deep blue, gem quality iolite also occurs in Baffin Land, on Garnet Island (Long. 72° 30′, Lat. 63° 45′). Here the mineral is found in association with a feldspar rock, and probably also occurs as lenses in gneiss. Some irregular fragments, only very slightly flawed, were brought out (circa 1915). Some of these measured as much as two inches in diameter (Walker, op. cit.).

JASPER.—Good specimens, in the form of rounded pebbles, occur in the Atlin Mining Division, and in the Boundary District of B.C. ; in the Grass River and Rice Lake Districts of Manitoba ; at the east end of Great Slave Lake, N.W.T. ; and, with magnetite and hematite, as float in the wash of Bonnet Plume and Snake Rivers ; and at Patterson Mountain and Tagish Lake, Yukon.

KYANITE.—Occurs in British Columbia, with beryl, in the mica vein south of Tête Jaune Cache, and in the Kamloops, Nelson and Vernon Mining Divisions (no report on quality). In the Kamloops Division it occurs in the form of radiated columnar aggregates of a pure blue, bluish-grey and greyish-green colour, on the North Thompson River.

LAZULITE.—This mineral is found in quartz, three-quarters of a mile east of the Churchill River, Northern Manitoba. It possesses a rich blue colour (similar to lazurite) and takes a good polish. Some of the Churchill lazulite is on display at the Royal Ontario Museum of Mineralogy, Toronto.

MARCASITE.—Marcasite is found in British Columbia in some of the mines at the head of Kettle River, and in Manitoba, on the banks of the Assiniboine, and as nodules in boulders of white sandstone on various islands in Lake Winnipegosis.

NEPHRITE.—This variety of jade occurs as water-worn boulders, near Lytton, in the valley of the Fraser River, B.C. Some of the specimens from that locality have been examined by a Toronto lapidary, and were found to be of too dark a shade of green to make attractive gemstones. Nephrite also occurs as water-worn boulders on the Lewes River, a tributary of the Yukon, Yukon Territory.

OBSIDIAN.—Obsidian occurs in both large and small masses on the higher eastern slopes of Il-ga-chuz Mountain ; also in large quantities on Anahim's Peak (also named Beece), an isolated peak between the Il-ga-chuz and Tsi-tsutl Mountains, in the Upper Blackwater Country, British Columbia. In addition to these localities, obsidian is found on a small island north-east of Tas-kai-guns, on the upper part of Masset Inlet, Queen Charlotte Islands, B.C., and at other points in the province.

OPAL.—Some specimens of this mineral—approaching precious opal in character—have been found near Dropping-water Creek, about two miles N.W. from the head of Stump Lake, B.C.

White, pale greenish-white and apple green, translucent opal occurs in the Tertiary agglomerate of Savona Mountain, B.C., and common opal and semi-opal occur in the Quesnel, Similkameen and Slocan Mining Divisions, B.C.

PERIDOT.—This variety of the mineral Olivine is common in the eruptive rocks of British Columbia, especially in the dunite of Scottie Creek, Clinton Min. Div., and at Olivine Mountain, Similkameen Min. Div. Gem quality material occurs, sparingly, in geodes at Timothy Mountain, B.C. Some of this has been cut.

PREHNITE.—Excellent prehnite, of a fine green colour, occurs at the Le Roi Mine, Rossland, in the Trail Min. Div of B.C. A beautiful green prehnite similar to this is found in veins at Admiralty Inlet and Adams Sound, and (with copper) at Copper Mountain, N.W.T.

ROSE QUARTZ.—Dr. A. L. Parsons (Director Emeritus of Min., Royal Ontario Museum) describes the rose quartz of Manitoba as follows: " The Manitoba material . . . is a deep pink and is well suited for all purposes for which rose quartz is adapted. When taken out of the deposit with care, it is equal to the best rose quartz from other countries " (Contrib. Can. Min., 36—Univ. Toronto).

This material is found in a pegmatite dyke in the Oiseau River area. A large ornamental rose, cut from Manitoba material, is on display in the Royal Ontario Museum. This is shown in colour in the educational bulletin cited above.

Rose quartz is also found in Amadjuak Bay, Baffin Land. The surface deposit is very pale in colour, while the embedded material is a deeper pink, giving support to the claim that rose-quartz fades when exposed to bright sunlight.

SCAPOLITE.—White scapolite, having a vitreous lustre, occurs in large crystals at MacDonald Island, Baffin Land. Some of these crystals measure as much as five inches in diameter.

SILICIFIED WOOD.—Excellent specimens of silicified wood are found near the elbow of the South Saskatchewan River, Alberta ; also in the vicinity of Ross Coulée. Fine specimens have also been found in British Columbia, on Agate Mountain, on the Similkameen River, and on Wolf Creek, Similkameen Min. Div. This makes a beautiful ornamental stone when highly polished.

SMITHSONITE.—Smithsonite has been found in the Slocan Min. Div. of B.C., but no report on the quality is available at present.

SODALITE.—Large specimens of a very beautiful, light cornflower blue sodalite occur, in abundance, in the vicinity of Ice River, a tributary of the Beaver-foot, in the Golden Mining Division of B.C. Polished slabs of this sodalite are on display at the Royal Ontario Museum of Mineralogy.

SPHALERITE.—Widespread in British Columbia, but it is doubtful that any of the deposits would yield gem material.

SPINEL.—A beautiful lilac-coloured spinel occurs in Baffin Land, but all the pieces collected proved to be too badly fractured for gems.

SPHENE.—Sphene occurs in small, yellowish crystals in the granite of the coastal range of British Columbia.

STAUROLITE.—Staurolite is found on the west side of Slocan Lake, Slocan Min. Div., B.C. The mineral also occurs, as huge crystals, at Snow Lake, Manitoba. Some of these crystals are transparent in part. The stones are dark reddish-brown in colour, but will yield cabochons, and possibly faceted gems.

TOPAZ.—Transparent, pale yellow and pale blue topaz pebbles have been observed in the gravel of a small river west of Jasper House, Jasper Park, Alberta. Topaz is also found in British Columbia, at Mica Mountain, Tête Jaune Cache (Cariboo Min. Div.), and in Manitoba, in pegmatite dykes of the Oiseau River area.

TOURMALINE.—Rather fine crystals of tourmaline have been noticed in the pegmatite of the Oiseau River district of Manitoba, and some may prove to be of gem quality.

Tourmaline also occurs in the Ainsworth, Nelson, Skeena and Slocan Mining Divisions of B.C., but no reports on quality are available at present.

TREMOLITE.—Very pretty specimens of tremolite occur in a light bluish-grey calcite at Deadwood Camp, Greenwood Mining Division of B.C. These are white in colour, and possess a fine fibrous structure. Some of them would undoubtedly furnish cat's-eyes.

Tremolite also occurs, in association with copper ores, on Texada Island, in the Nanaimo Mining Div., and on Vancouver Island it has been noted in several localities,, associated with limestone.

UVAROVITE.—This handsome, but extremely rare variety of garnet, occurs as small bright emerald-green, transparent, imperfectly shaped crystals, associated with white quartz, white scapolite, and grey, greyish-green, and greyish-brown pyroxene, near the southern end of Upper Arrow Lake, on the west side, and between Despatch Island and the point opposite Nakusp, on the east side of the lake, in the West Kootenay district of B.C. These crystals will furnish gems, if any can be found that are large enough to cut.

VESUVIANITE (IDOCRASE).—Fine crystals of Vesuvianite occur at Marble Bay, Texada Island, B.C. Some of these may be of gem quality.

ZIRCON.—Small, but very well developed crystals of this material have been noted in the pegmatite of Wilson Creek, Slocan Mining Division, British Columbia.

REFERENCES.

References to Canadian Gem minerals are scattered through so many official Canadian geological reports that it would be an immense task to list them all. However, the following fourteen authoritative references contain much of interest on Canadian gems and gem localities:—

(1) BAILY AND JACK.—" The Woods and Minerals of New Brunswick " (1876).

(2) GESNER, A.—" Geology and Mineralogy of Nova Scotia " (1836). (An excellent account of the minerals of the Bay of Fundy.)

(3) GOODWIN.—" Geology and Minerals of Ontario " (1929).

(4) GOODWIN.—" Geology and Minerals of Quebec " (1929).

(5) GOODWIN.—" Geology and Minerals of Manitoba " (1930).

(6) HOFFMAN, G. C.—Part I, Ann. Rept. G.S.C., Vol. 5 (1888-89). " Annotated List of the Minerals Occurring in Canada." (A good general descriptive list.)

(7) HOW, HENRY.—" Mineralogy of Nova Scotia " (1868).

(8) HUNT, T. S.—G.S.C., Report of Progress (1847-48). (An entertaining account of early exploration in virgin territory (Ontario and Quebec).)

(9) JACKSON AND ALGER.—" Remarks on the Mineralogy and Geology of the Peninsula of Nova Scotia " (1832).

(10) JOHNSTON, R. A. A.—Memoir 74, G.S.C. (1915). "A List of Canadian Mineral Occurrences." (The most comprehensive list ever published.)

(11) KUNZ.—Part " S," Ann. Rept. G.S.C. (1887). The Precious Stones of Canada."

(12) KUNZ.—" Gems and Precious Stones of North America " (1892).

(13) PARSONS, A. L.—" The Utilization of Semi-Precious and Ornamental Stones of Canada " (Univ. Tor.-Geol., Series 36) (1934).

(14) PARSONS, A. L.—Additional notes to the above (Univ. Tor.-Geol., Series 41) (1938).

Reviewed by Dr. A. S. Alexander
(Gem Trade Laboratory, New York)

A New Method for Fingerprinting Diamonds

AN instrument has been invented by Mr. Bruce D. Eytinge, of the Manhattan Research Laboratories, 352, East 82nd Street, New York, which will in a matter of a few minutes photographically record the light that is reflected from the facets of a gemstone. The device (Fig. 1) consists, briefly, of a metal cylinder, at the bottom of which is a fixed light source (a 6 or 12 volt lamp will suffice). The light is projected by a simple lens system through the tube on to the table of the stone to be " fingerprinted." Just below the optical glass plate on which the stone is placed is a holder which contains the photographic film. Film of the type used for back reflection X-ray work can be employed, since this particular film already has a circular hole in the centre.

Each facet reflecting light at a fixed angle will impinge itself on the film, producing as a result a series of irregular " spots." Should the same stone be photographed at a later date, an identical spot reflection pattern will, of course, be obtained.

By placing the second negative over the first, or original, and then viewing the two superimposed negatives in front of a convenient light source, it can be seen that the spots exactly coincide. If the stone is a different one, or should the original gem be re-cut or re-lapped, a wholly different spot reflection pattern will be reproduced.

Since the facets of no two stones of the same weight and cut are ever fashioned *absolutely* mathematically alike, no two reflection spot patterns of identical design and orientation are possible. The device will handle faceted stones of any cut, as well as gems of any colour or species.

Using ordinary commercial film, an exposure of 12 to 14 seconds sufficed to register the light reflected from the facets of a gemstone. Patent is pending on this invention.

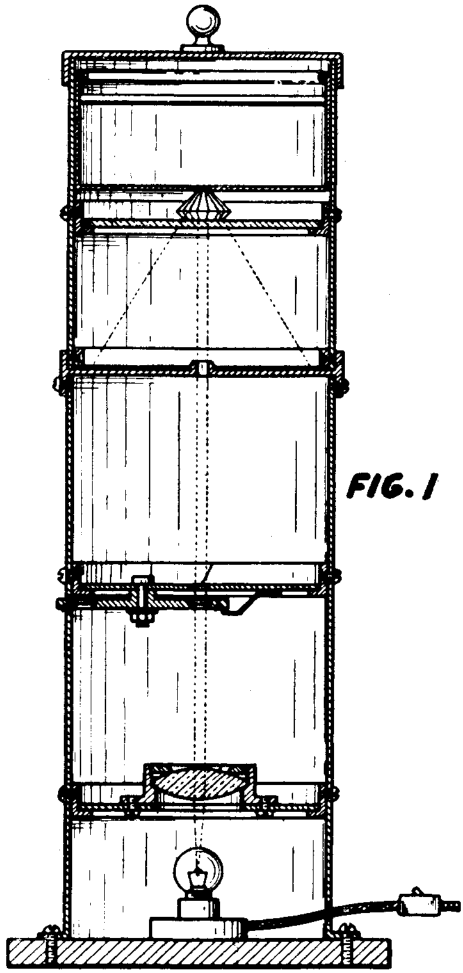


FIG. 1

The writer has personally tested this " camera." It is very simple to operate and it supplies a means of fingerprinting gemstones in a manner not hitherto possible (compare this method with X-ray diffraction and the time and cost involved).

The Gem Trade Laboratory, Inc. (New York) is considering installing an Eytinge camera so that all stones, loose or mounted, coming in for test can be " fingerprinted " and recorded for future reference. Comments from British gemmologists are invited.

A film shown to members on 2nd November, 1948, by courtesy of the High Commissioner of South Africa

GOLDEN HARVEST OF THE WITWATERSRAND

ON November 2nd at the British Council Cinema, London, W.1, members of the Gemmological Association were shown a film entitled " Golden Harvest of the Witwatersrand." A running commentary accompanying the film described the various operations carried out in the 40 mines which produce half the world's gold, from the time the natives are signed on to work in the mines to the time the gold in commercial ingots is shipped abroad.

Most natives work in the reefs with European supervision. Europeans are also employed in the mines on work other than actual mining. The welfare of the natives, of which there are a quarter of a million working in the various mines, is looked after very well. They are housed in compounds under the control of a Central Board in Johannesburg. The European workers which number some thirty thousand are encouraged to take part in outdoor sports and games. Shower baths are supplied at the mine head. Simple amusements mean a lot to the native workers and native dancing to music reminiscent of the rhythm of the mine machinery is one of their pastimes.

The actual blasting of the rock is done by Europeans who hold Government certificates for that work and every day before the natives commence work, a supervisor precedes them examining the structure for loose rocks likely to cause accidents and if any faults are found they have to be put right. The natives go 3,200 ft. below ground to do the preparatory work in connection with blasting. For every ounce of gold won, three tons of rock are blasted. Air, water, electricity and chemicals play their part in the daily working of the gold mines in which ten thousand drilling machines are used. Water, $2\frac{1}{2}$ million gallons of which is used daily in the various processes carried out, is a big factor in keeping down dust in the mines, thus overcoming to a great extent the disease which used to attack so many mine workers. The number of electricity units used in the mines in a year is equal to that used in Glasgow, and the amount of explosives used in blasting the rock is 27,000 tons. Factories have been built in the Cape and Natal for the purpose of manufacturing the explosive material. Safety measures are strictly enforced in the mines and whilst the actual blasting is in operation the natives are sent to places of safety.

The day after blasting has been carried out the men go down the mine and shovel the loose rock down a chute which loads it into trucks which are taken away and tipped into a train of railway trucks. This train takes the rock over to another part of the mine where it is sorted by natives—the gold bearing rock being placed on a conveyor and transported to the crushers and the waste rock is thrown away ; the small dust is passed through a fine screen. Thus begins the various processes of separating the gold from the rock which by this time has been reduced to fine sand. At one point in the procedure the gold concentrate is mixed with mercury and is known as amalgam. At other points cyanide and sulphuric acid are added. By the time the smelting house is reached the ingots contain 60 per cent. mercury and 40 per cent. gold, but after passing through the retort furnace the mercury is vaporized and subsequently recovered for further use. When the bars reach the refinery they are weighed and usually contain about 80 per cent. gold, 9 per cent. silver and the balance in other metals such as copper, lead, etc. Chlorine is added and after the chlorine leaves the crucibles the refining process is completed. The refined gold is placed in a furnace and thoroughly stirred and after that it is sampled and made into 400 oz. bars suitable for the bullion market. One million ozs. of silver are reclaimed each year from the processing of gold by the rand refinery.

(Extracted, by permission, from the " Jeweller and Metalworker," Vol. LXXIV, No. ixcc.)

MARGINALIA

Informal notes on points of interest and opinions of a controversial character compiled by Fellows of the Association (Contributors in this issue are members of the office staff)

FROM time to time we have heard of some strange results being obtained from use of Chelsea colour filter. Subsequent investigation has revealed that it has been the user and not the filter that has been at fault. Therefore it seems timely to caution would-be gemmologists to regard the filter as an *aid* to testing and not always as a conclusive test.

In experienced hands the filter can be very useful, but when we hear of a student gemmologist airing the knowledge he has yet to acquire by declaring that an amethyst is a synthetic spinel because it appeared red under the filter, it is necessary to urge intelligent use of the filter. We do know that a filter and a lens are the only stock in trade of many dealers, but in the majority of cases they are only concerned as to whether a stone shows " red or green." Unlike traffic lights, it is green that sometimes indicates danger, and what these knowing ones will do if they ever encounter a synthetic emerald we shudder to think. It will be a case of *Nimium ne crede colori.*

* * * *

The suggestion reported by Edgar J. Burbage in the October, 1948, " Marginalia," that a time may come when University recognition will be given to the gemmology diploma is likely to remain a suggestion. Although there are many non-trade gemmologists it must always be remembered that the majority of students, in the U.K. at least, are engaged in various branches of the jewellery and allied trades, and who would have little opportunity for achieving a University standard in gemmology.

In fact, it has often been commented that qualification in the study of gemmology, whilst expanding as fresh knowledge is gained, should not race away from the general requirements of the persons for whom it caters. We commend this opinion, often expressed, to those lecturers, instructors and examiners concerned.

A member recently brought to the notice of the Association that white synthetic spinels have been invoiced as " synthetic zircons." It was alleged that the term " synthetic zircon " in reference to these synthetic spinels was a standard trade practice! There does not appear to be any good reason for this kind of nomenclature, and we should be interested to hear of any other instances of this kind. Possibly gemmologists in other parts of the world can instance even more exaggerated misnomers.

*   *   *   *

When reading " They Struck Opal," by E. F. Murphy, two rather interesting points arose dealing with opal formation. Murphy remarks that the colour in the opal is always horizontal and keeps on an absolutely flat level. In whatever position the opal lies in the ground, the *colour* will cross it quite level. Even if there is a vertical seam, that is, one leading to the surface, it does not matter at what angle the opal in the seam may be, the colour crosses it horizontally, quite level. In fact, the author alleges that one can always tell opal that comes from a vertical seam by the way the colour crosses the stone.

The other point was that when following a seam of potch, that is, opal without commercial value, it suddenly turns into a patch of saleable opal with good colour. It may be a small or large patch, but eventually becomes potch again. Now the whole seam of opal is the same age, was deposited at the same time, and both potch and colour patch contain the same ingredients by analysis, but what causes the change from potch to colour? One might think that the colour part cooled more quickly or slowly to account for the difference, but when a patch of opal is found with a bar of good colour running through the centre of the stone, the top portion is white milky potch and the lower portion also white milky potch, it is more difficult to believe this theory. If the stone is lying flat the bar of colour will run through from end to end. No matter what position the stone may be in, the colour bar will continue its course absolutely level.

Perhaps readers may have some theories to explain the phenomena mentioned above.

Gemmological Abstracts

NOTES ON RECENT RESEARCH

ULTRA-VIOLET Transparency of Corundum. In an article in " The Gemmologist " for October, 1947, G. O. Wild and H. Biegel recorded the results of some experiments on the transparency of various natural and artificial sapphires to ultra-violet rays. They found that one of their specimens, an off-white synthetic sapphire, showed a considerably greater range of transparency than any of the natural or other artificial stones tested.

B. W. Anderson and C. J. Payne have followed up this interesting result with more extensive experiments, and have shown that not only do synthetic colourless and yellow corundums transmit much more light in the deep ultra-violet than their natural counterparts, but also that synthetic pink and red corundums show the same trend, though in a less marked fashion. Only in the blue corundums is the transmission in synthetic stones limited to the same extent as in natural corundums.

These results are scientifically interesting, and may have some practical importance where internal features are lacking. The authors point out that visual observation of these effects is possible with a Beck ultra-violet spectroscope in which the ultra-violet spectrum is seen on a fluorescent screen. More exact details will be found in the original paper (" Gemmologist," October, 1948).

Synthetic Rutile.—Descriptions of the new synthetic rutile which is now being manufactured by two firms in the U.S.A. have appeared in several gemmological journals. In " The Gemmologist " for last July Anderson and Payne give their data for a small rose-cut synthetic rutile kindly loaned to them by D. S. M. Field, an Associate of the Gemmological Association resident in Canada, who is already known to readers of this Journal as a contributor.

The rutile was off-white in colour, had a high lustre and tremendous display of fire. At a casual glance the stone had a superficial resemblance to a Cape diamond, but the strong doubling of the back facets prevented any likelihood of this impression surviving a closer examination. The most plausible error would be to mistake the stone for sphene, but an intense absorption band in the violet at about 4300 Å is seen in place of the weak didymium lines usually discernible in sphene. In loose stones the density of the rutile (4.23) is also distinctive.

A figure of 0.1070 for the partial disperson 6708Å-5350Å (Li-Tl) was established for the rutile, which makes the corresponding figure of .0171 for diamond seem very low. For the usual B-G range the dispersion figure for the ordinary was estimated to be about .300, and for the extraordinary ray even higher than this. The ordinary index for sodium light was 2.6104 for this specimen. For the upper ray, 2.8729 was the highest measurable with the angles available, so that the full birefringence of 0.287, as given in the literature, was not observable.

We understand that blue synthetic rutile is also obtainable ; this should be a striking gem, and would be all the more welcome for not resembling any natural gemstone except, perhaps, the very rare benitoite.

Coated Stones.—The latest fashion in the practical faking of stones is to coat their upper facets with a thin film of lower refractive index, either by sputtering, etching or controlled application of plastic resin. The principle behind their process is the same as that of the coated lenses now so much in vogue for binoculars and cameras. A quarter-wavelength film of suitable refractive index lowers considerably, by interference, the percentage of light reflected at the surface, and a correspondingly greater amount of light passes into the body of the substance.

The writer was shown samples of various stones treated in this manner when visiting Dr. Gübelin last summer, and reports from New York indicate that they are already known in America. J. de Ment is patenting a " Gemcote Process," and has written an article in the November " Mineralogist " (the Oregon Journal), pp. 547-556, in which he endeavours to explain why coated stones should display enhanced brilliance. It is doubtful whether stones faked in this manner have any real advantage over the ordinarily well-cut gems, and they are unlikely to have any place in good-class jewellery. They look decidedly " phoney " and show interference tints at certain angles. The coating has a nuisance value in that it prevents one from obtaining readings on the refractometer. Should a refractometer test be necessary a brisk rub with a wash-leather charged with jeweller's rouge will usually clean the film from the surface.

Structure of Tourmaline.—Tourmaline is the last important gemstone to yield the secrets of its structure under the persistent inquiry of the X-ray crystallographers. The increasing number of gemmologists who are becoming interested in the atomic configuration of the gem minerals will find the main features of the complex tourmaline structure explained in a paper by Hamburger and Buerger in the " American Mineralogist " for September-October, 1948. Working with a colourless sodium magnesium tourmaline from de Kalb, N.Y., having an " ideal " formula of $Na\ Mg_3\ B_3\ Al_6\ Si_6\ O_{27}\ (OH)_4$, the unit cell dimensions are found to be a = 15.951 Å, c = 7.24 Å, and the space-group R 3 m. Clear diagrams are included in the paper showing the structure as seen in the direction of the trigonal axis.

B. W. A.

General

" Diamonds: The Diamond Industry in 1947. Twenty-third annual review. Sydney H. Ball. " Jewelers' Circular-Keystone," New York, 1948, reprint, 25 pp.

World production during 1947 was slightly less than for preceding year, 9,754,231 carats against 10,212,573 carats, the loss being mainly in industrial grades. The British Commonwealth accounted for 31.1 per cent. of the weight and 68 per cent. of the value, while the Belgian Congo was the leading producer by weight with 56 per cent., although it produced only 12 per cent. of the value.

Scientists of many nationalities studied the diamond in 1947, notably G. N. Ramachandran—photoelastic qualities ; K. S. Lonsdale—divergent beam X-ray photography ; A. Guinier—abnormal diffusion of X-ray in diamond. Synthesis of diamond was attempted but no progress made.

G. F. A.

" Emeralds: The Muzo Emerald Zone, Colombia, S.A." Victor Oppenheim. Econ. Geol., 1948, Vol. 43, pp. 31-38.

A general account of the emerald mines in the Muzo district. Work is expected to recommence soon at the Muzo and Coscuez mines. None of the mines has been worked since 1939. The author, pointing out that the origin of emerald is still doubtful, comments upon the presence of salt beds and the finding of emeralds in salt mines.

G. A.

" Emeralds: Emeralds in Mewar." H. Crookshank. Indian Minerals (Geo. Survey, India), 1947, Vol. I, pp. 28-30.

Occurrence of emeralds at Mewar in Rajputana, from which good gems have been cut.

" Spodumene: Lithium—its sources, properties and uses." V. S. Swaninathan. " Canada's Weekly," October 29th, 1948, p. 126.

Brief account of a recently located deposit of spodumene some 90 miles north-west of Winnipeg, Canada. The report deals with the commercial uses of lithium and there is no mention of spodumene in crystals of gem quality.

H. W.

" Silicon Carbide: New gem superior to diamond." Jack de Ment. " The Mineralogist " (U.S.A.), April, 1948, pp. 211-218.

Report of use of silicon carbide, for many years produced commercially as an abrasive, as a gem material. Properties given are: Mean R.I., 2.668 ; H., 9.5 (Mohs' scale) ; S.G., 3.17. Its identification is not likely to present such difficulty as the author suggests.

SiC can be produced in hexagonal and cubic forms, and its easy colouration suggests use as a future possible substitute for various gems.

" Silicon Carbide." " Gems and Gemology," Vol. VI, No. 2, 1948.

The Gemological Institute of America does not consider that development of SiC as a gem material will take place in the near future, though admits that if process is developed to produce larger crystals the synthetic product could become an important gem material.

V. B.

Publications

" They Struck Opal." E. F. Murphy. Assoc. Gen. Pubs. Pty., Ltd., Sydney. 191 pp., 3 colour plates and numerous sketches. 12s. 6d.

An account of early days in opal mining. Murphy, who was an important opal buyer, describes conditions in the opal fields. The book, though of general interest, does not deal with any technical problems.

H. W.

" Popular Gemology." Richard M. Pearl. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. 1948. 316 pp. 116 illustrations. 24s.

A well-written popular volume on the principles of gemmology and of the gem species. The nature, chemistry and crystallization of gem minerals are discussed, and, with the fundamental backgrounds, the methods of gem testing are outlined. Shortened tables of constants taken from Dr. Herbert Smith's " Gemstones " are the only determinative tables given ; the values for many of the species discussed are not recorded nor mentioned in the text. An unusual scheme is used for the classification of the species which are first divided into three groups—" Faceted gems " ; " Cabochon and carved gems " ; and " Gems of the silica group "—the subdivision being in accordance with that of the new edition of Dana's System. The gem descriptions are mainly historical and topographical, but contain no technical information. Chapters on organic gems and on man-made gems, which includes the synthetics, doublets, pastes and artificially coloured stones, are adequate ; cultured pearl is also discussed in this section. An unusual feature is the inclusion of a complete chapter on luminescent phenomena and the equipment used in the production of ultra-violet light. The book is extremely well illustrated, has a good index, and is printed on art paper. There are few errors and omissions. A book for the general reader rather than the specialist.

R. W.

ASSOCIATION NOTICES

SWITZERLAND

A Course in Gemmology has recently been inaugurated at the Kunstgewerbeschule of Zurich. This Course is in addition to the classes held in goldsmithing and silversmithing.

AUSTRALIA

The 1948 Diploma Examinations of the Gemmological Association of Australia were held on the 12th and 13th November. The theoretical and practical papers comprised papers of three hours each.

This is the second occasion that diploma examinations have been held in Australia. The Association's Constitution has been slightly modified to allow it to work more efficiently, and there is no doubt that the Australian Gemmological Association is painstakingly laying the foundations of an organization which will bring great credit and benefit to all gemmologists.

TALKS BY FELLOWS

B. W. Anderson: "Gemstones"—B.B.C. Third Programme, 25th November, 1948.

S. T. Solomon: "Gemstones"—Women's Institute, Gittisham, near Honiton, 4th November, 1948.

H. S. Reese: "Salesmanship of Gemstones"—Merseyside and District Branch of the National Association of Goldsmiths, 29th October, 1948. "Synthetic Gems"—ibid., 22nd November, 1948.

R. Webster: "Gemstones"—Southend jewellers, 11th November, 1948 (demonstrator, L. F. Cole).

T. H. Bevis-Smith: "Precious Stones"—London Central Y.M.C.A., 27th November, 1948.

MEMBERS' MEETINGS

A meeting of members was held on Tuesday, 2nd November, 1948, at the British Council Cinema, Hanover Street, London, W.1, when the film "The Golden Harvest of the Witwatersrand" was shown. The Council of the Association is indebted to the High Commissioner for South Africa in once again making the film available to the Association.

COUNCIL MEETING

At a meeting of the Council held at 94, Hatton Garden, London, E.C.1, on Wednesday, 24th November, 1948, the following were elected to membership of the Association:—

FELLOWS

W. S. Allan (Prestwick)
L. A. Baker (Seven Kings)
F. C. M. Bawden (Johannesburg, S.A.)
L. Bolton (Leeds)
W. C. Buckingham (Goodmayes)
R. Buckle (Edinburgh)
W. T. Cooper (London)

W. Crombie (London)
G. R. Crowningshield (New York, U.S.A.)
C. E. Davenport (Sutton)
V. A. Dembo (Bristol)
A. Forsyth (South Queensferry)
W. F. Goldschmeding (Amsterdam, Holland)
J. Hammes (Zeist, Holland)
L. Harkness (Halifax)
Mrs. B. C. Hayman-Joyce (Eastbourne)
J. Hodge (Campbelltown)
H. A. Jenkinson (Birmingham)
E. Jones (Leicester)
D. G. Kent (London
W. H. Knowles (West Byfleet)
L. Levett (Romford)
Roy Martin (Southall)
Grant W. Miller (Pasadena, U.S.A.)
A. S. Murray (Edinburgh)
I. H. McLean (Bushey)
J. A. R. Page (Orpington)
O. P. Peresypkin (Hong Kong)
J. Plas (London)
L. Ricketts (London)
I. P. Roberts (London)
D. F. Rossiter (Clevedon)
N. J. Rostron (London)
J. W. Ruddock (St. Albans)
H. G. Stonley (Wembley Park)
R. H. Tugwood (London)
H. W. Weeks (Woking)

FELLOWS (transferred from Probationary Membership)

P. N. Bodes (The Hague, Holland)
A. Cairncross (Perth)
A. D. Conway (Birmingham)
C. E. Dawkins (London)
Ove Dragsted (Copenhagen, Denmark)
P. H. Higgs (Wollaston)
A. H. Jutson (Sandwich)
Nigel W. Kennedy (Tadworth)
R. C. Kino (London)
D. C. Kirtley (Sunderland)
G. D. Llewellyn (Ilford)
P. G. Meakin (London)
Miss Joan Pyman (Letchworth)
D. M. Spero (London)
N. Stein (London)
E. G. Stone (Hove)
L. G. Trumper (Devizes)
D. Wheeler (London)

ASSOCIATE

A. E. Horn (Nigeria)

ASSOCIATES (transferred from Probationary Membership)

D. S. M. Field (Canada)
S. J. Hale (Maidstone)
D. E. Mayers (Cambridge, U.S.A.)

PROBATIONARY

R. Biggar (Glasgow)
F. M. Cunningham (Toronto, Canada)
G. Denton (Clacton-on-Sea)
M. Kussman (London)
C. A. Piek (Amsterdam, Holland)
F. O. Soughton (Terrace Bay, Canada)
Miss M. L. Sprankle (Oklahoma City, U.S.A.)
Mrs. J. M. Thomas-Ferrand (Bury St. Edmunds)
R. F. H. Wakeley (Swindon)
G. T. Wright (London)

ORDINARY

Siu Man Cheuk (Hong Kong)
A. B. Hemachandra (Colombo, Ceylon)
B. C. Lowe (Birmingham)

The Council has received with regret the resignation of Mr. E. R. Levett, who has taken up residence in Rhodesia. At its November meeting the Council recorded appreciation of Mr. Levett's services to the Association while he served as a Councillor. Mr. R. K. Mitchell was appointed to serve on the Council in the place of Mr. Levett until the next General Meeting.

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