money is so high as in Turkey. (8) When constructed in iron the *whole* is transportable. (9) The Pioneer, owing to its climbing powers, can follow a crow line more nearly, and can open up hitherto inaccessible positions; and, moreover, can follow up the rivers (in their beds, if necessary), which frequently form the only means of communication in most mountainous countries.

"The locomotive is fitted on its underside with two pairs of horizontal wheels covered with leather, which grip the wall on either side with any desired force. Owing to the constant changes of gradient incidental to following the natural surface of the ground, the intensity of the grip should constantly vary, which is effected by a screw and lever arrangement acted upon by the draw-bar, which attaches the engine to the train. Thus, as the inclines are steep or moderate, so does the pull on the draw-bar vary, and by its action on the horizontal driving-wheels open or close their fell embrace, moderating the adhesion or grip precisely in the proportion that the gravity of the train varies in its ascents and descents. Thus the whole weight of the train is secured for adhesive purposes.

"The equilibrium of the locomotive is maintained by the grip of its horizontal wheels. The train is composed, firstly, of a locomotive, then of a caravan of articulated carriages, each articulation being about 7 ft. long, the whole concluding with a brake-van, fitted like the engine with four horizontal wheels. The whole mass is attached together by rigid couplings, which, while freely permitting articulation do not allow of the smallest lateral motion; that is to say, that no single carriage can lose its balance, upheld as it is by its two companions fore and aft; and as the whole train is continuous, the horizontal wheels of the engine at one extremity of the train and those of the brake-van at the other, effectually maintain the equilibrium of the whole train and prevent all oscillation whatsoever. A train of twenty-four of our basket carriages, capable of accommodating ninety-six passengers, will measure in length about 50 metres, and will weigh about 20 tons = 8 cwt. per metre run. Each double carriage contains four passengers, two on either side of the wall and facing each other. The seats are composed of slung strips of carpet—like American chairs—the balance of the passengers is consequently always preserved, even on the stiffest inclines. The brake-van is fitted with a stair passage to allow of communication with both sides of the train. I spoke of the permanent way as a brick wall—in some cases I should adopt stone or concrete; and in marshy districts a light wooden or iron viaduct, consisting of a single line of posts or columns In all cases the external dimensions of the wall or fence must be the same, so that though different soils may be differently treated, yet the permanent way will be continuous. That portion of the wall or other structure which the horizontal wheels work against is especially prepared for their grip. In the case of the wall it consists of a string of cement, and where posts and rails are used, of light iron or wood rafters strutted to resist compression. In semi-tropical countries it is very difficult to avoid interference with the water-sheds. The Pioneer leaves innumerable openings in the wall for this purpose, the numbers of these culverts positively diminishing in lieu of increasing the cost. Necessarily posts and rails would be used in the most exposed positions, and in crossing rivers or arms of the sea. In Asia Minor as in many other places where no cross feeder roads exist, it becomes necessary that the main line should accommodate as large an area as possible. Therefore the Pioneer double line is not constructed as at home, side by side, but the up-line takes quite an independent route from the down-line, touching every now and then at the important towns. Where only a single line is used it forms on alternate days an 'up' or 'down' line.

"The cost of the Pioneer may vary between £300 and £1000 per kilometre, a safe rule being to divide an ordinary railway estimate by ten. Most of the railways in Turkey run but one train either way in the twenty-four hours, all the rest of the day the whole of the vast capital is lying idle. The Pioneer will, on the contrary, run its caravans all day long, and compete with its giant opponent like the hare with the tortoise."

Mr. Haddan concludes his paper with a few extracts from his work, "The Proper Gauge for Turkish Railways."

We have only to add that a line on this system is to be constructed from Alexandretta to Allepo, a distance of ninety-eight miles. The cost is put down at £100,000. The annual outlay for camel and mule transport, according to Mr Consul Skéne's report, averages per annum £50,000 The company therefore, expect a profit of at least 30 per cent. or 40 per cent. The works, Mr. Haddan states, will require twelve months only for their construction The first train on this system is now being constructed for the company in Munich.

## PUNCHING COLD IRON.

By Coleman Sellers.

At the meeting of the Franklin Institute, held in December 1873, two cold punched hexagon nuts were exhibited by Messrs. Hoopes and Townsend, bolt, nut, and washer makers of Philadelphia. These specimens are worthy of attention from the fact that one of them had a hole one quarter of an inch in diameter and one inch deep, the other was perforated with a hole half an inch in diameter and one and a half inches deep.

These specimens are remarkable when we take into consideration the oft-made statement "that the maximum thickness of iron that can be punched cold is about the diameter of the punch," as the depth of the smallest nut is four diameters of the punch, and the largest one three diameters of the punch.

In conversation with Mr. Barton Hoopes, who has conducted these experiments, I learn that he has since succeeded in punching a half-inch hole through an inch and three-quarters thickness of wrought iron; the punching which came out of the hole I have examined, and it differs in no respect from ordinary punchings, but it has been compressed to seven-eighths of an inch in length—that is, the punching shows an irregular cylinder half-inch in diameter and seven-eighths of an inch long. The metal forming the punching is not condensed into a smooth cylinder, but shows the usual roughness common to all iron punchings, while the punched holes are very smooth.

The punch and die hole were the same size, and there has evidently been a side flow of the cold metal upon the entrance of the punch, and the operation may in a measure be considered a piercing one, up to a certain depth and finally the punching out of the residuum after it has attained that depth.

In punching the quarter-inch hole through one-inch iron, the punching showed a very smooth surface, and was only three-eighths of an inch long, seemingly very much compressed.

I have examined the punches used in this curious experiment; they differ in no respect from ordinary punches; they are made of good steel and hardened in some peculiar manner unknown to me.

Bars of iron one inch square, punched with a quarter inch punch, show a sensible widening under the action of the punch, and a bar of inch and three quarters square iron, punched with a half-inch punch, is swelled sidewise to an inch and thirteen-sixteenths, showing conclusively that some of the iron has been forced sidewise.

The machines used in driving the punch through this great thickness are said to be of unusual strength and accuracy of construction.

American Patents.—The number of American patents granted since 1836 is about 140,000. The number of applications for patents has steadily increased from year to year, until it now averages from 20 000 to 21,000 per annum, and the number of patents granted annually is from 13,000 to 15,000. To perform the work of examining this large number of applications, the corps of expert examiners has been increased from time to time until it now numbers about 100; twenty-four principal examiners, and the same number of first, second, and third assistant examiners, together with a special examiner of trade marks and also of interferences. The clerical force has been correspondingly increased, so that the officials of all grades now employed in the office may be stated in round numbers as about 500. I should be remembered, when comparing the number of English and American patents, that in the States many designs, &c., are patented which are only registered in England.