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Diamonds in Tasmania

BY

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Issued under the authority of
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FOREWORD

When great activity prevailed on the Corinna goldfield in the nineties, several small diamonds were found in creeks in the Donaldson Range district, and another specimen came to light in the same district in 1906. The surprise created by the discoveries gradually died away, and even the fact that diamonds have been met with at all in Tasmania is now unfamiliar to many.

It is highly probable that the stones which have been found were merely companions of many others which still lie hidden in the gravels of that locality. Specimens of supposed diamonds have been brought from time to time to the offices of the Geological Survey, but have usually proved to be limpid colourless topaz or even pieces of glass. Several of the genuine diamonds have been carefully examined and their genuineness authenticated. Up to the present the Donaldson district appears to be the centre of the discoveries, only one being recorded from some unknown locality in the drainage basin of the Hellyer River.

This circular is designed by the Department to put on record all that is known in relation to the discoveries and to provide information for persons who may be engaged in sluicing sands for mineral in localities in which diamond is a likely occurrence. A special search for diamonds in Tasmania would probably not be a profitable undertaking, but stones may possibly be detected in the course of sluicing for other minerals, if the material treated is closely watched and the miner knows what to look for.

None of the non-gem varieties of diamond (bort or carbonado), so useful for drills, have been found. It is singular how few minerals are devoid of military utility. Among the technical applications of the diamend is that of boring heavy guns.

W. H. WALLACE, Secretary for Mines.

Hobart, August, 1918.

Diamonds in Tasmania

General Description of Diamond.

The diamond is a stone which has an extremely simple composition, being pure crystallised carbon. Moreover, it is combustible, and can be reduced by burning in oxygen to carbon dioxide. Alluvial diamond in its rough state rarely attracts notice by reason of any special brilliancy; more often than not it bears some resemblance to a piece of dull, greasy-looking washing soda, and is frequently coated with a resin-like skin which conceals the intrinsic beauty of the stone. Limpid, flawless stones, which are rare, are classed in the trade as of "first water" but the gems found are as a rule flawed with minute cracks or spots. The term "Cape White" refers to South African white stones with an almost imperceptible tinge of yellow. Yellowish-greenish stones are technically known as "off-coloured" or "by-water," but in the diamond trade there is a complex classifying nomenclature which embraces many different shades of colour. The diamond is not uniformly white or yellow, but may shade into blue, pink, green, brown, and ruby-red, and under the name of carbonado or bort passes into black.

There are three varieties of diamond:—

1. The gem diamond.
2. Bort, composed of aggregates of very small crystals of diamond. Commercially the term is extended to mean any diamond stone which cannot be classed as a gem. Consequently, it may include carbonado.
3. Carbonado, the same dark-grey to black mineral as bort, but with a still more irregular crystallisation. It generally occurs in somewhat globular or rounded forms, with dull lustre and a somewhat porous texture, which gives it a coke-like appearance. It is less pure than the gem, but often exceeds it in hardness. Bort and carbonado are used in the bits of diamond-drills.

Crystal Form.

The diamond crystallises in the cubic system and has normally the octahedral habit, though it is sometimes in the form of cubes and rhombic dodecahedra.* The faces are frequently marked with triangular pittings, which have been supposed to be corrosion phenomena, but are now with greater probability regarded as being connected with crystal growth. The crystal faces are characteristically curved, which is of great assistance in identification.

Hardness.

The diamond is the hardest of all minerals (though metallic tantalum runs it extremely close), having the highest position on Mohs' scale (10). This is harder than sapphire or corundum (9) or topaz (8). Quartz is only 7, but crystals of quartz have been occasionally received by the Geological Survey from prospectors who inquired whether they could be diamond as they scratched glass. Although quartz will scratch glass, it will not cut it, and diamond can be cut only by diamond. It is said that the best hardness test is with carborundum, as this will not scratch a genuine diamond but will scratch any inferior stone. Diamonds of some countries are harder than those found in others. Thus the South African diamonds are said to be the softest, generally speaking; while Australian stones are harder than normal, and can be cut only with their own powder. The same applies to Borneo. Bort and carbonado are often harder than the gem diamond. A steel point, which has about the same hardness as quartz, is often used to detect imitations in glass.

When struck smartly, diamonds will split in the direction of the octahedral cleavage. It is a common fallacy that a diamond will not break on the anvil, and this silly test has been applied to many stones with disastrous results. Owing to its microscopic gas and fluid cavities, its substance is often in a state of high tension, and gems have been known to break into fragments on first being removed from their matrix or on being allowed to fall to the ground.

* An octahedron is a solid bounded by eight equilateral triangles; the rhombic dodecahedron is one bounded by twelve equal rhomb-shaped faces.

Specific Gravity.

The density of the diamond is constant within the narrow limits of 3·516 and 3·525, mostly in the neighbourhood of the figures 3·521. Bort is generally near 3·5, and corbonado from 3·1 to 3·4, but this inferior density is due to the porous structure, the specific gravity of the powdered stone being identical with that of the gem.

Optical Features of the Diamond.

It is singly refracting and remains therefore dark under crossed nicols. The lustre of a polished diamond is remarkably brilliant, and is described as adamantine. The brilliancy, however, varies a good deal, sometimes being quite splendent, and again very feeble. Alluvial stones which have been worn by attrition in the bed of a creek will be found to possess little or no lustre until fresh surfaces are exposed by cutting. Imperfectly translucent stones have a nearly metallic lustre.

The diamond will phosphoresce in darkness after being rubbed on wood, wool, and some other substances, and sometimes (but this is rare) is self-luminous after being exposed to sunlight.

Exposure to Röntgen rays or emanations from radium causes diamonds to glow with a pale-green fluorescent light, and this is a good test in cases of doubt. This characteristic was noticed by Sir William Crookes, and has since become well known. R. J. Strutt, in his work on "The Becquerel Rays and the Properties of Radium," says (p. 52):—

"This fluorescence of diamonds forms a very convenient test of their genuineness, quite within the reach of anyone who can obtain the use of a little radium. For imitation diamonds do not fluoresce, or at least so slightly, compared with the real ones, that there is no possibility of mistaking them."

Levy and Williams, in their "Radium and other Radio-active Elements," state (p. 54):—

"One of the most interesting of the luminous effects is that produced in diamonds. It affords a ready method of distinguishing real from artificial stones. The former fluoresce brightly with a pale-green light, whilst false stones or white sapphires (frequently used in their place) show little or no luminosity. . . . . . . All diamonds of equal size and value do not glow with equal intensity, some appearing much more luminous than others. This may be due to slight differences in their composition or in the cutting."

Experiments were made by the writer and the late W. F. Petterd with diamonds found by Mr. L. Harvey in Harvey's Creek and Sunday Creek in 1894, and with one found by Mr. T. Batty near Mt. Donaldson.* When placed on a sheet of mica over a preparation of radium bromide the gems fluoresced with a very pale-green light, even at a distance of two or three inches from the radium compound.

WEIGHTS AND SIZES OF DIAMONDS.

A diamond weighing 1 carat (3·168 grains or ·205304 gramme) will measure about $\frac{1}{4}$-inch in diameter

The unit of weight by which diamonds are bought and sold is the carat, divisible theoretically into 4 diamond grains, but in usual transactions divided into $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{12}$, $\frac{1}{16}$, $\frac{1}{24}$, $\frac{1}{32}$, and $\frac{1}{64}$ carat. The carat weight had its origin in the weight of the seeds of some tree (supposed to be the carob tree), which when dried retained a constant weight. There are many confusing discrepancies in the international weight values of the diamond carat, and a fixed metric weight of 200 milligrammes has now been adopted or decided upon in several countries.

Brazilian diamonds weigh mostly between $\frac{1}{4}$ and $\frac{1}{2}$ carat; stones of 1 carat and upwards are infrequent The few diamonds which have been found in Tasmania range from $\frac{1}{8}$ to $\frac{1}{3}$ carat.

In South Africa it is estimated that diamonds under 1 carat represent from half to two-thirds of the entire output. Some famous diamonds are of exceptional size. The Great Mogul is supposed to have weighed in the rough 560 to 787½ carats. The Koh-i-noor weighed 186½ carats before being cut or cut up. The Orloff is now 195 carats. The South African fields are famous for large stones. The Jubilee (640 carats) and the Excelsior (971¾ carats) were from the Jagersfontein Mine, Orange Free State. But the largest on record from any part of the world is the Cullinan, or Star of Africa, from the Premier Mine, near Pretoria, which weighed in its rough state 3024¾ carats

* In Harvey's Creek.

(1·37 lb. avoirdupois), a pure quality gem which is only part of a larger crystal.

Artificial Diamonds.

Various attempts have been made to produce diamonds in the laboratory, and with success. Moissan dissolved carbon in molten iron in a cylinder which, immersed in molten lead, yielded on cooling minute transparent crystals of diamond. Friedländer added carbon to molten olivine, and obtained on cooling a separation of diamond crystals. Ludwig obtained diamonds in the manipulation of carbon and iron; Hasslinger obtained diamond crystals from a solution of graphite in an artificial rock mixture of nearly the same composition as kimberlite (the rock matrix of the diamond at Kimberley). E. de Boismenu obtained diamonds of about 2½ mm. diameter by the electrolysis of fused calcium carbide.

All these experiments are purely of scientific interest, and do not seem likely to have any effect on the diamond trade.

Use of Diamond.

One important and familiar use is as an ornamental gem when cut and polished; the glazier uses it for cutting glass, the watchmaker for drilling holes for bearings, the lapidary as an abrasive; and the non-gem varieties, bort and carbonado, are employed for setting in bits for rock-drills. The diamond is said also to have some application in giving an edge to steel tools for boring heavy guns. Some idea of the extent to which this stone is used may be gathered from the figures of the British South African output, which to date must have reached a value of over £170,000,000. It is not often realised that Australia has produced diamonds to the value of £130,000.

Market Prices.

The old system of valuing the best cut stones by multiplying the rate per carat by the square of the weight in carats no longer obtains. One way was to square the weight and multiply by 8; the result would be in £ sterling. A more complicated rule was to halve the weight in carats and multiply the result by the weight plus 2 and by the value of a stone of 1 carat. The increase in the output of diamonds, the discovery of so many large stones, and the numerous classes of quality, have had their influence on the market quotations and made these rules inapplicable.

The De Beers and Kimberley mines yield stones ranging from 40s. a carat upwards. On the other hand, the general output of the great Premier Mine shows a value of about 22s. per carat.

The present Australian quotations for diamonds suitable for boring are as follow:—

South African bort, £2 15s. per carat.
South African shot ballas, £2 17s. 6d. per carat.
Brazilian bort, £16 per carat.
Brazilian carbon, £16 to £22 10s. per carat.

The stones used range from 1 to 4 carats each, according to the size of bit. Supplies of Brazilian goods are very difficult to obtain.

Owing to the limitation of output and other war conditions, the prices of gems are at present not normal. The prices for cut diamonds of good average quality are approximately—for ½-carat stones, £28 per carat; for 1-carat stones, £30 per carat; and for 2½-carat stones, £50 per carat. This is an advance of 75 per cent. to 100 per cent. on pre-war values.

It may be mentioned that in cutting the gem there is generally a loss in weight of a little under to a little over half.

Mode of Occurrence.

For the most part the diamond output comes from alluvial or detrital or decomposed rock material, and the accompanying minerals and geological associations have generally to be studied carefully before the original source can be safely identified. In many cases a suspension of judgment is the wisest course.

At Kimberley diamonds are won in the so-called blue ground, which is a tuffaceous, brecciated, or decomposed product of kimberlite, a serpentinised porphyritic peridotite,* into which the blue ground passes in depth. The deep-seated kimberlite is also diamondiferous, and can be considered as unmistakably a primary source of the gem. In South-West Africa diamonds occur in coastal sands

* Peridotite is a deep-seated igneous rock, with olivine as a dominant constituent and without felspar.

and shingle, and it has been thought that they are derived from submarine beds in the neighbourhood.

The French mineralogist Lacroix has detected nepheline in the groundmass of kimberlite. The resemblance of the latter to certain melilite basalts in South Africa has led to comparisons between the two types, and they have been thought to be genetically related, the series running through nepheline-melilite basalt and melilite basalt to basaltic kimberlite, from which it is inferred that kimberlite may be a member of the alkali-peridotites. Nevertheless, the chemical composition of the two rocks does not lend much support to this suggestion.

In Brazil diamonds occur in Recent river sands and older terraces and conglomeratic sandstones, none of which are original sources. Great scientific interest attaches to the occurrence in Arkansas of a porphyritic diamond-bearing peridotite. In Russian Lapland the gem has been met with in sand assumed to have been derived from pegmatite rock, but this reference cannot be said to be established. In India the diamond is present in conglomerates and sandstones and their disintegration products, and in recent and older river sands. Here, too, a doubtful reference to pegmatite as a source has been made. Diamonds have been found in all the Australian States, but only at Oakey Creek, in New South Wales, has it been detected *in situ*. The rock is a hornblende-diabase in the form of a dyke intersecting granite. In the diamondiferous alluvial in Borneo, stones of pegmatite and granite from some unknown source have given rise to the hasty conclusion that the stones and the gems are derived from the same rock.

Diamond also occurs in meteorites, associated with olivine, nickel-iron, and amorphous carbon. As our olivine rocks are the nearest relatives of meteorites, it has been contended that such rocks (serpentines) are the likeliest home of terrestrial diamonds. On the other hand, it has been suggested that diamond in meteorites is to be regarded as a separation product from iron carbide, and that no necessary relationship exists between olivine-bearing rocks and diamonds.

The Rocks of the Tasmanian Diamond Province.

The Donaldson Range, north of Corinna, consists of Pre-Silurian slate, sandstone, and conglomerate, surrounded by and sinking below Tertiary and Recent terrace gravels of a more or less auriferous nature. These gravels are being dissected by the streams, in the beds of which intermittent prospecting has won gold, osmiridium in small quantities, and the diamonds. No serpentinised rock is known in the immediate neighbourhood, though some veins of nickel-ore were met with in the Rocky River Mine, a few miles from Corinna, when that mine was being worked in 1900. Four miles from Corinna on the main road to Waratah is a patch of Tertiary basalt, but this is unrelated to the diamond occurrences. Serpentine is said to occur on Serpentine Hill between the Rio Tinto Mine and Specimen Reef, but the nearest great massif of serpentine rock is the Bald Hill Range. Unless some yet undiscovered serpentine exists on the Donaldson Range, it is most likely that the diamonds which have been found there are derived from the serpentine of the Upper Savage and Bald Hill.

No porphyritic peridotite, such as the South African kimberlite, has been found at Bald Hill; the rocks there are ordinary serpentinised peridotite and pyroxenite, with here and there some gabbro, forming the outermost ultrabasic fringe of the great granite mass of the Meredith Range. Still, kimberlite belongs to this rock-group; and one may assume with a high degree of probability that the diamonds found have been liberated from these rocks. Diamond has been found in Africa embedded in the mineral olivine, and olivine is an important constituent of the Bald Hill serpentinised rocks.

Discoveries of Diamonds in Tasmania.

An incorrect reference to diamonds in Tasmania is made in Max Bauer's work on "Precious Stones" (Spencer's translation, 1904, p. 225), as follows:—

> "Tasmania has recently been added to the list of diamond-producing countries. According to newspaper reports, a large number of stones were found at the end of the year 1894 in Corinna, one of the richest goldfields of the island. The reported occurrence caused a rush of diamond-seekers into Tasmania from the Australian mainland; many companies for the exploitation of the deposits sprang up, but apparently with no marked results."

The real facts are that 16, or at most 18, diamonds have been authenticated. They were mostly about $\frac{1}{8}$-carat in weight, one reaching $\frac{1}{3}$-carat.

These have all been found near Corinna in the Donaldson Range district, between the Savage and Donaldson Rivers. In December, 1894, L. Harvey, prospector for the New Donaldson Sluicing Company, brought to Launceston two diamonds, one of which he stated that he had found in Sunday Creek, on the west side of Mt. Donaldson, which flows into the Savage, and the other in Harvey's Creek, which falls into the Badger, also a tributary of the Savage River. These were transparent octahedra, tinted straw-yellow at the apices.

In the same year the late Mr. Leslie Jolly brought a diamond back from the same district: this also had the characteristic tinge of yellow at the apices.

Another prospector (Lawson) found five specimens at the Donaldson Range; the exact locality has not been verified, but they are believed to have been discovered in either Middleton's Creek or the Badger. They also had the same tinge at the apices.

In 1906 Mr. T. Batty, of Long Plain, found a specimen in Harvey's Creek. It weighed ·025 gramme or about $\frac{1}{8}$-carat. It was a brilliant octahedral crystal, tinted faint greenish-yellow at the apices. The crystal faces had the curves characteristic of diamonds. It contained numerous fluid cavities of microscopic size.

Another specimen has been recorded from Middleton's Creek, which flows into the Savage River north of Corinna.

A parcel of gem sand from near the Hellyer River, in the Waratah district, was sent to England by the Van Diemen's Land Company many years ago, and this was reported to contain a small diamond. It has not been possible to ascertain the locality of this sand.

It is quite a usual thing for diamonds from different fields and countries to be distinguished by certain differences and similarities, and one may record the constant yellow apices as characteristic of the Savage River or Donaldson district as a diamond province.

Information for Prospectors.

The few diamonds which have been found hitherto are sure and certain indications that more remain to be discovered. They were found at a time when unusual activity prevailed on the alluvial fields near Corinna. These fields are now idle, but it is a warrantable supposition that diamonds are still in the gravels waiting to be removed. They are in all probability present in the sands which the osmiridium workers are treating, but are escaping unnoticed in the waste. Being so small and so much like grains of quartz to a cursory glance, it is possible that they elude notice in considerable numbers. Even in the blue ground in South Africa diamonds are seldom seen in the course of mining. G. F. Herbert Smith, in his "Gem-stones" (1912, p. 147), says:—

> "The diamonds are so sparsely, though regularly, scattered through the mass, that even of the actual workers in the mines but few have ever seen a stone in the blue ground."

Again, P. A. Wagner, in his "Diamond Fields of Southern Africa" (1914, p. 137), says:—

> "So sparsely distributed, however, is the gem, that it is only by the merest chance ever observed *in situ*. It may be pointed out in substantiation of this statement that there are miners who have worked for over twenty years in the Kimberley pipes without having ever come across a diamond."

In confirmation of this, Mr. A. McIntosh Reid, Assistant Government Geologist, who has had personal experience at the De Beers Mine, informs the writer that he was told by an employee there that in the course of his 22 years' work underground he had never seen a diamond in the rock. The yield of the matrix in South African mines varies from 5 to 40 carats per 100 loads of 16 cubic feet ($\frac{3}{4}$-ton).

In Tasmania the district in which the diamonds were found while working the auriferous alluvial has long been abandoned by miners, and no discoveries have been announced for the last 12 years. The osmiridium workers higher up the Savage have been too much engrossed with their special mineral to pay much attention to anything else; nevertheless, wherever osmiridium is present in the alluvial there is a possibility of diamonds turning up, though they are likely to be sporadic, and it will hardly pay for a prospector to devote his time exclusively to the search for these stones. It would be well, however, for all who are washing sands in this district for gold or osmiridium to be on the look-out for diamonds. Unfortunately, the crystals are apt to escape with the quartz grains, and this renders detection difficult.

The only minerals which in the least resemble diamond to the inexperienced eye are quartz, topaz, and white sapphire. Small water-clear crystals of quartz are often known locally as diamonds; the limpid stones of topaz from Killiecrankie Bay, on Flinders Island, are well known as "Killiecrankie diamonds," and the collector who first attempted to dispose of them in London as a kind of diamond got into trouble over the transaction. But quartz and sapphire crystallise in the hexagonal system and topaz in the orthorhombic system, while diamond belongs to the cubic system, and has most frequently a dodecahedral or octahedral habit. None of the minerals mentioned will scratch a diamond. It may be mentioned here that tin country minerals are not necessary companions of diamond, and are only present where certain conditions obtain. Thus, prior to the existing river systems, the sands of the plains between Bald Hill and Corinna received accessions of sediment from the tin-bearing Meredith Range, and this has mingled with the waste from the serpentines, so that in some places and to some extent a mixture of minerals has resulted which have no community of origin.

The curved convex crystal faces of diamond specimens are of great assistance in identification. The pitted surfaces furnish an additional indication. When to crystal form and curvature, weight, hardness, pittings of surface, is added the yellow tint of the apices, the prospector has an aggregate of characters upon which he may rely as regards stones from the Bald Hill, Savage, and Donaldson diamond province. In cases of doubt with regard to any particular specimens, they may be tested in the Geological Survey laboratory, Launceston, free of charge.

In looking round Tasmania for likely diamond fields, it is not sufficient to locate mere exposures of serpentine, for the solid rock will fail to reward the prospector. Beds of alluvial derived from the serpentine are what is required, and again these beds should be payable propositions for gold or osmiridium, as it is extremely improbable that any appreciable output of diamonds will result in any other way than in the course of gold (or osmiridium) winning. This is why the Savage and Donaldson districts are indicated as promising fields. Other serpentine districts are Dundas, Trial Harbour, Macquarie Harbour, Wilson and Huskisson Rivers, Denison Range, Styx River. Anderson's

Creek, Salisbury, &c., but some of these outcrops are not accompanied by alluvial deposits of any importance, and therefore carry only bare possibilities.

It has been thought by some prospectors that the tinfields of the north-east coast might carry deposits of the gem. Specimens of other gems and substances from that part of the island have been brought to the Geological Survey under the impression that they were diamonds, and in one instance the prospector was firmly convinced that he had struck the blue ground which is diamond-bearing in South Africa. Hence, it seems quite time to make available some definite information respecting diamond and its occurrence. An outstanding fact is that no peridotite rock has ever been recorded in association with the granites of the eastern and north-eastern tinfields; in the west of the island the massive tin-bearing granites are surrounded by fringes of gabbroid and ultra-basic rocks, some of which are most probably the matrices of diamonds. The question arises whether diamonds could be looked for in the debris or alluvial shed from granitic rocks.

It cannot be denied that in some other parts of the world there are occurrences of diamond which have been considered as suggestive of a pegmatitic source.*

It must be added, however, that the literature of these occurrences is not absolutely convincing. In Russian Lapland, a district characterised by gneissose rocks intersected by pegmatites, some sands carry sparsely diamonds associated with garnet, zircon, tourmaline, &c., and it has been assumed that the diamonds have been derived from the gneiss and pegmatites. Too little is known of the geology for the source to be looked upon as established. References to pegmatites in India and Borneo as being sources of diamonds are also lacking in precision. The occurrence of diamonds in Rhodesia, associated with tourmaline, sapphire, &c., in gravel lying on decomposed granite may also be cited, but a diamondiferous pipe of kimberlite rock in granite exists in the same region, and similar pipes may have furnished the diamonds now found in the gravels and conglomerate.

It would not be correct to say that pegmatites are absolutely impossible sources of diamonds, for it is known that

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* Pegmatites are those coarsely grained aggregates of quartz and felspar which were formed in or traversed granite during a late phase in the cooling of the magma, in the super-heated water of which a large number of unusual and characteristic minerals separated out.

these rocks contain certain quantities of carbon gases, but it is also true that basic and especially ultra-basic rocks contain these in far greater proportions. It would seem that the acid rocks of the tin districts are not promising for diamonds, and the total absence of any record of a discovery in such localities, though a negative feature, is in harmony with an *a priori* anticipation that a search would not meet with success.

As indicated above, discoveries of diamonds in Tasmania are most likely to be made by individuals on the look-out for them while working gold-bearing or osmiridium alluvial derived from the weathering of serpentinised rocks; and the Donaldson and Savage River districts seem at present the most promising in this respect, though alluvial country anywhere round the serpentine fringes of the Meredith Range has possibilities which should be borne in mind.

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