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“The Recovery of a Diamond-Crown from a Deep Bore-hole.”

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THE following is a description of work which came under the Author's notice during the latter part of the year 1903.

With the object of exploring for the Van Ryn Reef, boring-operations were commenced in 1902 on a farm on the far East Rand, about 33 miles from Johannesburg. When work had proceeded for more than a year, and the bore-hole had reached a depth of 3,233 feet, the bit became jammed, and the rods were consequently withdrawn. When the last rod had been removed, the core-barrel, which was 40 feet in length, was drawn up. On its arrival at the surface, it was found that the core-barrel contained no core, and that the shell and diamond-crown were missing.

The shell is a piece of steel tubing, about 4 inches in length, containing the spring which holds the core in position in the barrel, and it forms the connecting-piece between the core-barrel and the bit or crown. The thread at the end of the core-barrel which screws into the shell, had broken off flush with the top of the shell. The core, with the exception of about $\frac{1}{2}$ inch at the bottom end, was recovered without difficulty, and the shell was recovered by means of a tap, cut short in order to ensure its not being too long for the threaded tapered portion to grip the shell. When the shell was brought up, it was found that the crown had broken off from it, flush with the end of the shell, leaving its threaded portion within the shell.

In order to recover the crown, a special tap was made in Johannesburg. This tool was 6 inches in length, of which $1\frac{3}{4}$ inch was threaded to screw into the end of the bottom rod; the next 2 inches consisted of a shoulder, $2\frac{1}{8}$ inches in outside diameter, to guide the tool, and contained four longitudinal grooves or waterways to allow the water to pass up outside round the edge of the bore-hole; and the remaining $2\frac{1}{4}$ inches consisted of a threaded tap,

tapered from $1\frac{9}{16}$ inch to $1\frac{5}{16}$ inch in diameter, *Figs. 1*. The tool was not solid, being $\frac{5}{8}$ inch in inside diameter. It was made of

steel, the end of the taper being softened to permit of diamonds being set in it. Four small diamonds (about $1\frac{1}{2}$ carat in all) were set in the end, in order to cut, within the crown, through and beyond the rock in which it was presumably imbedded. By the use of this tool the crown was speedily recovered. All the diamonds were found to be intact; there were eight diamonds on the face of the crown, four inside and four outside, and also four inferior diamonds round the outside of the bit, to keep the hole sufficiently large to insure easy working, and to prevent the bit from becoming jammed. The carbons, when recovered, weighed $17\frac{5}{8}\frac{3}{4}$ carats, and were valued at more than £230, or £13 per carat; moreover, having been used, their quality had been tested, and reliance could therefore be placed upon them.

When the crown was recovered, it was found to have been very badly burned, and to be worn down to only $\frac{1}{2}$ inch in depth, a new crown being $\frac{3}{4}$ inch in depth, neglecting the threaded portion. The bit having first broken off flush with the end of the shell, the two parts had been grinding against each other. As it was afterwards discovered that three rods had split at a depth of between 1,700 and 2,000 feet from the surface, it was concluded that the pressure-water, which is forced down through the rods and returns through the clearance-space between the outside of the rods and the side of the bore-hole, had escaped where the split occurred, and so had found a quicker and

easier course to the surface. Thus no circulation of water had been taking place round the bit to keep it cool and to carry away the cuttings. The bit would thus quickly become jammed, and,

probably weakened by overheating, would be unable to withstand the torsion to which it was subjected, and would therefore break. The fracture occurred in the lower quartzites of the Upper Witwatersrand Beds.

The drill was a Sullivan machine, warranted to bore to a depth of 4,000 feet; the rods used were of steel, of English manufacture, in 10-foot lengths, which at this depth were unscrewed in 50-foot lengths for removal. The core-barrel was in two 20-foot lengths.

The risk involved in the accident was that the hole might have to be abandoned entirely. This would have meant:—(1) a year's work wasted; (2) probably 9 months' delay before the same depth could again be reached in another hole; (3) loss of the total amount spent up to that time (about £8,000); (4) loss of £230 worth of diamonds; (5) loss owing to depreciation of plant and machinery for one year; and other incidental losses.

The Paper is accompanied by a drawing, from which the Figure in the text has been prepared.