dearly bought. For example, it has been shown that the Liverpool and Manchester Railway Company has had several times to alter the rails on that line; to increase the weight from 35 lb., the weight of the original rail, to 50 lb., 65 lb., and 75 lb. per yard, successively; while the London and Birmingham Railway Company, notwithstanding the advantages derived from Mr. Barlow's able report, was obliged to reduce the width of the bearings or supports from 5 feet to 3 feet 9 inches, and to increase the weight of the rails from 64 lb. to 75 lb. On other railways equally expensive alterations have been made. There is every probability, therefore, that, so long as that plan of railway construction continues, whatever may be the first cost to railway companies, a still greater weight must be given to the rails, and a still farther reduction of the width of the bearers must take place, in order to adapt the stability to increased rapidity of traction.

It may be observed that the rails have gradually been increased in strength since steam power was introduced; the bars are usually made in 12, 15, and 16 feet lengths, with square or butt ends, and are laid end to end, the earlier complex contrivances to secure the joints being all dispensed with, and the half-lap joints now rarely used. About $\frac{1}{16}$ of an inch, at least, should be left between the ends for expansion; for it has been ascertained that a bar of 15 feet in length will expand about $\frac{1}{11}$ of an inch at 75° F. Some have, indeed, proposed to place a small piece of wood between the ends of rails, as the different expanding properties of wood and iron would fill the space, the wood expanding as the iron contracts: but such a plan is liable to objection from the wood being likely to be shaken out, and the space being left vacant. There is no part of railway construction that requires more accuracy of fitting than the joints: the squareness of the ends, and the space allowed for expansion, cannot be too carefully regulated. Instead of that, how often are seen spaces at the joints of different widths, and the ends of the bars in juxtaposition, without parallelism and uniformity of level; thus increasing the amount of friction, adding to the jolting and rocking motion, and to the risk of the wheels of carriages being thrown off the rails."

Civ. Eng. & Arc. Jour.

On a new method of Boring for Artesian Springs, by M. FAUVELLE, of Perpignan, in France. Read by MR. VIGNOLLES, being furnished by M. ARAGO, for the purpose of being communicated to the Association, M. Arago himself being prevented by illness from attending.

The paper was an abridged translation of M. Fauvelle's own account, in which he says:—"In 1833, I was present at the boring of an artesian well at Rivesaltes; the water was found, and spouted up abundantly. They proceeded to the tubing, and for that purpose enlarged the bore-hole from the top downwards. I was struck by observing that it was no longer necessary to draw the boring tools to get

rid of the material, and that the water, rising from the bottom brought up with it, in a state of solution, all the soil which the enlarging tools detached from the sides. I immediately observed to my friend, M. Bassal, who was with me—This is a remarkable fact and one very easy to imitate; if, through a hollow boring rod, water be sent down into the bore-hole as it is sunk, the water, in coming up again, must bring with it all the drilled particles. On this principle I started to establish a new method of boring. The apparatus is composed of a hollow boring rod, formed of wrought iron tubes screwed end to end: the lower end of the hollow rod is armed with a perforating tool, suited to the character of the strata which have to be encountered. The diameter of the tool is larger than the diameter of the tubular rod, in order to form around it an annular space through which the water and the excavated material may rise up. The upper end of the hollow rod is connected with a force-pump by jointed or flexible tubes, which will follow the descending movement of the boring tube for an extent of some yards. This boring tube may be either worked by a rotary movement with a turning handle or by percussion with a jumper. The frame and tackle for lifting, lowering, and sustaining the boring tube, offer nothing particular. When the boring tube is to be worked the pump must be first put in motion. Through the interior of the tube a column of water is sent down to the bottom of the bore-holes, which water, rising in the annular space between the exterior of the hollow boring rod and the sides of the bore-hole, creates an ascending current which carries up the triturated soil: the boring tube is then worked like an ordinary boring rod; and as the material is acted upon by the tool at the lower end, it is immediately carried up to the top of the bore-hole by the ascending current of water. It is a consequence of this operation that the cuttings being constantly carried up by the water, there is no longer any occasion to draw up the boring tube to clear them away, making a very great saving of time. Another important and certainly no less advantage, is, that the boring tools never get clogged by the soil; they work constantly (without meeting obstructions) through the strata to be penetrated, thus getting rid at once of nine-tenths of the difficulties of boring. In addition, it should be mentioned, that experience has shown there are no slips in any ground which ordinary boring rods can penetrate; that the boring tube works at 100 yards in depth with as much facility as when only ten yards down, and that from the very circumstance of its being a hollow rod, it presents more resistance to torsion than a solid rod of equal thickness and quite as much resistance to traction: these are the principal advantages of the new system of boring. Indeed these advantages have been fully confirmed by the borings which I have just completed at Perpignan. This boring was commenced on the 1st July and was completed on the 23rd, by finding the artesian water at a depth of 170 mètres (560 English feet.) If from these twenty-three days, each of ten hours' work, are deducted three Sundays and six lost days, there remain fourteen days or one hundred and forty hours of actual work; which is upwards of 1 mètre per hour, that is, ten times the work of an ordinary boring rod. In the method I have de-

scribed, it will be perceived that the water is injected through the interior of the boring rod. Experience has taught me that when gravel, or stones of some size are likely to be met with, it is better to inject the water by the bore-hole, and let it rise through the boring tube. The additional velocity which may be thereby given to the water, and the greater accuracy of calibre of the tube, allow the free ascent of all substances which may be found at the bottom of the bore-hole, and which the former mode of working may not so readily accomplish. I have brought up by this latter way stones of 6 centimètres long and 3 thick ($2\frac{1}{2}$ by $1\frac{1}{4}$ English inches.) The idea of making the water remount through the interior of the boring tube suggests an easy mode of boring below a film (sheet) of flowing water: it would be sufficient to close the orifice of the bore-hole hermetically, still, however, so as to allow the boring tube to work, but yet so that the flowing water should be always forced down to the bottom of the bore-hole to find its way to a vent: it would thus draw up and carry away all the detritus. If, in addition to the above, we consider the possibility of making the hollow stem of the boring rod of wood, and of balancing it so that it would weigh no more than the water in which it has to move, the problem of boring to depths of 1000 mètres (1100 yards) and upwards would appear to be solved. In the square of St. Dominique, at Perpignan, a boring had been carried on upon the old method for upwards of eleven months for the purpose of forming an artesian well, and the water had not been found." Fauvelle placed his new tube alongside the old boring tackle, and soon got down to a depth of nearly 100 yards when an accident occurred which would have required some days to remedy. Fauvelle decided upon abandoning the bore-hole already sunk so deep, and commencing a new one, satisfied that there would thereby be a saving in time. The rate of sinking was equal to four English feet per hour of the time the hollow boring rod was actually at work, the depth of 560 English feet having been obtained in 140 working hours, for a bore-hole of about six English inches in diameter. M. Arago, who had seen the rods of Fauvelle at work, mentions how fully they answered, and that the large powerful tools at the bottom of the hollow boring rod cut easily through the hardest strata; he confirmed the fact of the large sized stones and gravel coming up with the ascending current, having himself watched them. He also mentioned, that such was the opinion of the people in the vicinity of Perpignan, and so much was water wanted, that orders for the sinking upwards of 200 artesian wells had been given to Fauvelle. The introduction of this system into this country, especially if combined with the Chinese or percussive system of boring, as practised with bore-holes of very large diameter, at the Saarbruck mines, and at many other places on the Continent, must be productive of great benefit, and would not merely effect a saving of money and labor, but the paramount advantage of immediately solving the question of the existence of coal, minerals, water, &c.

Sir JOHN GUEST asked Mr. Vignolles to explain the system of percussive boring, for the information of those gentlemen present who might not be acquainted with it.—Mr. VIGNOLLES said, instead of

boring with augers or rods, there was a heavy weight suspended by a rope and pulley ; and fixed to the bottom of the weight was a tool of the crown form, viz., a circular tool of iron indented at the bottom. There was no description of rock on which he had tried it that this tool did not penetrate with facility. The prejudice of English workmen, however, had hitherto prevented its introduction in this country, but he had no doubt it would make its way, particularly if it could be combined with Fauvelle's system.—J. LOBB, Esq., Mayor of Southampton, wished to ask a question relative to the applicability of Fauvelle's plan to the boring of the Southampton artesian well. They had got to the depth of 1200 feet with a bore 6 inches in diameter, and the expenses had been nearly 20,000*l.* ; this system, however, seemed to diminish the expense of boring in an extraordinary manner ; and he wished to ask if it could be applied to the present boring at the Southampton Common?—Mr. VIGNOLLES, as an engineer, had no hesitation whatever in saying that it could be applied without difficulty. If they wanted force to send the water down the tube, they might use a steam-engine.—Dr. ROBISON suggested that a deputation from the Section should go to the works of the Southampton well, and inspect them.—Mr. J. HILL said that percussion had long been used in this country. They had used that plan whenever they came to hard substances in the Southampton boring. The rods were drawn up by a windlass, and dropped down a foot or six inches ; and after the material was loosened the rods were drawn, and the pulverized material raised up by a cylinder.—Mr. VIGNOLLES said this was different from the Chinese system of percussion, where a rope was used, which saved the trouble and loss of time in drawing the rods. The power required for sending down the water on Fauvelle's plan was much less than might be supposed.—The MARQUIS OF NORTHAMPTON suggested that a committee of the Geological Section should be invited to accompany the committee from this Section.—Dr. LANKESTER expressed his warm approval of M. Fauvelle's plan, and his opinion of its applicability. A conversation followed, in the course of which Sir JOHN GUEST said the weight of a hollow rod, three inches in diameter, and the iron a quarter of an inch thick, would be less than that of a solid rod of an inch diameter : the weight would be further lessened by the rod floating in water.—*Trans. Brit. Assoc.*

Athenæum.

AMERICAN PATENTS.

List of American Patents which issued in the month of November, 1845,—with Exemplifications, by CHARLES M. KELLER, late Chief Examiner in the United States Patent Office.

1. For an *Improvement in the Cultivator Tooth* ; David B Rogers Stafford, New York, November 1.

The body and shank of the tooth is made of sheet metal swaged into the required form, the shank being so formed, that a horizontal section passing through that part of it which is inserted in the frame,