THE DIAMOND MINING INDUSTRY OF SOUTH AFRICA

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INTRODUCTION

The discovery in 1866 of a 21½ carat diamond by a Dutch farmer, Schalk Van Niekerk, which was being used as a plaything by some children at Hopetown, was an epoch making event in the economic development of South Africa. Niekerk gave it to a trader O'Reilly who took it to Cape Town for inspection. Here a French jeweller pronounced it a diamond of first quality and priced it at $2,500. This gem was sold and the proceeds honestly divided with the former owner. Two years later Niekerk bought a second stone from a Hottentot for $2,000 which weighed 83½ carats and this he immediately sold for $56,000. It was later known as the "Star of the South" and is now in possession of the Countess of Dudley.

These discoveries led to the immediate rush of diamond diggers in large numbers searching for stones in the Vaal river gravels, which, if found, could change the status of the owner in one day from poverty to riches. In no other form of mining is the element of chance so remarkable or rewards so instantaneous, but on the other hand no other kind of mining presents a greater gambler's luck and the digger frequently remains in poverty, using the funds of each random discovery to finance his further explorations.

The writer met some of these miners washing gravel 40 miles west of Kimberley at Longlands on the Vaal river and they were most interesting characters who had experienced the ups and downs of life with all its hazards.

KIMBERLEY

No one thinks of diamonds without a vision of Kimberley and this "City of Diamonds" owes its existence to diamond mining alone and upon this industry its entire future prosperity and life depends. Kimberley was a semi-arid plain of the high Karroo in 1867, but a cluster of miners tents in 1870
when the city was founded. Kimberley is a most interesting place to visit, but the greatest sight here and one of the unique sights of the world lies within five minutes walk of Market Square near the Post Office. This is the OLD KIMBERLEY MINE, the second largest diamond mine hole on earth, being exceeded only by the Premier 25 miles east of Pretoria, Transvaal province.

The famous Old Kimberley mine is now abandoned, but was dug to a depth of 3,601 feet. It covers an area of 38.19 acres and the perimeter measures 0.93 mile. There was no “Yellow Ground” at this volcanic pipe and the entire workings were in “Blue Ground” 800 feet thick. Below the blue comes a melaphyre, then a quartzite 800 feet thick resting upon a granite base through which the Kimberlite pipe erupted from a still greater depth. The bottom of the mine is filled with water up to 1300 feet from the surface and the crater walls have caved downward. Trees and brush are growing on the talus slopes. This pipe trends north and south, but with a width in this direction of 1,550 feet and an east and west axis of 1,500 feet the opening appears nearly circular.

The remarkable thing about the Old Kimberley mine was the high yield of diamonds per load which amounted to 30 carats per 100 loads.*

Low as this recovery might appear to be, it is nearly double that of most of the Kimberley pipes now being worked. In fact, so few diamonds occur in Kimberlite that it is only rarely a stone is found in situ.

This minute amount of diamond content may be better understood if you take a “ten carat” mine, which is quite a good mining proposition; the richness would be equal to 2 grams per 100 loads each weighing 1600 pounds, or less than one twenty-two thousandths of one per cent. This means one diamond, on the average, in 40 cubic feet of broken blue ground. Only three or four volcanic pipes are worked to-day within a radius of four miles at Kimberley, the more important being the Wesselton, Bulfontein and the Dutoitspan. We collected blue ground from the latter at a depth of 1350 feet, for the deeper mines are now being developed both by open pit and shaft methods. The mines of Kimberley and of the Premier, *A load, the unit of measurement of South African diamond rock, represents 16 cubic feet of broken blue ground, roughly equal to 1,600 pounds.
400 miles northeast in the Transvaal, supply the bulk of the world’s diamonds to-day, but the production could easily be expanded if trade demanded. A larger yield than $60,000,000 a year would lower the price and flood the market. The De Beers Consolidated not only controls the production, but they stabilize the price of diamonds to prevent a collapse of the industry.

The wealth taken from within an area of four square miles at Kimberley has exceeded one billion dollars in less than 50 years, a truly astonishing sum expended upon a luxury and not a necessity of life.

It is difficult to gain any idea of the magnitude of diamond mining operations from description. The great pulsator plant near the Wesselton mine pulverizes 11,000 tons of blue ground daily, uses nearly one million gallons of water for washing which comes from the Vaal river 17 miles distant. If only one diamond is recovered from three loads, which is perhaps a fair average, the day’s run would furnish about 4,430 diamonds, but of very varied size and value.

Kimberley lies 647 miles north of Cape Town in the Orange Free State and is a city of 17,095 whites and 21,095 colored. It lies at an elevation of 4,018 feet and is wind swept by the dust storms of the Kalahari desert to the west, but has a fair rainfall in the wet season.

The city is irregularly laid out and like most mining camps the streets cross at all angles. The museum is rich in Bushman art relics, diamond exhibits and beautiful mineral specimens, but for a municipality which has produced such exceeding wealth the buildings are not imposing.

**Kimberlite Pipes**

The number of volcanic pipes and dikes of Kimberlite diamond bearing rock in South Africa is unknown for they are scattered over an enormous territory in groups from the Orange Free State southwest boundary, to Pretoria of the Transvaal and northward in isolated areas into the Belgian Congo. Many are so concealed by ages long surface weathering that they are discovered by accident, as where a few gems have weathered out at the surface of the pipe.

There are at least 60 such pipes in the vicinity of Kimberley which have broken through the red granite base, overlying
quartzites, slates, melaphyres and Dwyka shales above. They are without any orderly arrangement, occur in varying dimensions, shapes, and igneous rock composition; and what is more remarkable, these pipes differ in area downwards and pinch out into dike-like extensions on one side as if occurring as a swelling in some original fissure. The Old Kimberley mine was nearly circular at the surface and nearly 1600 feet across, but with its axis trending north and south; at a depth of only 340 feet the pipe was an oval measuring 820 by 500 feet, but at 2,160 feet this had contracted to a width of 250 feet. At a still greater depth the pipe seemed to have moved bodily eastward for quite a distance and from this bottom working, had sent out a tongue-like dike in a north-northwest direction toward the St. Augustine mine, and this mine at 800 feet becomes a wide fissure striking toward the Old Kimberley pipe.

What was more surprising to me was the fact that even within one pipe diamonds differed from one end of the crater to the other, and in each pipe the diamonds are so different that an expert can tell at a glance from what mine a given gem has come. Nearly all the stones from the Dutoitspan mine are of a distinct yellow shade, but of very remarkable size. I saw one just recovered from the washing table in July 1929 that weighed 199\(\frac{1}{2}\) carats*—a perfect octahedron crystal valued at $10,000 uncut.

The crystals from the South African mines are nearly all octahedrons, but with modified surfaces, bevelled edges, curved or fluted as well as etched by tetrahedral depressions.

Dodecahedral and other isometric forms occur, but they are not as abundant as the octahedron. Jagersfontein stones are usually cleavage fragments, Koffyfontein gems are nearly pure white, Voorspoed diamonds are dull and very hard to cut, while those from the Wesselton are cold blue-white crystals of purest water, but of small size and usually less than 2 or 3 carats weight.

Kimberley produces stones weighing several hundred carats and, of the million dollars worth of freshly collected diamonds from the Kimberley pipes, I noted a good many weighing from 10 to 30 carats each.

The largest diamond in the world, however, came from the

* A carat = 0.2 gram or about 3.1 grains.
Premier mine in the Transvaal. This immense diamond weighed uncut 3,085\(\frac{3}{4}\) carats, or 1.37 pounds avoidupois, but it was only a cleavage piece from a still greater octahedron, whose adjoining parts have never been discovered. The mine superintendent told me that, when they found this diamond, he threw it over the railroad track feeling certain that such an immense crystal could only be a chunk of glassy quartz.

The Kimberley pipes and similar diamond bearing igneous intrusions broke through an enormous thickness of overlying granite and sedimentary strata with explosive outpourings which continued through a long period in late Cretaceous time. Many of these deep-seated basic Peridotites now called Kimberlites are connected at great depths by fissure fillings of the same igneous magmas, but the igneous rocks vary widely in composition and in mineral content.

The Kimberlite is an ultra-basic rock containing enough minerals and gem crystals to fill a museum, but the more abundant and best crystallized types include Olivine, Chrome Diopside which is often in large crystals, Garnets, often so abundant in masses as to constitute Eclogite rock with scarcely any other mineral present, Enstatite, Phlogopite, Magnetite, Spinel, Sapphire, Cyanite, Hornblende, and of course, the Diamond.

The huge green diopside crystals we found at the Wesselton mine seemed translucent enough to be gems and the garnets look like true red rubies. Many other minerals occur both secondary and original, and the pyrite crystals caught on the washing tables are very perfect and of fair size.

The rock fragments in the Blue Kimberlite seem to include granite and granite gneiss, schist, slate, shale, quartzite, porphyry and basalt. Serpentine is present and the limestone infilling in one of the Kimberley pipes is very difficult to explain.

The wedge-shaped felsitic porphyry mass at the Premier mine is tapering downward and will soon be entirely removed as the pipe comes together at each end around this "horse" which must have fallen in from above during the explosive eruptions of the Kimberlite. It is this brecciation of the infilling igneous rock which makes decomposition so rapid and which assists in crushing without destruction of the diamond.
OCCURRENCE OF DIAMONDS IN SOUTH AFRICA

It is safe to assume that the original home of all African diamonds found in river gravels all over the Union, the sea coast, and in volcanic brecciated pipe fillings in widely separated areas, came from igneous magmas lifted by explosive forces from great depths within the earth's crust. The diamond looks as if it were an accidental occurrence rather than an original primary mineral of the ultra basic Kimberlite.

The alluvial stones below the Premier were traced back to the old crater walls of the pipe and diamonds far from these interior pipes show stream abrasion and water wear. While the bulk of South African stones come from the high Karroo plateau and in true igneous eruptive pipes, gems have been found in the Witwatersrand gold bearing conglomerates of Pre-Cambrian age, in the Forest Sandstone of Upper Triassic time, most abundantly in the late Cretaceous eruptions, but in the Tertiary and Recent formations in river gravels, sandstones and coastal deposits, especially on the west coast as far northward as Port Nolloth and on islands off shore. Each year seems to add new discoveries and the Namaqualand surface diamonds of surprising beauty and size occur in such abundance as to prove a menace to diamond crushing at the great interior pipe centers. I saw these cut at Cape Town and they were remarkably free from flaws and inclusions, and the color was unsurpassed.

PREMIER PIPE, TRANSVAAL

While the diamond mining center is and probably will always be around Kimberley in the Orange Free State, the largest and richest diamond mine in the world lies 25 miles east of Pretoria, the administrative capital of the Union with a total population of white and colored of 100,000. Pretoria is a wonderful city with beautiful buildings, museum, zoological gardens and parks; with its suburbs included, it covers an area of 40 square miles. The Government buildings cost over five million dollars and are so situated that a most commanding view of the entire region can be had from the central archways and platform steps.

Pretoria does not depend entirely upon diamond mining as does Kimberley farther south, but the biggest diamond mine on
earth only 25 miles away must have had some influence upon
the growth of the city. It is worth a trip to Pretoria to stand
at the edge of this gigantic man-made surface opening, worked
for 27 years, covering 78 acres and dug to a depth of 650 feet,
with workings in 50 foot benches. The general grade of the
mine is worked at $1\frac{1}{2}$ per cent, the fall being from the South
to the North end. The broken ground is hauled up to the re-
duction plant crushers 3000 feet on a grade of one in five feet.

The Premier pipe is oval, with the longer axis trending north-
west; it is about 2,000 feet long and 1500 feet in width, or
roughly one-half mile by a quarter of a mile, and from the rim
presents an awe-inspiring spectacle. The size of this gem-
mining industry at the Premier can be judged when you learn
that 5,000 natives and 570 white men are employed throughout
the company’s works. The output up to August 31, 1928
amounted to 121,119,541 loads of ground, which have been
treated by the combined gears, and from which have been re-
covered diamonds weighing 27,020,773 carats.

From the way the present walls of the pipe stand up it is
known that this open pit method of mining at the Premier can
be followed downward to a depth of 1000 to 1200 feet, and
nine bore holes from 300 to 1001 feet still continue in diamond
bearing rock. This depth of workings will represent
400,000,000 loads of ground of 16 cubic feet each and, cal-
culated on the present rate of production of 12,000,000 loads
per annum, will make it possible to dig in this pipe for 34
years without resorting to shaft and tunnel mining methods.

RECOVERY OF DIAMONDS

Alluvial washings present no difficulty in diamond recovery,
but they do involve treatment of enormous tonnage for carat
extraction. After washing in revolving pans with walking
arms for cleaning mud and sediment away, the pebble gravel
deposit left behind is spread out on burlap-covered tables,
scrapers are run over the wash and the brilliant glistening
gem stones are picked out by hand.

Dams are constructed along the river basin, waters con-
trolled by selective intake, gravel raised in benches and in
zones from the river bed and, if these rolled materials have
not already been gone over, they may yield some beautiful
stones which are of very superior quality and, when of large size, far surpass the pipe recovered stones in money value.

In mining diamonds from Kimberlite the process is involved and we wonder how a tiny gem stone can go through the blasting process from the bench floor, be hauled in cable cars like ordinary rock to the crusher, gyroratory, washing pan, sizing grizzleys, and then be floated out on grease tables to be caught in vaseline while the broken pebbly wash material rushes on to the slime basins below the jigs.

The rolls are huge affairs, several feet in diameter, but hung on springs, they are sufficiently elastic to permit the hard diamond to pass uninjured while they are tough and resistant enough to break up the blue ground containing the occasional gem stone.

After crushing, washing, sorting and sizing and the catching of the stones on the vaseline coating, the grease is melted and the diamonds are carried to a sorting table where the gems are graded, sorted by color, freedom from flaw, and passed to the office for lapidary cutting.

OTHER OCCURRENCES

The discovery in 1908 of diamonds in sands of the Luderitz Bay coast is truly remarkable because it is so far removed from known volcanic pipes of the high interior Karroo.

This discovery has been pushed still farther northward up to Conception Bay and to Port Nolloth as well as to islands off the shore.

ORIGIN OF THE DIAMOND

It would appear to be a simple matter to explain the origin of diamonds when they are found in situ in basic igneous rocks in volcanic necks where explosive eruptions have lifted them within reach of surface mining, but the problem is so complex that just how and where these brilliant carbon crystallizations originated and at what depths within the crust is still unknown. It is not certain that they actually belong to the altered Kimberlite basic rock types where found for they must be considered occasional, and not uniformly essential primary rock forming minerals of these unique blue masses. Surely in one pipe the diamonds should be similar in crystallization, color, form,
and abundance, but this is not the case. Not only is each pipe
different in every way from its adjacent group, but the dia-
monds in each are so distinct that they can be recognized at
once as occurring in a given pipe blue ground.

Artificial production of the diamond ought to shed light on
its origin, but diamonds of large size and of commercial value
have not yet been formed by laboratory methods. Many sci-
entists have worked for years upon this problem and several
have actually been able to crystallize tiny diamond crystals in
molten steel, lead, silver and carbon bearing solutions when the
fused mass is subjected to high pressure and sudden cooling.
There is no agreement yet upon just how these peculiar gem
stones, the hardest substance on earth, came into existence in
beautiful, transparent, colorless minerals while the counterpart
carbon is as black and opaque as coal, lusterless and the softest
substance known. Graphite is pure carbon, but it is as differ-
ent from pure carbon in the diamond as black is from white.

Pressure under exceeding depths is a most important factor,
but just under what conditions and in what state the carbon
occurs is not yet positively known. There is no substance on
earth that can match the diamond in hardness and some other
peculiar physical properties which, with its unrivalled beauty,
make this mineral the queen of precious stones and the most
costly of all gems.