end of a series of hollow rods, and being rotated under pressure wears away the rock upon which it bears, the core rising up in the hollow of the rods, or rather of the co e barrel forming the terminus of the series As the hole is put down additional lengths of pipe are screwed on, and when it is desired to bring the core to the surface the rods are raised and the core taken out. In this way a continuous section of the ground from the time the drill enters solid rock can be obtained, the boring capacity of the machines varying from a few hundred up to two thousand feet Some of the smaller drills are made to work by hand, but the majority are operated by steam power, or in underground workings by compressed air For surface work the engine is usually attached to the drill, both being mounted on a waggon for convenience of transport. The boiler for the same reason is also set on wheels. A supply of water is essential to the working of the diamond drill, and a steam pump forms part of the outfit, the duty of which is to send a constant stream through the rods down to the bottom of the hole where the bit is at work, and so bring the cuttings to the surface by means of the ascending current, which comes up between the rods and the casing or walls of the hole. It may occasionally happen that in porous or broken rock some fissure or jointing affords the water a subteranean passage, and it is "lost," or ceases coming to the surface. This is far from a desirable state of affairs, and it is necessary for the driller to recover the water. He usually seeks to do so by sending down to the bottom of the hole a supply of cement sufficient when hardened to stop the leak. In some cases bran or similar material is resorted to. Besides bringing the cuttings to the surface, and so keeping the drill runner constantly informed of the nature of the ground being passed through, the "wash" water, as it is called, indicates by its flowing freely or scantily the favorable or unfavorable progress of the work at the bottom of the hole.

An important part of a diamond drill outfit, and one which enters largely, both into its first cost and the expense of operating it, is the diamonds, or carbons, as they are sometimes called. They are veritable diamonds, procured mainly from Brazil, and are of precisely the same chemical composition as the white and more highly priced gems used for jewelry and ornamental purposes, differing only in color. They are black, or nearly so in shade, occasionally of a reddish tinge, and are found in various sizes. A stone recently got in the old diamond district of Brazil weighs 3,100 carats, and is by far the largest diamond ever known. It is now in the hands of the jewelry firm of Messrs. Kahn & Co, of Paris, and the Government of Brazil is negotiating to purchase it for the national museum of that country. Uncertainty as to how so unusually large a stone would turn out has made the dealers somewhat chary of handling it, and the price demanded is considered too great. The probable value is about $40,000, or 52s. 6d. per carat. When stones are found of larger size than can be conveniently used in the diamond drill, they are broken into pieces of about two carats weight, which is the size ordinarily employed. They are of a hardness quite equal to that of the white or colorless variety, and as the abrading action is largely done by the edges and angles of the stones, there is room for considerable skill on the part of the operator in setting the diamonds so that they may do the greatest amount of work with the minimum of loss. The price of black diamonds fluctuates a good deal according to the conditions of supply and demand, and also to the ability of the combinations which control the black diamond mines to rule the market. In the summer of 1894, when the department purchased the diamond drill plant, the market price was $17 per carat, and at that time and a little later a supply of diamonds was laid in amounting to 82.605 carats, at a cost of $1,356.16, or an average price of $16.40 per carat. Since then the market in the autumn of 1895 advanced to $19 per carat, and again in the following November to $21 per carat. An exceedingly brisk demand set in from the South African gold fields, and in January, 1895, the price rose to $25 per carat, in March to $30, and in April to $36, by far the highest price ever known. Almost the whole production of black diamonds at the present time can find ready sale in South Africa.

The practice in operating a drill is to keep a sufficient supply of diamonds on hand for at least two bits, so that one may be set while the other is in use Usually eight stones are set in the bit. Some are placed directly on the face of the bit, some are made to project a fractional part of an inch on the outside of it, and some to project similarly on the inside, the object being to cut an annular ring out of the rock a little greater in width than the bit itself, thus allowing the latter and the rods to which it is attached free play. If for any reason it is desired to enlarge the diameter of the hole after it is put down a "reaming" bit is employed, in which the diamonds are set wholly on the outside. The wear on the diamonds varies greatly according to the hardness and compactness of the rock which is being drilled. In comparatively soft rocks, such as limestone, slate or shale, the loss is insignificant, while in such material as quartz, diorite or granite, the wear is very much greater. In the same way, the rate of boring varies widely. Where the rock is solid and not too hard, a hole may be put down 30 or 40 feet in a day of ten hours, but where greater resistance is met and drilling operations are interfered with by seams and fissures, perhaps the utmost diligence on the part of the drill runner will not suffice to gain more than 3 or 4 feet in the same time.

Numerous difficulties are likely to present themselves to the operator of a diamond drill plant, and as his work is so largely hidden from view, only native ingenuity and skill born of experience can enable him to overcome them. The following extract from an excellent article in a recent number of *The Engineering Magazine* of New York deals with this practical aspect of diamond drill work:

"The mishaps that may occur in drilling are many. The most common is the parting of the rods while in a hole. This may come from a fracture of the rods, the stripping of a thread, or the unscrewing of a coupling. The last is more liable to occur when pulling the rods than at any other time, and may result in smashing a set of stones. If rods are simply uncoupled, they can usually be caught by gently lowering and entering the top piece, and turning it to the right. In cases of fractures various sizes of inside and outside recovery taps are provided. The writer once spent two days in recovering a bit in a flat hole where the core shell had twisted off at the core lifter ring and left the ring in the lower half of the shell. The recovery tap entered the ring, which was so hard that the tap would not catch it, and yet it would twirl round with the tap, preventing the tap from advancing and catching the inside of the shell. After cutting several portions from the end of the tap, it finally caught the top of the broken shell with one thread and pulled it out.

"When casing or rods are fast in a hole near the bottom, that portion above the construction can be removed with a left-hand tap. In using left-handed taps the right-handed rods must be pinned at their joints to prevent unscrewing. Fishing for broken rods is much complicated in cases where the ground is soft or caving, and large chambers have been washed out in which the end of the rod may rest and the tap pass by it. It sometimes happens that a diamond is wrenched loose from its setting and remains at the bottom of the hole, either unbroken or in several fragments, when the rods are withdrawn. In cases of this kind the bottom of the hole should be cleaned out by a mass of soap or wax attached to the end of the rods and lowered in the hole. The fragments of rock and carbon will adhere to the sticky material when it is withdrawn. If caving ground catches the rods above the bit, they may be released by drilling down a casing outside of the rods and cutting away the bound rod with a steel rose bit.

"Overcoming difficulties at the bottom of a deep hole will tax the ingenuity of a good runner and show his capacity. No man should undertake a deep hole--one over 750 feet—who has not had a good experience with shallow holes." *

* "Prospecting with the Diamond Drill," by J. Parke Channing, in *The Engineering Magazine* for March, 1896, pp. 1085-6.

(To be continued.)