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AND PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

Vol. I, No. 8. OCTOBER 1948

THE MINERAL GALLERY REOPENS

MEMBERS of the Gemmological Association will be pleased to read that part of the Mineral Gallery of the Natural History Museum at South Kensington has been reopened to the public. Great efforts on the part of the Keeper of Minerals (Dr. Campbell Smith) and his staff have produced an exceptional show of the most attractive specimens selected from the vast number in the great National Collection in their care. The reopening was timely in view of the International Geological Congress held in London during August: that the exhibits held the interest of our overseas visitors was indeed evident to our representative, who noticed many of the visitors to the gallery wore the " crossed hammer " badge of the Congress.

With such a splendid show it is difficult to know where to start, but a gemmologist will at once be attracted by the case of cut gemstones which meet the eye on entering the door of the gallery. An entirely new type of display has been given to this show of specimen coloured stones, now segregated together. The stones are displayed inset in a colourless " perspex " sheet which is held some inches above a self-colour fabric background. The effect is intriguing and made further so by the grouping of the gems into colours ; the blue stones being at the top left, the reds at the top centre, and the browns and yellows at the top right ; the greens below had the darker shades in the centre with the bluish-greens on the left to merge with the blues and the yellowish-greens on the right to blend with the yellow group ; the whole making an attractive display of colour.

The stones are neatly labelled with the species name and a number which by reference to a key at each bottom corner additional information could be obtained. It is an open secret that our Vice-Chairman, Dr. G. F. Claringbull, was responsible for this fine show of stones, which included the two large beryls ; topazes, tourmalines, spinels, and fluorites in all hues ; and the more unusual andalusite, kornerupine, fibrolite, hiddenite, scapolite and many others.

The diamond display shows the various occurrences of this gem ; a number of fine diamond crystals and a range of cut stones and crystals showing the various hues, also a number of crystals illustrating the characteristics of the various mining fields. The precious metals, platinum and gold, in native state and many worked pieces of ornamental minerals from the Hans Sloane collection were on view.

The general exhibit showed the finest of the crystal and mineral specimens, beautifully spaced and set out. It would be unfair to select specimens for special mention, but the gemmologist can hardly fail to spot the fine aquamarine crystal from Pinqueira Mountain, Brazil, and the fine emerald crystals, including the 1,384 carat " Duke of Devonshire " emerald. Among the tourmalines two slices of tourmaline crystal from Antsirabé, Madagascar, cut parallel to the basal plane, showed pronounced and unusual zoning, while other crystals from Pala, Brazil and Ava, Burma, made an impressive sight. Fine topaz crystals, too, are well evident, including the striking magenta-coloured variety from the Sanaka River, U.S.S.R.

The fine group of pseudo-hexagonal alexandrite crystals need to be seen to be fully appreciated, and how much more precious is an opal which replaces the humerus of a plesiosaurian. A sincere prayer was offered that no examinee at a future G.A. practical examination would meet the ruby crystal with " octahedral " habit. Space forbids description of the many more fine crystals, but two recent acquisitions, a fine group of doubly-terminated crystals of greenish yellow colour and complex crystals of rose beryl, both from Minas Gerais,* and the brazilianite crystals deserve mention.

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* The old name Minas Geraes has been replaced by the corrected spelling—Minas Gerais.—EDITOR.

Other exhibits show the range of colour that may be found in a single species (fluorite) ; early mineral treatises and crystal models and a very excellent show of models illustrating Crystal Chemistry. One must not forget, too, the grand show of uranium and radioactive minerals, far better as mineral specimens than as fuel for the God Mars.

In the outer corridor are seen exhibits showing large crystals of beryl and calcite ; the meteorites and a series showing the formation of minerals by precipitation of mineral matter from charged waters producing stalactites and stalagmites which show concentric structure. Calcite, rhodochrosite, " Gibraltar stone " and a limestone cavern illustrate the effect. The ultra-violet light fluorescence exhibit is again in operation so that one can see the intense blue fluorescence of fluorspar ; the green of willemite and the yellow of scapolite. The old display of the ornamental stones is still in place, but a fine show of " British Minerals " has caused the smaller mammals to retreat along the corridor.

Thanks, Dr. Campbell Smith and your staff, for again giving us a sight of the old familiar pieces, and so many new ones, in such a finely arranged display.

CORRESPONDENCE

From Sir Lewis Fermor, O.B.E., F.R.S.

Bristol.
4th August, 1948.

The Editor,
" The Journal of Gemmology."

Dear Sir,

I notice that on page 15 of Volume I, No. 2, of your Journal, Mr. B. W. Anderson proposes a " New Name for an Old Garnet," namely *pyrandine*.

He will probably be interested to learn that a somewhat similar name for this same garnet, namely *pyralmandite*, was proposed by me as long ago as 1926 in a paper " On the Composition of Some Indian Garnets,"* and that the general question of the nomenclature of garnets was discussed by me in a later paper on " On Khoharite, a New Garnet, and on the Nomenclature of Garnets."†

You will find from the latter paper that I have been using similar compound names for garnets since 1909, the earliest example being " *spandite*," the composition of which the reader can easily guess.

With reference to the pronunciation of the first syllable in pyralmandite or Mr. Anderson's variant thereof, it should, of course, be pronounced long, as in pyrope, and not short, as in pyrrhotite.

Yours faithfully,
L. L. FERMOR.

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* " Records, Geological Survey of India," LIX, p. 205 (1926).

† *Op. cit.*, Vol. 73, pp. 145-156: specially pp. 151 and 156 (1938).

Spectrochemical and Spectrophotometric Analyses of RUBIES and SAPPHIRES

by

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Director, Gem Trade Laboratory, Inc., New York, N.Y.

DURING the course of a comprehensive investigation of rubies and sapphires, the writer felt that an accurate series of spectrochemical analyses might prove very useful in an undertaking of this kind. The results of the initial analyses made on both genuine and synthetic rubies are now available for study and comparison. At a later date, a similar spectrochemical analysis will be made on the sapphire. (1), (2), (3)

Preparing the samples for spectrographic analysis posed a problem, due to the excessive hardness and toughness of all corundum. To reduce outside contamination as much as possible, a boron carbide mortar was used to grind the rubies. The gems are cleaned with, and ground under, acetone to remove handling contamination. The excitation of the samples in the spectrograph was performed under conditions specified by the Harvey Method for semi-quantitative analyses. The writer is indebted to Dr. Harold P. Klug and Mr. William L. Weeks of the Mellon Institute of Industrial Research for making these tests.

The percentages listed in the table below have been calculated on a basis of the elements' oxides, assuming that all the elements existed in the oxide form in the samples. Though this is not strictly true, the variation caused by some of the elements existing in the form of silicates falls well within the range of accuracy of the method.

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(1) A. E. Alexander, "Genuine and Synthetic Rubies and Sapphires," Jour. Chem. Education, Vol. 23, 418-422, 459, 1946.

(2) A. E. Alexander, "Fluorescence in Synthetic Stones," Jewelry Magazine, March 15th, 1948.

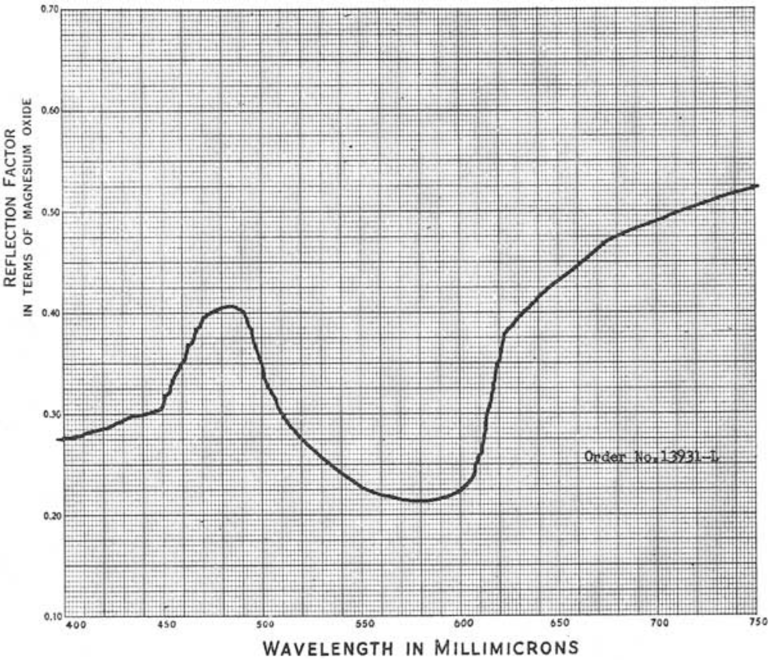
(3) A. E. Alexander, "Linde Synthetic Star Stones," National Jeweler. "NJ," November, 1947.

TABLE I

Spectrochemical analyses of four rubies, two genuine, two synthetic

Oxide		Specimen A	Specimen B	Specimen C	Specimen D
Al_2O_3	...	98.8%	97.5%	96.5%	97.3%
Cr_2O_3	...	.945	1.81	1.915	2.58
SiO_2	...	.137	.542	.410	.464
CuO	...	.00237	.00160	.00483	.00308
CdO	...	.0168	.0351	.00937	.01121
MgO	...	.02265	.0328	.0170	.0625
MoO_3	...	.00448	.0117	.0142	.01725
V_2O_5	...	.0320	.0582	None	None
Fe_2O_3	...	.0147	.0252	.0215	.0409

Specimen A—Genuine ruby, light in colour.
Specimen B—Genuine ruby, dark in colour.
Specimen C—Synthetic ruby, light in colour.
Specimen D—Synthetic ruby, dark in colour.



SPECTROPHOTOMETRIC TEST

Spectral Reflection Factor in the Visible Region of Genuine Ruby (Dark)

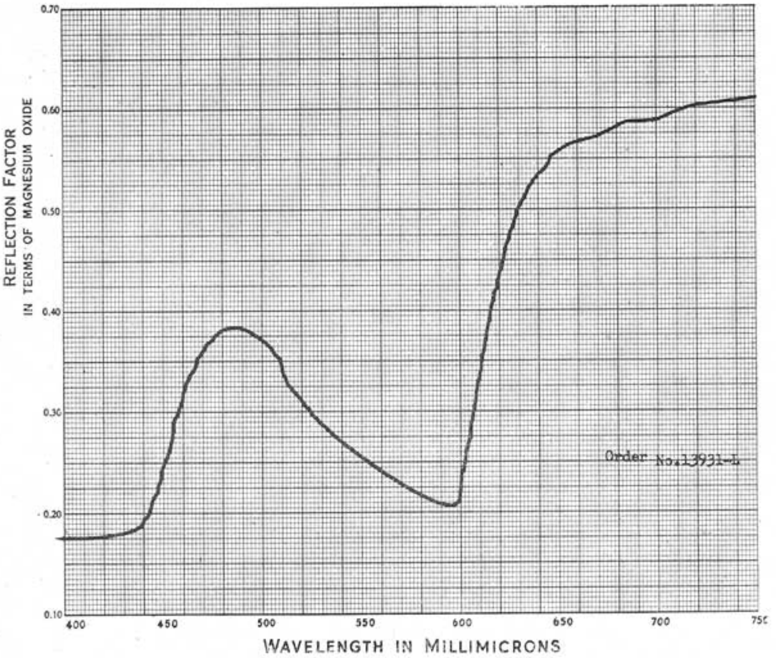
The following elements were sought in all samples but were not found: K, Li, Be, Sr, Cb, Bi, Pb, Ru, Ce, Rb, Cs, Ag, Ni, Co, Ti, Sn, Sb, Mn, Te, W.

The keen interest aroused at the time Linde synthetic star stones came on the market resulted in a decision to have spectrochemical analyses made of this material. Since petrographic examination of the star producing medium suggested titania, a detailed analysis for this component was undertaken(3). For this test, only synthetic star ruby was employed. Linde star sapphire was not available at the time. The results obtained are noted in Table II.

TABLE II

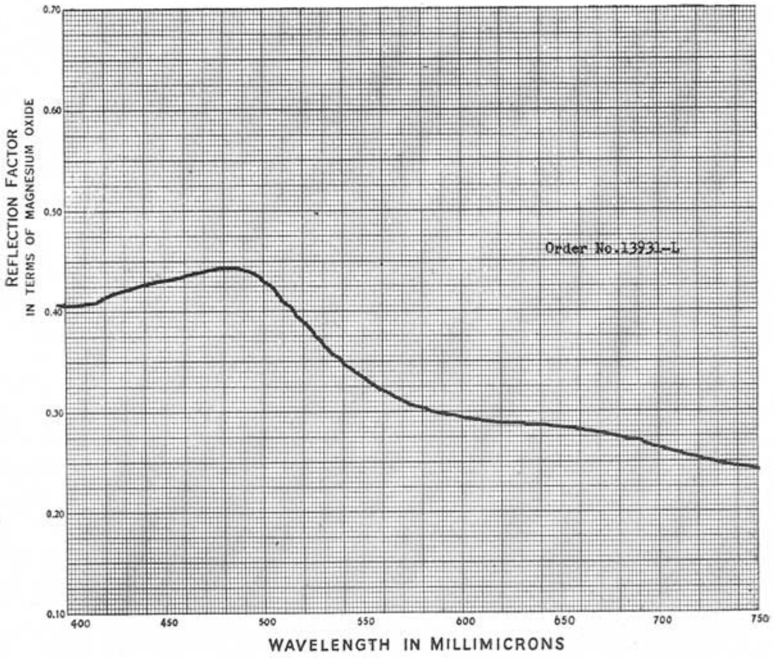
Spectrochemical analyses of sections of a Linde synthetic star ruby

Sample	Mg	Cr	Si	Ti
Core	.024%	2.54%	—	.064%
Core, plus outer layers ...	.023%	2.63%	—	.070%
Outer layers alone ...	.080%	2.48%	.31%	.162%



SPECTROPHOTOMETRIC TEST

Spectral Reflection Factor in the Visible Region of Synthetic Ruby (Dark)



SPECTROPHOTOMETRIC TEST

Spectral Reflection Factor in the Visible Region of Genuine Sapphire

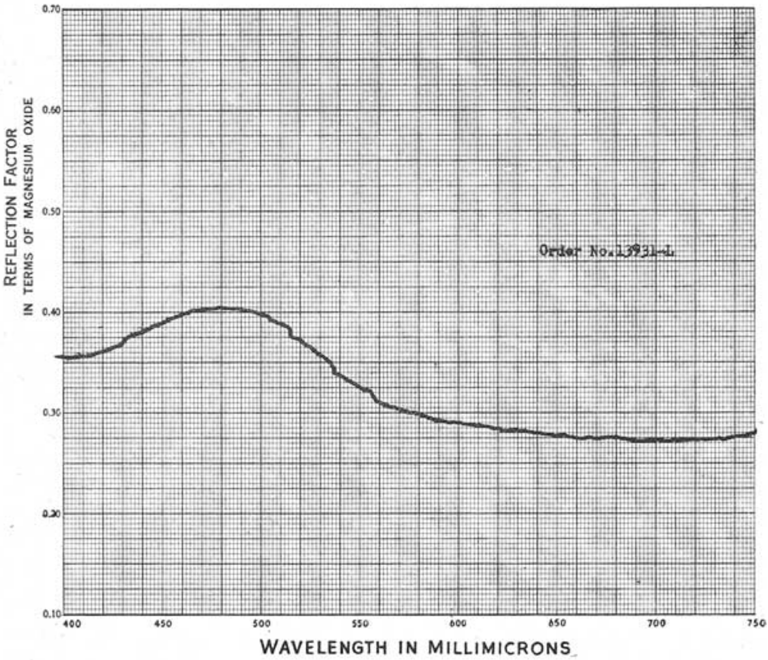
NOTE: " Core " means centre or clear part of this particular stone. " Outer layers alone " means area around apex of this stone, which contained the crystalline material which produces the star effect.

Noteworthy is the finding of increased titanium in the area characterized by the presence of dense, interlocking crystals. Their resemblance to rutile needles in the star synthetics, when compared with those noted in Burma rubies, for example, has been described elsewhere(1), (3).

In line with another part of the corundum investigation, a series of spectrophotometric tests were deemed necessary. To undertake this work necessitated the preparation of special material. Several small plates of both synthetic and genuine ruby and sapphire were made. These measured 2 millimetres square and 1 millimetre thick and were highly polished. All measurements were obtained from a Hardy recording spectrophotometer. The graphs which accompany this report are interesting in that spectral reflection curves show a similarity of pattern. One would expect this, since the chemical and physical properties of genuine and synthetic corundum are, for all practical purposes, identical.

These graphs were subsequently submitted to the research laboratories of the Eastman Kodak Company, Rochester, N.Y., with the idea that a special filter might be developed which could be used in the Laboratory to quickly differentiate genuine corundum from its synthetic counterpart. As yet, with research incomplete, no wholly satisfactory filter of this type has been obtained.

In connection with this research, Gem Trade Laboratory, Inc., is indebted to Mellon Institute of Industrial Research and Eastman Kodak Company for their co-operation and interest ; and to Tiffany & Company, Inc., for generously furnishing the genuine rubies and sapphires used in the experiments.



SPECTROPHOTOMETRIC TEST

Spectral Reflection Factor in the Visible Region of Synthetic Sapphire

M. D. S. LEWIS, A.R.C.S., B.Sc., F.G.A., C.G.

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SPECULATIONS ON LUSTRE

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THIS is not an article purporting to explain lustre ; it is no more than the title suggests—an expression of thoughts and speculations (many of which, on further reflection, may prove unsound or at least highly controversial) on one of the most mysterious of gemmological phenomena. Some time ago Mr. B. W. Anderson drew attention to the fact that it was difficult to explain lustre in terms of the known characteristics of light and in the standard textbooks it is barely mentioned. Simply defined as " the effect produced by light reflected from the surface of a stone " or as " the appearance of a surface in reflected light," lustre becomes a most difficult problem when one realizes that physically this light is completely described by three properties—intensity, wave-length (or frequency) and state of polarization. Intensity needs no explanation, wave-length determines colour, whilst state of polarization is not normally detected by the unaided eye and so drops out of the picture. When, therefore, we describe lustre in terms of intensity and colour, have we said all there is to say, or does there remain some further imponderable quality—wholly subjective, psychological, perhaps physiological?

Before considering this question I think we must revise our definition of lustre, because the light which produces that effect in our minds has not only been reflected from the surface. It is always mixed with rays which have travelled into the interior of the stone, from which they have been scattered or reflected back to reach our eyes. As a matter of fact, only a small proportion is reflected from the surface and the greater part of the light we receive from the stone has travelled some distance through it and has thus undergone modification.

Recently, Dr. G. Gardam, of the Jewellery Trades' Design and Research Centre, recommended me to read two references, which to my mind place the whole subject in quite a new perspective. The The first is a series of articles, " Colours of Colloids," in the American publication " Journal of Physical Chemistry " (1919, Vol. 23), in which W. D. Bancroft discusses at great length the lustre of many substances, including gemstones. The second is a book, " Definition and Measurement of Gloss," by Dr. V. G. W. Harrison (published by The Printing and Allied Trades' Research Association). The author summarizes the scattered literature on the subject and deals in attractive but erudite manner with the three principal aspects of the problem—the physical basis, the very difficult mathematical attempts at evaluation and, perhaps most interesting of all, the psychological angle. It is, of course, written from the point of view of the paper technologist and it is difficult to decide how far his " gloss " differs from our " lustre," but there is no doubt they are so closely related that they can be considered side by side. Most dictionaries infer that " gloss " and " lustre " are synonymous, but I think that gloss seems to be a measure of " shine," whilst the gemmologists' lustre carries in addition to " shine " some vague mental description of the appearance of the stone. To illustrate the psychological or physiological aspect of lustre Dr. Harrison cites several phenomena. Black glass is always judged more lustrous than white glass of the same properties and polish. It is a quite general experience that if two identical diagrams on fairly rough paper are viewed through a stereoscope, the flecks in the paper stand out above the plane of the paper and look like *small bubbles in a block of glass ;* one gets a " glassy " sensation, which has remained unexplained in spite of long investigation by physicists and psychologists. When two stereoscopic prints are examined singly they may have little lustre, but there nearly always appears an increase when the two are combined in the instrument. The connection between stereoscopic effect and gloss is too marked for it to be ignored as a factor in the quality of lustre, or perhaps as a cause of " pseudo-lustre." In the last century, H. W. Dove, also experimenting with the stereoscope, made another strange discovery. If two identical geometrical figures are drawn, both on matt surfaces, one in black lines on a white background, the other in white on black, and both are viewed through a stereoscope, the resulting picture is invested with a lustre reminiscent of polished graphite or pewter. These two diagrams are shown in Dr. Harrison's book and would have been reproduced here if the paper of this journal were matt instead of glossy, as many people can get the effect even without the aid of a stereoscope. (By looking fixedly at the pair of diagrams for a few moments and then relaxing the attention and diverging the eyes, four pictures are seen, the inner two coalescing.) The undeniable increase of lustre accompanying stereoscopic vision suggests that in some cases lustre is due to our looking simultaneously at two surfaces, one behind the other. Dr. Harrison calls this the " parallactic effect " and in his theory it is one of the primary causes of lustre. Possibly this may be the reverse of the process by which " glare " (a form of high lustre) produces a feeling of strain in the eyes. When the eyes are strained in a certain way, e.g. by having to look at one surface through another, we may " suggest " to ourselves that lustre is present.

Dr. Harrison refers all cases of gloss to his " gloss complex," of which there are three primary constituents—mirror images, changes in intensity, and parallactic effect. The first is purely a physical property depending mainly on refractive index and smoothness (with consequent specular reflection), the second introduces a time factor, and together with the third may be psychological or physiological or both. In the same way as any tint can be matched by mixing three primary colours in suitable proportions, so can any state of gloss be obtained by a suitable variation of the three ingredients of the gloss complex. Every gemmologist knows it is often impossible to distinguish one stone from another by visual judgment of colour. An emerald and a green paste may look almost exactly the same shade, but their absorption spectra will be very different and from the physical point of view the light which has emerged from the two stones is not the same. Different wave-lengths have been absorbed, the residual rays have different composition, but yet their integrated effect on our senses is the same in each case and we think the colours identical. In the same way, our final sensation of gloss is the integrated effect on our senses of the three primary constituents of the " gloss complex."

A plane glass mirror gives high specular reflection and superlative mirror images but is not considered glossy, since the other two factors are not present. A varnished piece of furniture, say a piano top, is glossy because here we have all three causes in operation. The intensity of light specularly reflected is not large and the mirror images not particularly good, but as we move about we get changes of intensity as lights or windows are brought into reflection. One can also see the surface of the wood through the varnish layer, which thus provides the parallactic effect.

Now let us turn to gemstones and see if Dr. Harrison's theory (with modifications) can be applied. Before doing so, however, let us convince ourselves that lustre is not wholly a physical property depending on refractive index, hardness, smoothness and other measurable qualities. Suppose we are looking from a fixed position at a motionless diamond in perfectly still surroundings. Should we experience the characteristic lustre of this stone? Undoubtedly not, since movement and changes of intensity are inseparable from the lustre of a diamond, which we appreciate partly by the flashes and colour effects as we view the stone from different angles. Neither would we get the true lustre of a diamond if it were cut in the form of a perfectly flat plate, even if we were to move about in front of it. We would miss the effect of the side facets, in spite of the fact that the purely physical properties of a diamond plate are no different from those of a perfectly cut brilliant. Obviously, then, we must introduce a time factor into lustre, involving changes of intensity or colour. I know nothing of paper technology, but assume that (with the exception of titanium oxide) the usual materials involved do not have very high or variant refractive indices. Although gemmological surfaces do often provide very good reflection they are relatively so small that " formation of mirror image " properties do not seem very applicable to them. Light does not travel very far into the majority of papers, which are thin and opaque, whereas most gemstones are transparent and of considerable depth. For these reasons I would like to try the effect of resolving Dr. Harrison's three primary ingredients into a few more fundamental ones. I would like as a first choice to select refractive index, smoothness, changes of intensity, dispersion and parallactic effect as the essential constituents of the " lustre complex." There may very well be others in addition, perhaps opacity and texture, but these would be difficult factors. Refractive index, of course, plays a large part in lustre, since it determines the proportion of light reflected from the surface. For light incident normally on an average paste only about 5 per cent. is reflected at the surface, the remainder passing in to the stone. With diamond the proportion rises to about 17 per cent ; thus stones with high refractive indices tend to have good lustre, e.g. diamond, zircon, sphene. Needless to say, a high refractive index by itself will not ensure a good lustre, e.g. the unpolished diamond crystal.

Smoothness of surface is a dominant factor in lustre, as if the inequalities approach half a wave-length, the light falling on the surface is mainly diffused instead of being specularly reflected. It is only really smooth surfaces which can be very lustrous and some authorities consider that this largely determines variation in lustre between stones. The ability of a stone to take a good polish is mainly dependent on its hardness and cleavage properties ; needless to say, mere flatness by itself does not confer lustre, for, as Dr. Harrison points out, the crinkled surface of orange skin is quite glossy, whereas the dead smooth surface of egg shell can be extremely matt.

If refractive index and smoothness were solely responsible for lustre, we might just as well cut our gemstones in the form of thin highly polished plates, backed by metal mirrors, and we would then get excellent specular reflection and mirror images. There may be very sound purely optical reasons for the disposition of the small facets on the front of a brilliant, but I would like to suggest that it is also in a psychological or physiological way that their effect is appreciated. It is mainly through them that we get the " time " factor—the changes of intensity which are so essential to lustre. No one who picks up a stone holds it motionless ; it is always moved and tilted so that light plays on the small side facets from which we get intermittent flashes of varying intensity. An emerald is not prized for its lustre ; in fact, we try to diminish it so that we are not dazzled and can then better appreciate the beautiful colour. To do this we deliberately enlarge the table at the expense of the side facets, which thus become smaller in size, number and importance. The " change of intensity " effect is thus reduced and lustre declines—hence the " emerald cut."

I think it must be admitted that dispersion affects lustre. The characteristic lustre of diamond includes its high dispersive effect—

the constantly changing coloured gleams from the surface. Dispersion seems to make a lively lustre. Benitoite, although much softer than sapphire, has a better lustre, in spite of similarity of refractive index, whilst demantoid is outstanding among garnets probably for this reason.

Now we come to the most interesting of all the ingredients of the lustre complex—the parallactic effect. We look simultaneously at the surface and through it into the body of the stone. If we immerse a stone in liquid to diminish the surface reflections we certainly get none of the characteristic lustre. Neither can we appreciate it by focussing a microscope past the surface down into the interior (even using dark field illumination so as to obtain the minimum of direct transmitted light), and if we hold the stone at such an angle that we get practically only the light specularly reflected from the surface it looks like little more than a bad mirror, also with poor lustrous effect. It is clearly essential that our eyes shall simultaneously receive light reflected from the surface in addition to the transmitted light in order to appreciate the lustre. The parallactic effect may perhaps be the principal cause of stones of similar physical properties having different lustre. Quartz and phenacite have refractive indices and hardness of the same order, yet the lustre of the latter is far higher. (Phenacite is definitely a problem on account of its unusual silvery lustre.) A synthetic white corundum is less lustrous than synthetic white spinel in spite of superior hardness and refractive index ; yellow orthoclase and yellow apatite are sometimes quite lustrous stones despite moderate refractive index, low hardness, and (in one) cleavage difficulties. These anomalies are difficult to explain on purely physical grounds because lustre is not a physical property ; it is an effect on our senses, which cannot be measured like refractive index, and among the constituents of our lustre complex the parallactic effect is one of the psychological factors which perhaps " take care " of these anomalies. It would be tempting to try to connect the " parallactic effect " with double refraction, by which " two of everything " sometimes appear and some doubly refracting stones have good lustres (sphene, zircon). If there were any correspondence, however, hambergite with its enormous birefringence should be lustrous, but the only specimen I have seen was singularly unlustrous in appearance.

The parallactic effect has been the subject of prolonged discussion and is dealt with at some length in Bancroft's paper. Some authorities infer that it arises when two surfaces are seen simultaneously, one closely behind the other. Others consider it due to the combination of two " masses of light," and if it is of significance in gemmological lustre it must be regarded in the broadest possible way. The light reflected from the surface of a gemstone is not much changed, but that from the interior is often greatly modified. Preferential absorption of some wave-lengths may take place and others may be preferentially scattered. It is in this way that texture and opacity can be brought into the picture as contributory causes of lustre.

The gemmologist seems to divide lustre roughly into three classes. The adamantine or extremely brilliant, I think, infers that we are so dazzled by the specular reflections that we cannot see very clearly into the stone. When these specular reflections diminish, our eyes are no longer dazzled and we can easily observe the interior. If it is featureless we call it glassy or vitreous, but if we observe any " texture " we instinctively compare it to other substances and say the lustre is greasy, silky, pearly, etc. Now how can the appearance of a gemstone possibly resemble that of grease? The two substances are totally different—in composition, structure and physical properties, but yet with a polished zircon one does get the feeling that the surface looks somewhat greasy. Some authorities consider it due to inequalities on the surface, which in parts may have failed to respond to the polishing process—a theory which receives some support from the experience of lapidaries who find zircon a difficult stone to polish. Since a poor polish on a stone of low refractive index does not usually result in a similar lustre, it must be inferred that on this theory the greasy lustre of zircon is due to a combination of poor polish on a substance of high refractive index, but a poorly polished diamond (e.g. a native cut stone) does not look greasy. Dr. Harrison (in a private communication) says: " As far as I can judge, a greasy appearance depends on the existence of a weakly reflecting slightly irregular layer on a stronger, more regular layer," and asks whether there is a possibility of there being minute faults beneath the surface of zircon which, acting as weakly reflecting planes, create a somewhat similar condition. My knowledge of mineralogy is far too small to answer this question. Some white zircons do show a tendency to turn milky owing to the formation, perhaps, of minute light scattering particles. The only answer, of which I can think, is that if we consider grease on the one hand and a zircon on the other against the background of the lustre complex the total integrated effect on our senses is similar in each case and we almost imagine the zircon to be covered with a film of grease.

Finally, a few words on the difficult subject of metallic lustre, which hardly enters gemmology except, perhaps, with marcasite, haematite, and graphite. Optically, metals are peculiar substances, and differ greatly from others, due, no doubt, to their internal structure. In most of them the atoms or ions are closely packed together and share electrons, which can be imagined to form a loosely held " froth " extending round the structure. The closely packed atoms account for the high density of metals and the ease with which they can slide or glide over each other confers ductility and malleability. The electrons, being fully mobile, convey electric charges when in motion—hence the good electrical conductivity. Under the stimulus of light (of long or medium wave-lengths) these electrons obsorb energy, but having no fixed positions about which they can vibrate, do not retain but re-radiate it. Hence metals are very good reflectors—far better than other substances. Even a diamond reflects only 17 per cent. of normal incident light ; metals can reflect over 70 per cent. The structure of graphite somewhat resembles that of metals in that there is considerable sharing of electrons—hence the metallic lustre of this substance. There is practically no penetration of light into metals, so what we see is almost all surface reflected light. Now in gemstones light reflected at the surface is white ; the coloured component comes from within, where light suffers some preferential absorption, becomes residually coloured and is scattered or reflected back to our eyes. Light reflected from a metal surface—the lustre—is, however, coloured. This raises the interesting question as to what are the real colours of gold and silver. In thin films gold leaf is purple and silver blue by transmitted light. We might perhaps be justified in saying that these are really bluish metals having a golden or silvery " lustre."

The principal characteristics of metallic lustre are, therefore, the very high proportion of light reflected from the surface, great opacity and the ability to reflect coloured light, so if for any reason these should occur with a non-metallic substance it assumes a " metallic " lustre. For example, a small bubble of air imprisoned in water appears silvery in certain directions where there is a high concentration of reflected rays owing to total internal reflection. As Dr. Harrison points out, the silvery streak of the moon reflected in ruffled water appears metallic, because owing to inclination of the wave there is not much penetration of light and we get a high intensity of reflection from the surface, which thus appears opaque. In a previous article in this journal* it was explained how some very intensely coloured substances show selective reflection—that is, they appear to be differently coloured according to whether they are viewed by transmitted or reflected light. This arises from the fact that for certain wave-lengths of light these substances have very high refractive indices and for others very low. The former are therefore mainly reflected at the surface, whilst the latter are mainly transmitted through the substance. The component reflected at the surface is coloured and thus tends to confer metallic lustre. Many solid dyestuffs and the plumage of some birds also exhibit this phenomenon.

In short, many non-metallic substances assume metallic lustre ; somehow they suggest to our minds they are like metals, whereas in fact there is not the slightest " physical " resemblance, which again underlines the strong psychological aspect of lustre.

In conclusion, I would like to re-emphasize the warning I made at the beginning. This is no " authoritative article "—even if it were possible to write one. The problem of lustre has baffled physicists, psychologists, and physiologists for nearly a century and still remains unsolved. I have merely tried—perhaps unwisely—to apply a very attractive theory from another branch of technology to our own rather more complicated subject. I think, however, that Dr. Harrison's qualifications together with his long and probably unique preoccupation with the subject do justify the attempt.

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* " Journal of Gemmology," p. 10, No. 4, Vol. I.

A GEM LABORATORY IN HOLLAND

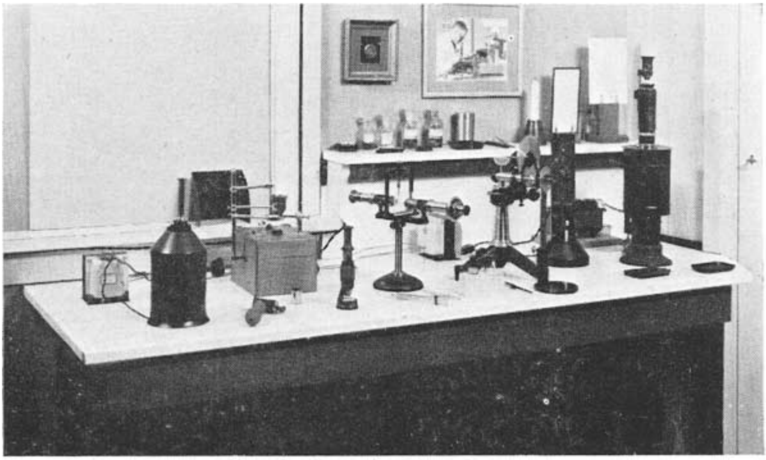

Photo I. From the left to the right.
Spectroscope with illumination and lamp transformer. Detectoscope with screen. A small Zeiss microscope, magnifies 280 times ; this instrument to be used for studying and examining slides and microscopical crystals. Horizontal Conoscope, instrument to examine the interference figures of optical uniaxial and biaxial gemstones and crystals. Bolman syst. Pulfrich-Zeiss Refractometer, with polarizer and monochromatic (Medium) lamp. The hemisphere with a R.I. = 1,90116. Pearloscope (Bolman syst.) with transformer.

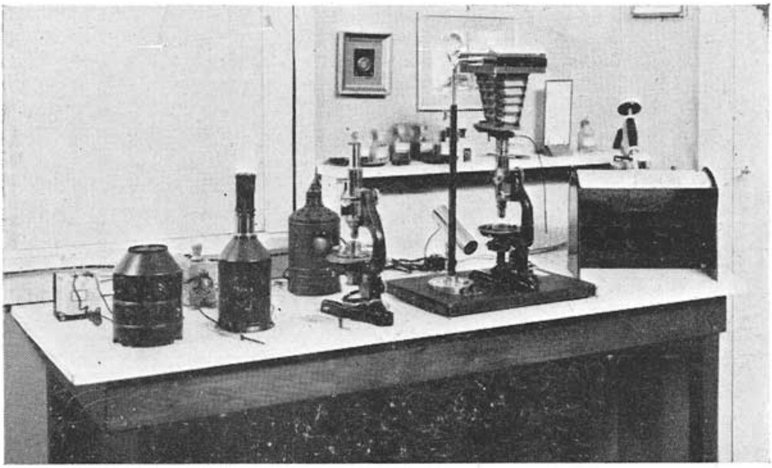

Photo II. From the left to the right
Brillantoscope, Bolman syst. to examine the angle—and double refraction besides the dispersion in faceted stones. This instrument is also used to make refractograms of a gemstone. Polarizing Microscope with apparatus for making photomicrographs. Ultra violet illumination in box to examine fluorescence. (Photos: Dr. J. Bolman, Gem Laboratory, Hilversum).

MARGINALIA

Informal notes on points of interest and opinions of a controversial character compiled by Fellows of the Association. The contributor in this issue is Edgar J. Burbage

IT has been suggested that with the advance in fame and reputation of the Gemmological Diploma, a time may come when it may achieve University recognition. It cannot be denied that under the aegis of such a body, the Association's examinations would gain greatly in prestige, but the advantages and snags of such an elevation in status seem to be pretty well balanced. The University would not unreasonably expect to take a hand in framing the syllabus, in setting the examination papers, and in selecting the examining body. Personally, I should be reluctant to see any of the activities of the G.A. becoming subject to outside control, however benevolent in intention. Also, the traditional functions of an English university do not include the provision of technical education of this sort, and I hope they never will do so.

* * * *

Evidence of the extent of recent work on the fine structure of diamond has been given by the publication of papers forming a symposium on the subject. Although of considerable importance to physicists, the gemmologist may be forgiven for knowing little of the progress and scope of this research, as it does not touch him closely, and the subject is somewhat too recondite for a non-specialist to follow from the original papers. It is to be wished that a " popular " account could be written in terms intelligible to the average gemmologist, and in a publication normally accessible to him. The name of Dr. Kathleen Lonsdale suggests itself as the ideal expositor of this subject, to which her own research work has contributed so greatly.

* * * *

Here is a mystery of a minor sort, which I confess has proved beyond my capacity to unravel. In Meade Falkner's best-known novel, " Moonfleet," Elzevir Block and John Trenchard are in Amsterdam trying to sell the Mohun diamond to a Dutch dealer, but the latter tells them that the stone is false and so acquires it without payment. For the purpose of the deception the dealer purports to show the vendors a chemical test proving that the stone is paste. He says: " Against high chymic tests no sham can stand ; and first it is too light in weight, and second, when rubbed on this Basanus of Black-Stone, traces no line of white as any diamond must. But third, and last, I have tried it with the hermeneutic proof, and dipped it in this most costly lembic ; and the liquor remains pure green and clear, not turbid orange, as a diamond leaves it." Now, I need not be reminded that there is no simple chemical test for diamond, and certainly none that was known in the eighteenth century ; also, the alchemical blarney may be intentionally meaningless. But I have a suspicion that the passage describes a garbled version of an operation which the disciples of Robert de Fluctibus, Lillius, the Dees, and other students of " the Matter " believed to furnish a test for diamonds. That this is probable becomes evident from a careful examination of the loving care which Falkner has taken over his pastiche elsewhere (as in " The Lost Stradivarius "), and recent reassessments of the writer and his work tend to strengthen this probability. Perhaps some erudite F.G.A. can provide confirmation for my theory by running to earth the source employed by Falkner.

* * * *

A scrutiny of a recent issue of the " B.P.C." confirms a suspicion that medicaments compounded from the gem minerals no longer form part of the stock-in-trade of the modern pharmacist. His predecessor of three centuries ago rated sundry decoctions from the gemstones as of medicinal value equal to preparations of Egyptian mummy and of salves employing Sir Kenelm Digby's famous Sympathetick Powder. Apparently a faith in the efficacy of gem preparations survives in the East, for within recent years an order has been received from India by a London jeweller, requiring a supply of diamond dust for medicinal purposes. Having regard to the former sinister employment of this substance, it was considered advisable to tell the inquirer that the powder was unobtainable. Among gem substances formerly employed in medicine, lapis-lazuli had some popularity ; I find that Brasavolus in " De Medicamentis Purgantibus " commends its employment as a purge. No doubt a competent pharmacist could translate his somewhat esoteric formula into reality, should some curious gemmologist wish to hazard a test of it, but I suspect that Epsom salts would be vastly more effective at a fraction of the cost.

Canadian Gems and Gem Localities

By *D. S. M. FIELD*

Part II
(continued)

GEMS OF QUEBEC AND ONTARIO

CORUNDUM (Gem Var.: Ruby and Sapphire).—An account of the Canadian occurrences of corundum which should be of special interest this year, for it was exactly a century ago that it was first discovered in Canada.

Dr. T. Sterry Hunt, Chemist and Mineralogoist to the Provincial Geological Survey, discovered the mineral while making an examination of the rocks in which is now the township of Burgess, Ontario. In April, 1848, the following report was submitted to the Provincial Geologist:—

> ". . . Not far from the locality of the apatite, on the land of Mr. George Holliday, on the second lot of the ninth range of Burgess, is a deposit of copper pyrites. It occurs in the crystalline limestone, but the explorations, which had consisted only in two or three small blasts, had not developed any well defined vein. . . .
>
> " Among the masses of rock thrown out in blasting, were some consisting of silvery mica, with quartz, feldspar or albite, and calc-spar, which contained imbedded masses of a delicate emerald green and almost transparent pyroxene of rare beauty, and crystals of a dark honey-yellow sphene The mica is often aggregated in masses of small crystals having a columnar arrangement ; imbedded in this, and indeed disseminated throughout the rock, were a great number of small crystalline grains of a transparent mineral, varying in colour from a light rose-red to a deep sapphire-blue. Their hardness, which is so great as to enable them to scratch readily the face of a crystal of topaz, showed them to be nothing else than the very rare mineral corundum, which from the colours is referable to the

> varieties known as the *oriental ruby* and *sapphire.* The grains obtained were small, none indeed larger than a pepper corn,* but at the time I was on the spot they were not noticed, and the specimens were collected for the pyroxene, in only two or three of which I have since detected the corundum. It is probable that further examinations may develop larger and more available specimens of these rare and costly gems. . . .
>
> "Those of the sands of Ceylon, which have supplied the market of the world with these gems, are derived from a similar crystalline limestone. . . . I am indebted for this interesting fact to the courtesy of Major Lachlan, now of this city,† a gentleman who spent many years of his life in India, and, ever alive to the interests of natural science, made a fine collection of the minerals and other natural curiosities of Hindustan and Ceylon. Among these is a fragment of white crystalline limestone, containing small crystals of sapphire, with grains of chondrodite. The latter mineral . . . is quite characteristic of these peculiar limestones . . . and although I have not yet observed it in place in Canada, I have seen a specimen in the hands of Dr. Holmes . . . [of *Montreal*] which was broken from a boulder near Bytown [*Ottawa*], and which contains crystals of spinel, with chondrodite, in limestone."

In 1876, the largest known deposit of corundum was discovered in Lot 3, Concession XVIII, in the township of Raglan, Renfrew County, Ontario. The corundum from this locality—now known as Craigmont—is found in large barrel-shaped crystals, but unfortunately, few, if any, of them would yield cutting material. This is true also of the crystals found in the several Canadian deposits later discovered, one of which has been traced for over 100 miles, with few interruptions, through several counties in the province of Ontario.

In Lot 12, Concession XIV, in the township of Dungannon, Hastings County, the syenite is rich in corundum crystals of a translucent grey to pale blue colour, some of which—although almost invariably traversed by fine cracks—are transparent in the centre and of a rich, deep sapphire-blue colour.

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* Small pea. † Montreal.

One of these splendid crystals was classed a true sapphire, and was exhibited along with other Canadian gem minerals at the Pan-American Exhibition of 1901.

In more recent years, some little attention has been given this and other deposits with a view to obtaining flawless gem material for cutting purposes. The crystals found by itinerant prospectors are larger than any previously discovered, and being of much finer quality—in so far as cracks are concerned—offer considerable promise.

In 1924, the late Dr. H. V. Ellsworth, of the Geological Survey of Canada, published a short report* on the Bancroft sapphire, part of which is given below:—

> " Usually the discoverers do not wish to divulge the exact location of their finds. The writer visited one such occurrence under promise not to mention the exact locality, and obtained some specimens. . . .
>
> " The corundum crystals occur in a gneissoid micaceous phase of the so-called syenite, in which but little nephelene was apparent. The crystals are externally a pale greyish colour and are more or less translucent so that sometimes indications of an internal blue colouration can be seen from the outside. The larger blue-coloured areas are usually found in the centre of the crystals, but many crystals contained only sporadic blue spots. The specimen illustrated was one of several obtained in place by the writer in person. The two portions taken together represent about half of the original crystal, which was broken across, normal to the C axis, by repeated blows of a heavy hammer. The half crystal was sawed in two in a direction normal to the C axis giving the specimens illustrated here. These are 2 × 1½ in. in diameter over all, the coloured areas being 1½ × 1 in. in diameter. The colour is a very fine deep cobalt blue."

Dr. Ellsworth submitted the specimen to the late Dr. George Frederick Kunz, who stated that if it were not for the aforementioned defects, each half would have been worth 10,000 dollars.

Blue corundum is also found in the township of Methuen, Peterborough County, Ontario. Here the crystals are generally imbedded in muscovite, with no indication of their presence until

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* In "Can. Mining Jour.," October 10th, 1924.

the books of mica are broken open. The crystals from Methuen township are often rounded in form, due to their alteration into the mica.

Very little work has been done anywhere in Canada with a view to obtaining gem sapphire, the specimens so far obtained having been found practically at the surface of the deposits. A few of the grey-blue crystals have yielded quite large star stones of medium quality, but the pre-Cambrian rocks of the district have been so badly deformed by secondary heating and pressure that the constituent crystals so far uncovered are capable of yielding only small fragments, hardly suitable for cutting into faceted stones. It is possible, however, that some of the larger now deeply-imbedded crystals may have a flawless, deep blue central core from which large gem sapphires could be cut.

The Craigmont deposits also yield a bronze-coloured corundum and some of the crystals have been cut, by amateur lapidaries, into cabochon gems. These have no particular appeal to the general public, however ; consequently it would be rather difficult to find a ready market for them in Canada.

SPINEL.—Although very few perfectly transparent crystals of spinel have been found in Canada, several deposits might yield material suitable for cutting into cabochon stones.

In the Seigniory of Daillebout, Joliette County, P.Q., fine blue translucent octahedra of spinel are found in a micaceous crystalline limestone. Some of these might possibly yield star stones.

Opaque, light blue, cube-shaped crystals, nearly an inch across, and translucent pink and dark blue cubes—usually slightly rounded in form—are sometimes found near Wakefield, P.Q.

Splendent crystals of black spinel (the so-called pleonaste), measuring as much as two inches in diameter, occur abundantly in a vein of crystalline limestone, in the townships of Burgess and Bathurst, Lanark County, Ontario. This vein is over a mile in length.

TREMOLITE.—Tremolite is a calcium-magnesium amphibole which was originally discovered in the Tremola Valley, on the south side of St. Gothard, Switzerland. It is closely related to actinolite, differing only in that it contains little or no iron.

Tremolite is generally somewhat fibrous in structure, and of a white to dark grey colour. It is rarely transparent.

Small, deep blue and brilliant emerald-green stones have recently been cut from fragments of crystals found near Wilberforce, in the township of Monmouth, Haliburton County, Ontario.

The tremolite from this locality is associated with chrome diopside, and the green had previously been mistaken for that mineral.

Greyish-green, grey, greenish-grey and brown tremolite is found in some abundance in the same County, near the town of Haliburton. Several dozen fine tremolite cat's-eyes have been cut from this material.

The writer has cut a number of these cat's-eyes—the best of which are deep bottle-green in colour, and display razor-sharp, silver-white lines of light.

WILSONITE.—Rich purplish-red wilsonite is found in large masses, in association with scapolite, in the townships of Bathurst and Burgess, in Lanark County, Ontario ; and in Ottawa County, P.Q.

The material is susceptible of a splendid polish, and this, together with its great beauty, makes it one of the most interesting of the rare gem minerals of Canada (v. Kunz, op. cit.).

PERIDOT.—This lovely gem is found as a constituent of many of the rocks of Ontario and Quebec, but as yet no good material has been discovered.

The nearest approach to gem peridot are the small, imperfect crystals found in the rocks of the ancient volcanic mountains of Montarville, Mount Albert, and Rougemont, which rise abruptly from the plain within a fifty-mile radius, south-west of the city of Montreal, P.Q., and including Mount Royal, in the heart of the city itself.

The peridot crystals or grains average one-half inch in diameter, and range in colour from amber to olive-green. Few of them are transparent enough to furnish gems, and the majority are full of feathers and inclusions.

CANCRINITE.—A string of beads and a couple of attractive pear-shaped pendants cut from cancrinite are exhibited in the gallery of the Royal Ontario Museum of Mineralogy. The material from which the specimens were fashioned occurs in pure lemonyellow to orange-yellow masses, in association with sodalite, at Bancroft and French River, in the province of Ontario.

Cancrinite has a hardness of 5 to 6, and a sub-vitreous to pearly lustre. It derives its name from Count Cancrin, Minister of Finance in Imperial Russia, where it was originally discovered.

SPHALERITE.—The only gem sphalerite that has yet been reported from Central Canada comes from a small deposit near Wiarton, Bruce County, Ontario. A Toronto collector has a six-carat round brilliant, cut from a twinned crystal found at this locality. It has a rather patchy, golden brown colour and a resinous lustre.

PHENACITE.—Very brilliant, transparent crystals of colourless phenacite have been noted in pegmatite dykes near the Kewagama River, Temiskamingue County, P.Q. These may yield faceted stones.

CHRYSOBERYL.—Tabular crystals of chrysoberyl have been found in pegmatite dykes near the forks of the Rivière du Poste, a branch of the Matawin River, in the Province of Quebec ; but no further details are at present available. It also occurs in Renfrew County, Ontario, but none of the crystals so far discovered there are of gem quality.

PERISTERITE.—Although some thirty mineral species have been originally described from Canadian material, only a few gemstones have enjoyed that distinction. Among these is peristerite, or pigeon-stone, a beautiful, iridescent variety of feldspar, with a composition near to that of albite.

Much of the peristerite from Canada is white or colourless with a celestial-blue opalescence characteristic of the best grade of moonstone ; but perhaps the most attractive varieties have a cream to fawn or brownish-pink body colour, and display a brilliant iridescence rivalling that of a good opal.

The most beautiful peristerite known is found in the township of Monteagle, Hastings County, Ontario. It displays prismatic colours of exceptional brilliance, and when cut as beads, or into cabochon gems, it makes exceedingly attractive jewellery.

Good specimens of ivory-white peristerite have been found in considerable quantities in the Villeneuve Mica Mine, Labelle County, P.Q., and in the township of Buckingham, P.Q. It is also found in crystals of many tints, and in large cleavable masses —often weighing a ton or more—in a pegmatite dyke, in Lot 19, Concession IX, in the township of Bathurst, Lanark County, Ontario ; and as large crystals near the mouth of Eel Creek, on the north shore of Stony Lake, in the township of Burleigh ; and in the township of Bromley, Renfrew County, Ontario.

The large cleavages from Bathurst might well be adapted for use in the arts, and attractive jewellery sets could doubtlessly be cut from them.

Some of the best of the peristerite from the township of Monteagle has been cut and polished, and is on display in the gallery of the Royal Ontario Museum of Mineralogy, Toronto.

PERTHITE.—Perthite, which derives its name from the town of Perth, Ontario, the site of its first discovery, is another ornamental mineral originally described from Canadian material. It consists essentially of both the potash and soda feldspar, the component minerals having been miscible to form a homogeneous compound at high temperatures, but one having been thrown out of solution at a lower temperature to form an interlaminated combination.

If the cutter takes care to orient the stone properly before cutting, the resultant gems will exhibit a rich golden labradorescence against a flesh-red to reddish brown, or white, background. The mineral is susceptible of a high polish and furnishes very beautiful ornamental panels and tallow-topped cabochons.

Perthite is also found in large masses in Lot 20, Concession X, in the township of Dungannon, Hastings County, Ontario ; in Lot 3, Concession VI, in the township of North Burgess, Lanark County ; and in association with Amazonite in the township of Cameron, Nipissing District, Ontario.

In the Province of Quebec, high grade, white perthite occurs at the Villeneuve Mine, in the township of Villeneuve, Papineau County ; and the mineral is found in several shades of grey, cream, white and pink at the Leduc Mine, Wakefield township, P.Q.

An exhibit of cut and polished Canadian gems and ornamental stones in the National Museum at Ottawa includes several specimens of perthite from the provinces of Ontario and Quebec.

SUNSTONE.—Sunstone is a transparent to translucent variety of sodic plagioclase characterized by minute, disseminated particles of red oxide of iron, which cause fiery flashes of colour from the interior of the stone.

Some very fine crystals of sunstone have been found in several places near the contact of the Bancroft sodalite and nephelene syenite in Hastings County, Ontario, and near Perth, in Lanark County. Attractive specimens also occur in the township of Sebastopol, Renfrew County, Ontario ; and sunstone of a brownish-pink colour is found in a pegmatite dyke some twenty miles east of French River, on the north-east side of Lake Huron.

Many splendid cabochons—some of which are chatoyant—have been cut from Canadian material. The most attractive of these have a translucent, golden brown body colour, and resemble the " goldstone " imitation which was popular before World War I.

Another deposit has recently been discovered at Drag Lake, in the township of Dudley, Haliburton County, Ontario. A Toronto collector has acquired a large taupe cabochon from this locality which shows minute fiery flashes and a blue moonstone flame.

There would seem to be two distinct colour varieties of this mineral. The writer possesses two cabochons, one of which weighs approximately sixty-five carats, and is of a light fawn colour with pale bluish-mauve moonstone flame ; the other is of a much darker brown, and displays a white moonstone flame. It weighs forty carats. Both colour varieties display good aventurescence—the deeper colour being superior in that respect.

A less attractive, grey-to-white variety of plagioclase from Norway, with similar inclusions, is known as aventurescent feldspar, or, simply, aventurine.

FLUORSPAR.—Fine cubic crystals of transparent green fluorspar occur in the Mica mines of Quebec, north of Ottawa, Ontario, and a green, compact variety is found at Baie St. Paul and near Murray Bay, P.Q.

Deep purple-to-violet crystals of fluorspar occur in association with the amethyst and smoky quartz crystals of the Lake Superior district of Ontario, and in small, splendent crystals lining geodes at Niagara Falls, Ontario.

CHLORASTROLITE.—This mineral is a silicate of aluminium, calcium, etc. It occurs, in Canada, as small stellated masses in the basic ignerus rocks of Michipicotem Island, in Lake Superior ; and chlorastrolite pebbles may be picked up on the beaches of this island, and at other points along the shores of the lake.

Chlorastrolite is frequently chatoyant, and this, together with its attractive mottled green colour, makes it eminently suitable for cutting into cabochon stones. It takes a fine polish, and is locally called " Lake Superior Greenstone."

Chlorastrolite is also found on Isle Royale, a U.S. island at the south side of the lake. These are the only known deposits of this rare and attractive gem material.

In order to halt the wholesale exploitation of the deposits by tourists and local collectors, it is reported that measures have been instituted to limit the collection of specimens—which each year are becoming increasingly more difficult to find.

Prehnite and Zonochlorite.—Closely related to chlorastrolite is the mineral prehnite, a hydrated silicate of aluminium and calcium. This, and the chemically impure variety known as zonochlorite, are found at a number of points on the north shore of Lake Superior, and in spherical masses of crystals in the trap rock along the Kaministiguia and Slate Rovers, in Ontario.

The prehnite from these localities is translucent and of a rich emerald-to apple-green colour, and resembles prase or first-quality Burma jade.

The zonochlorite variety is only feebly translucent, and if of a much darker shade of green. It is, however, beautifully veined and mottled with contracting shades of green, and since it admits of a high polish, the mineral is cut into cabochons and sold at tourist resorts along the lake.

Prehnite and zonochlorite with inclusions of native copper are found at Simpson's Island, in Lake Superior.

Thomsonite.—Thomsonite is a hydrated silicate of alumina, lime and soda, which owes its beauty and value as a gem material to concentric rings or bands of flesh-red, white, yellow, and green colours. Some fairly large specimens are found on the beaches of Michipicoten Island, in Lake Superior, and while it occurs in more striking colours along the north shores of the lake (especially in the amygdaloid basalt at Cape Gargantua and Point Mamainse), the pebbles found there rarely exceed an inch in their greatest dimension.

Thomsonite takes a splendid polish, and in the past great quantities were cut and sold to tourists and collectors ; but, like the chlorastrolite described above, good material is not plentiful now.

The most attractive thomsonites have, when polished, bright green zones of lintonite (an uncrystallized form of the same mineral) framed by concentric rings or bands of contrasting green or pink colours. Such specimens are very beautiful, and are readily saleable at good prices.

AMETHYST.—Great quantities of splendid amethyst crystals are found in the vicinity of Thunder Bay, and at other points along the north shore of Lake Superior ; also on the shores of Lake Nipigon, and at the mouth of the MacKenzie River.

Dr. George Frederick Kunz* described the Lake Superior amethyst as follows:—

> " Amethyst is found in some form in nearly every vein cutting the cherty and argillaceous slates around Thunder Bay. . . . At Amethyst Harbour this mineral constitutes almost the entire vein, and numerous openings have been made to obtain it for tourists who visit the spot. Thousands of dollars' worth are annually sold here, and as much more is sent to Niagara Falls, Pike's Peak, Hot Springs, and other tourist resorts, as well as to the mineral dealers. Surfaces several feet across are often covered with crystals from one quarter to five inches long, rich in colour and having a high polish. Sometimes, especially when large, the crystals have a coating of a rusty brown colour, owing to the oxidation of the included goethite. This is one of the most famous occurrences of this mineral, regarded as mineral specimens. . . ."

In common with the Bay of Fundy amethysts described in Part I, the colour is not evenly distributed throughout the crystals. But, whereas the Bay of Fundy stones are often transparent, the amethyst crystals from Lake Superior are generally opaque. Occasionally, however, a portion of a crystal is clear enough to be cut into transparent, crimson-shaded amethyst gems of rare beauty.

SMOKY QUARTZ occurs in fine groups, with the amethyst described above. The crystals are of about the same general quality.

ROSE QUARTZ.—Rose quartz of gem quality has been found in the Villeneuve Mica Mine, in Labelle County, P.Q., and in the township of Lyndoch, Renfrew County, Ontario. The material from these localities is frequently opalescent, and when cut in the

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* See Kunz: " Gems and Pr. Stones of N. America," 1892.

cabochon form shows a six-rayed star. The Lyndoch rose quartz ranges in colour from a pale rose to pale purplish rose-pink, and quite large flawless pieces are plentifully distributed throughout the pegmatite dykes of the district. A rich, deep pink variety of excellent gem quality occurs in Manitoba. (The Manitoba material will be further described in Part III.)

MASSIVE QUARTZ.—Agates, onyx, carnelian, etc., are found in great abundance at nearly every point along the shores of Lake Superior. The masses exhibit a wide range of colours—green, red, blue, brown, etc.—and furnish cut gems to equal the finest from other countries. This is especially true of the banded agates found in the trap rock and along the beaches at Michipicoten, Ignace, and Simpson Islands. At these localities the colours are exceptionally vivid. and the stones, when cut, seldom require artificial staining to enhance their beauty.

Agates of good quality are rarely met with in the Province of Quebec. However, the agate pebbles found along Chaleur Bay, in Gaspé County, P.Q., are sometimes cut for the tourist trade.

JASPER.—Dr. Kunz (op. cit.) gave an excellent account of the jasper deposits of Ontario:—

> " Jasper conglomerate exists in mountain masses, along with the quartzite masses of the Huronian Series, for miles in the country north of the Bruce Mines, on Lake Superior north of Goulais Bay, on the St. Mary's River about four miles west of Campment d'Ours, and at two places on the east shore of Lake George, and on Lake Huron, Ontario. It is a rock consisting of a matrix of white quartzite, in which are pebbles often several inches across, of a rich yellow, green, or black jasper, and smoky or other coloured chalcedony, which form a remarkably striking contrast with the pure white matrix. It is susceptible of a very high polish, and has been made into a great variety of ornamental objects, such as vases, paperweights, etc. Some very beautiful mosaics have been produced by using the rock and included pebbles. The stone occurs in thick bands which extend for miles, and large boulders of it are scattered along the shores of the lakes and rivers. Within half a mile of the northern extremity of Goulais Bay, Ontario, there is a ridge containing several varieties of it. . . .

> "Considering the abundance of this jasper it seems strange that so beautiful an ornamental stone should have been so long neglected, but the recent improvements in sawing and polishing hard stones for ornamental purposes will doubtless bring it into extensive use in the near future."

Fine jasper also is to be met with in Quebec Province, associated with chalcedony along the Rivière Quelle ; also near Sherbrooke ; and rich red material occurs in large quantities in the township of Hull, P.Q.

BANDED JASPILITE.—The Royal Ontario Museum of Mineralogy recently secured specimens of a banded jaspilite of exceptionally fine colour which were taken from a small deposit on an island in McInnis Lake, Patricia District, Ontario. Several extremely attractive cabochons were cut from this material and, although care must be taken to achieve an even polish, it offers considerable promise as an ornamental stone or gem material.

EPIDOTE.—This mineral is found in veins traversing a fine-grained red-coloured gneiss in the township of Ramsay, Ontario ; also at the Mingam River falls in the Province of Quebec. The epidote is generally cut with the matrix into cabochon stones and ornamental slabs.

The epidote from these localities is usually pea-green in colour, and since both it and the reddish matrix take a good polish, the cabochons and slabs cut from it are of very great beauty.

Epidote is also found with quartz along the Matane River in Quebec ; in association with flesh-coloured feldspar in the trap rock of the Lake Superior region, Ontario ; and in huge masses in the Shickshock Mountains, Gaspé County, P.Q.

The epidote from all these localities takes a good polish, and, if cut with the matrix, would make an excellent ornamental material and furnish attractive and unusual cabochon gems.

ILMENITE.—Ilmenite containing small grains of green feldspar and imbedded acicular crystals of rutile is found near St. Urbain and Baie St. Paul, P.Q. It makes an excellent ornamental stone when polished.

SERPENTINE.—This beautiful ornamental stone is found at Kilmar, P.Q., in association with magnesite. Some of the material is beautifully mottled, and ranges in colour from oil-green through pea-green to citrine-yellow, and it is quite distinct from any of the serpentines found elsewhere. A few attractive ornamental objects have been fashioned from it, and it would doubtlessly furnish pretty cabochon stones.

Precious serpentine is also found in large quantities in the eastern townships of Quebec, and in other parts of the province, and large slabs of rich colour have been taken out.

PORPHYRY.—This rock forms a twenty-foot dyke running east and west through the townships of Chatham and Grenville, P.Q. It consists of a compact, dark green to brownish-black base in which are imbedded crystals of red orthoclase feldspar. Polished sections of this rock produce a distinctive mottled design of great beauty.

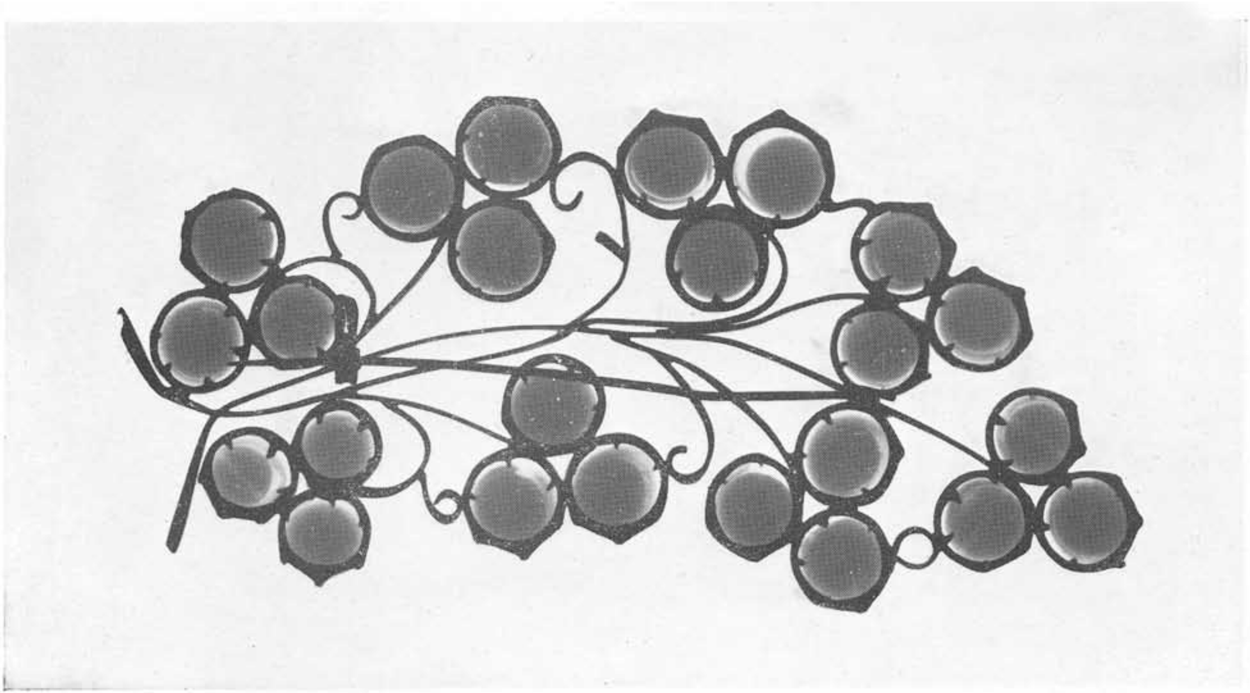
COBALTITE.—Shining cubic crystals of this metallic silver-pink mineral occur in and around the town of Cobalt, Ontario. These are sometimes cut as cabochons, or faceted like pyrites and marcasite.

DATOLITE.—Compact, opaque masses of beautifully mottled datolite, cometimes containing inclusions of native copper, are found in association with prehnite in veins and cavities in the Lake Superior copper district. The material, which resembles delicately tinted meerschaum when polished, is sometimes cut into cabochon stones and ornamental slabs.

DIAMOND.—Although small diamond crystals were believed to have been discovered in the chromite of Rheume township, Ontario, and in the massive chromite near Black Lake, Megantic County, P.Q., their existence has not been definitely confirmed. But in the glacial drifts south of Lake Superior—especially in the State of Wisconsin—diamond crystals are occasionally found.

Were these U.S. diamonds transported there, during the Glacial Period, from the vicinity of Hudson Bay? Nobody knows. But the supposition sends engineers and prospectors incessantly deeper into Canada's vast uncharted North ; for if, as many believe, the diamonds of Wisconsin came originally from Canada, then rich pipes may lie somewhere in this northland, undiscovered.

PHOTOGRAPHS FROM THE LABORATORY



Photograph of a cultured pearl floral brooch taken by direct radiography (slightly enlarged).

ASSOCIATION NOTICES

MEMBERS' MEETINGS

12th October, 1948: At Geological Society's Hall, Burlington House, Piccadilly, London, W.1, 7 p.m. Dr. Kathleen Lonsdale, F.R.S. "The Atomic Structure of Diamond."

2nd November, 1948: At British Council Cinema, 7 p.m. "Golden Harvest of the Witwatersrand," a sound film showing the mining of gold in S. Africa.

24th January, 1949: At British Council Cinema, 7 p.m. "Atomic Physics," a remarkable sound film dealing with a topical subject.

EXTRACT FROM MINUTES OF COUNCIL MEETING

A meeting of the Council was held on Thursday, 5th August, 1948, at 93-94, Hatton Garden, London, E.C.1, under the Chairmanship of Mr. F. H. Knowles-Brown.

A report of the 1948 Diploma examinations was submitted by the examiners and approved by the Council. (The list of qualifiers appears hereunder.) The Council discussed the possibility of forming a European Gemmological Federation and agreed to ascertain views of other Associations.

The following Fellows were elected:—

T. G. Balson (Rickmansworth) (re-election).
M. J. Stevenson (Adelaide).

The following Ordinary and Probationary Members were elected:—

Ordinary: M. I. A. Khalik (Singapore), R. E. Lee (Uttoxeter), J. Pike (Thames Ditton), Miss L. Willis (London).

Probationary: D. Baxter (Blackpool), J. R. H. Chisholm (Leverstock Green), Mrs. L. M. Chisholm (Leverstock Green), N. A. Clayton (Birmingham), G. Croston (Liverpool), R. J. Dudfield (Oxford), Miss J. E. Fitch (Vancouver), D. N. King (Birmingham), R. W. Lowe (N. Rhodesia), N. Masso (Barcelona), A. H. Parfitt (Bristol), E. D. Rainbird (Bedford), W. A. Rance (High Wycombe), J. Sais (Barcelona), S. G. Stephanides (Birmingham), G. W. Whitehead (Surbiton).

AMERICA

It is reported that the Diamond Council of America has appointed Prof. Paul J. Storm, University of Pennsylvania, to conduct two correspondence courses for members of the Council and their employees. The courses include a general study of gemstones and a special one on diamond, with appropriate certificate awards. Myer B. Barr, of Philadelphia, is President of the newly formed Diamond Council, and Clement J. Wyle, Executive Director. The Council's objects are stated to be the promotion of the study of gemstones and maintenance of a code of ethics.

The Gemological Institute of America has opened an Eastern Headquarters office at 5, East 47 Street, New York. This will be the first time the Institute has had an Eastern Headquarters since the closing of the Boston office following the death of Dr. Edward Wigglesworth in the spring of 1945.

In August the Association had the pleasure of calls from Dr. Frederick Pough, Curator, American Museum of Natural History, and Dr. Ralph J. Holmes, of Columbia University. They visited this country in connexion with the International Geological Congress held in London in August.

Dr. Pough very kindly arranged to show members of the Association the technicolour film "Paricutin and Mexico's Volcanic Area." This was done on Monday, 20th September, at the British Council Cinema. Dr. Pough explained the film as it was shown, and his interesting and entertaining talk impressed members as much as the vivid and exciting film.

AUSTRALIA

The Association has received news of the passing of A. E. Tombs, Federal Chairman and State President of the Gemmological Association of Australia. Mr. Tombs was one of the founders of the Association in Australia and his work and knowledge will be sadly missed.

SWITZERLAND

Recently Dr. A. E. Alexander, of the Gem Trade Laboratory, New York, and Mr. B. W. Anderson, from this country, met Dr. E. Gübelin in Lucerne and spent an enjoyable week discussing and working out various gemmological problems.

Dr. Alexander visited this country on his return journey to America.

INSTRUCTORS, 1948-49

Mr. B. W. Anderson, B.Sc., and Mr. C. J. Payne, B.Sc., continue as the Association's Instructors in the Diploma and Preliminary Correspondence Courses. The following have been appointed as Instructors in the various Gemmology Classes by local Education Authorities:—

London (Chelsea Polytechnic): B. W. Anderson, T. G. Jones and R. Webster, assisted by R. K. Mitchell and L. F. Cole.

Birmingham (Jewellers' and Silversmiths' School): N. A. Harper and W. A. Perry, assisted by A. D. Conway.

Edinburgh (Heriot Watt College): D. Ewing.

Glasgow (Stow College of Engineering): A. T. Dollar, Ph.D., B.Sc. and Dr. Holgate.

Plymouth (Technical Institute): S. T. Solomon.

TALKS BY FELLOWS

Miss M. J. Biggs: Women's Provisional Club (20th July, 1948). Subject: Gems.

F. E. Leak: Toc H, Brislington (Bristol) Branch (3rd May), Clifton (Bristol) Arts Club (20th May). Subject: The Science of Jewellery. St. Edmund's Church (Bishopston, Bristol) Youth Club (21st April). Subject: Pearls.

RESULTS of the 1948 Examinations

FOR the 1948 Diploma (Fellowship) Examinations of the Gemmological Association of Great Britain an unprecedented number of candidates, 95 in all, presented themselves, of whom 81 sat in Great Britain and 14 overseas ; of these 6 did not take the practical part of the examination and could qualify for Associateship only. Upon the recommendation of the examiners no award of the Tully Medal has been made. The Anderson prize for the best work in the practical examination has been awarded to Mr. D. M. Spero.

A record number of entries was received for the Preliminary Examination also, 20 from overseas and 156 in Great Britain, making a total of 176. The Rayner Prize has been awarded to Mr. E. H. Gudridge.

The following is a list of successful candidates, arranged alphabetically:

DIPLOMA

Qualified with Distinction

Crowningshield, George (Los Angeles, U.S.A.)
Dragsted, Ove (Copenhagen, Denmark)
Hodge, John (Campbeltown, Argyll)
Kirtley, Dennis C. (Sunderland)
Llewellyn, Graham D. (London)
Spero, Douglas M. (London)
Stevenson, Malcolm J. (Adelaide, Australia)
Stonley, Henry G. (London)
Wade, Michael B. (London)

Qualified

Allan, Wallace S. (Ayr)

Baker, Leonard A. (Seven Kings)
Bawden, Frederick C. (Johannesburg, S. Africa)
Bodes, Pieter N. (The Hague, Holland)
Bolton, Leslie (Leeds)
Buckingham, William C. (Goodmayes)
Buckle, Robert (Edinburgh)

Cairncross, Alastair (Perth)
Conway, Arthur D. (Birmingham)
Cooper, Walter T. (London)
Crombie, Walter (London)

Davenport, Charles E. (Sutton)
Dawkins, Charles E. (London)
Dembo, Victor A. (Bristol)

Forsyth, Adam (Edinburgh)

Godfrey, Kenneth E. (Winchester)
Goldschmeding, W. (Amsterdam, Holland)

Hammes, Johan (Zeist, Holland)
Harkness, Leslie (Halifax)
Hayman-Joyce, Mrs. B. (Eastbourne)
Hedges, Frederick C. (London)
Higgs, Paul Henry (Stourbridge)

Jenkinson, Herbert A. (Birmingham)
Jones, Ellis (Leicester)
Jutson, Allan Harry (Sandwich)

Kent, David G. (London)
Kennedy, Nigel W. (Tadworth)
Kino, Richard C. (London)
Knowles, Water H. (Byfleet)
Knowles-Brown, Miss E. (London)

Levett, Leonard (Romford)

Martin, Roy (Southall)
Meakin, Peter G. (London)
Miller, Grant (Los Angeles, U.S.A.)
Murray, Arthur S. (Edinburgh)

Page, John A. (Orpington)

Peresypkin, Oleg (Hong Kong)
Plas, Joseph (London)
Pyman, Miss Joan (Letchworth)

Ricketts, Leslie (London)
Roberts, Ian (London)
Rostron, Norman J. (London)
Rossiter, Donald F. (Clevedon)
Ruddock, John W. (St. Albans)

Stein, N. (London)
Stone, Ernest G. (Hove)

Trumper, Leonard C. (Devizes)
Tugwood, Ralph H. (London)

Ungerson, Daniel (London)

Weeks, Herbert W. (Woking)
Wheeler, Douglas (London)

Diploma (Associateship) Examination

Field, Dean S. (Dorchester, Canada)
Hale, Sidney J. (Maidstone)
Horn, Aubrey E. (Jos, Nigeria)
Mayers, Daniel E. (New York, U.S.A.)

PRELIMINARY

Allan, Willa M (London)

Backers, Ferdinand G. (The Hague, Holland)
Barker, Reginald J. (London)
Batty, Jack (Keighley)
Bennett, Phillip (Pinner)
Bercott, Sydney (Glasgow)
Blanshard, Dennis (Croydon)
Boston, Thomas L. (Colchester)
Bowden, Aubrey (Plymouth)
Brocklehurst, Michael J. (Chorley Wood)
Butler, Miss Jean M. (Greenford)
Butterfield, Maurice L. (Leeds)

Campbell, Kenneth J. (Thornton Heath)
Carolyne, Charles E. (Youngstown, U.S.A.)
Chapman, Victor K. (Perth)
Christison, George I. (Glasgow)
Clayton, Norman A. (Birmingham)
Cole, Charles H. (Leonia, U.S.A.)
Coley, Miss Evelyn J. (Birmingham)
Cook, Gerard O. (London)
Crawford-Lindsay, J. C. (Calcutta, India)
Crosthwaite, Stanley A. (Glasgow)
Croston, Gordon (Liverpool)
Crowder, Phillip W. (Glasgow)
Crowningshield, George R. (Los Angeles, U.S.A.)
Cutts, Miss Patricia E. (Birmingham)

Davis, Keith C. (London)
Dembo, Victor A. (Bristol)
Dickson, Robert W. (Glasgow)
Doidge, Roger J. (Tavistock)
Dougan, George F. (London)
Dougan, Reginald W. (London)
Duncan, James M. (Paisley)
Dunn, Miss Margaret (Leicester)

Edwards, John I. (Stratford-on-Avon)
Ellis, Arthur C. (Newent)
Elzingre, Adolph E. (Karachi, Pakistan)

Feinmesser, John H. (London)
Feitelson, Paul (Hendon)
Fitch, Miss Jean E. (Vancouver, Canada)
Folkard, Miss Aileen J. (London)
Foskett, Ernest E. (London)
Frake, William J. (London)

Gale, Herbert C. (Isleworth)
Gold, Alfred B. (London)
Goldschmeding, W. F. (Amsterdam, Holland)
Good, Miss Bridget M. (Halifax)
Gribben, Alan T. (Birmingham)
Gudridge, Edward H. (Perranporth)

Hack, Miss Evelyn O. (Birmingham)
Hammes, Johan (Zeist, Holland)
Hanslip, Malcolm J. (Torpoint)
Harkins, Thomas (Barrhead)
Harkness, Leslie (Halifax)
Harper, Michael G. (Swansea)
Hartland, Edward T. (London)
Haussler, Miss J. (Amsterdam, Holland)
Hayman, Miss Muriel C. (Clarkston)
Hayman-Joyce, Mrs. Betty C. (Eastbourne)
Hession, Thomas J. (Cardiff).
Hill, George W. (London)

Holmes, Geoffrey K. (Birmingham)
Horn, Aubrey E. (Nigeria, B.W. Africa)
Horn, Ian S. (Glasgow)

Janca, Francis (London)
Johnson, Thomas J. (Watford)
Jones, Owen D. (Burton-on-Trent)

Kench, Frank (London)
King, Douglas N. (Olton)
King, Martin P. (Miami Beach, U.S.A.)
Kirkpatrick, Maurice R. (Wembley)
Kussman, Morris (London)

Landsberg, Michael (London)
Leng, Herbert H. (Birmingham)
Lewington, Albert E. (London)
Lister, John M. (Birmingham)
Love, James (Glasgow)
Lowe, Rex D. (Wickersley)

Macdonald, Edgar W. (Bearsden)
Masterton, Hugh (Glasgow)
Matthews, Eric P. (Birmingham)
McCullough, Geoffrey A. (Harmondsworth)
McDonald, Miss Thea (Edinburgh)
McLeish, James (Coventry)
McMinn, Henry M. (Belfast)
McNicol, James (Cambuslang)
Meinke, William A. (London)
Miller, Grant W. (Pasadena, U.S.A.)
Miller, John W. (Glasgow)
Moore, Strafford M. (Cheltenham)
Moyes, William H. (Edinburgh)

Newell, George N. (Edinburgh)
Newman, Frederick E. (Kenton)
Newman, Jack A. (London)

Page, Eric B. (Birmingham)
Parfitt, Arthur Henry (Bristol)
Payne, Harold G. (Bournemouth)
Pearce, William J. (London)
Pellett, William C. (London)
Penn, Leslie (Birmingham)
Pinn, Ronald L. (Birmingham)
Priestley, Geoffrey F. (Folkestone)

Rack, Malcolm P. (London)
Radden, Robert S. (Plymouth)
Rainbird, Eric D. (Bedford)
Rance, William A. (High Wycombe)
Reeve, Arthur A. (London)
Rice, Miss Pauline C. (London)
Richards, Miss Gwynne (New York, U.S.A.)
Rillstone, Raymond (Fremantle, Australia)
Robertson, Ian (Edmonton, Canada)
Robinson, Charles (Manchester)
Robinson, Joseph E. (London)
Rosas, Manuel M. (Oporto, Portugal)

Salloway, John M. (Lichfield)
Saunders, Colin K. (Sutton Coldfield)
Scott, Hector (Glasgow)
Seaton, Edward (Belvedere)
Shapshak, Leon (Johannesburg, S. Africa)
Shearer, Edwin H. (Edinburgh)
Smith, Mrs. June (Tenterden)
Solomon, Trevor P. (Birmingham)
Stephanides, S. G. (Birmingham)
Stern, Theo (London)
Stevenson, Malcolm J. (Adelaide, Australia)

Taylor, George B. (Birmingham)
Thomas-Ferrand, Mrs. Joyce M. (London)
Thompson, Norman H. (Middlesbrough)
Thomson, James (Edinburgh)
Thomson, Peter J. (Thundersley)
Tristen, Ernest E. (Plymouth)
Trumper, Leonard C. (Devizes)

Venables, Henry A. (Dublin)

Waterman, Maurice (London)
Watt, Donald M. (Edinburgh)
Webb, Edward E. (London)
Whitehead, Gordon W. (Surbiton)
Wilson, Robert (Glasgow)
Wilson, Mrs. Sarah E. (Glasgow)
Wolfers, Freddy (Brussels, Belgium)
Wood, Stanley D. (Glasgow)
Woodward, Charles A. (Derby)
Wright, George T. (London)

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