

one in its place. This is done by heaping dry sand around the chair, as it stands in its place, and then running metal into the cavity so formed, leaving a lip projecting over the chair. Only a few of these have yet been put down; but they have stood the test of two years' working over without failure, and are still tight. In casting, the hot metal running into the chair expands it, and its contracting upon the cast key in cooling makes it tight.

It may be remarked, that the new chair occupies exactly the same position on the sleepers, and has the same fixing, as the common joint-chair; so that in case of damage to the line from accident or slips, it can be repaired quickly in the ordinary manner, by using the old chairs and wood keys until the same cupola can be brought to bear.

Mr. Norris exhibited specimens of the chairs and the cast iron mould, complete; also a specimen of one of the new joint-chairs from the North Union Railway, which had been laid down for eighteen months in a line of great traffic, where 500,000 wheels had passed over it during the time; the two rail ends were cut off, and remained fixed fast in the chair, and the surface of the joint was level and smooth, although the rail ends had been much indented at the time the chair was cast on, from the rails having been recently turned.

The Chairman inquired what length of line had been tried with the new chairs and how long they had been at work?

Mr. Norris replied, that five miles had been recently laid with these chairs near Rugby, and about a mile was previously laid near Crewe, and elsewhere, which had mostly been at work one and a half years.

Mr. Woodhouse said, the recent trial of the chairs near Rugby had been made under his superintendence, and he had found the result highly satisfactory. It had been intended to relay that portion of the line during the present summer; but the new joint-chairs had proved of such benefit, that they would probably give several years additional life to that road. He consequently recommended the adoption of the plan on a considerable length at other parts of the line, which was now in progress.

The Chairman asked what difference was felt in the train running over the joints on the portion that had been altered at Rugby?

Mr. Woodhouse said, the joints could not be felt at all with the new chairs; there was no comparison of the ease in traveling over the old plan of joints.

The Chairman asked what was the usual time required for the process of casting the chairs?

Mr. Woodhouse replied, that the average of the work done at Rugby was about one chair cast every four minutes, including the whole process of preparation.

Mr. Slate remarked, it was certainly a very ingenious process of casting the chairs, and must make a thoroughly firm joint; he inquired what was the expense of casting?

Mr. Norris said that the labor of casting cost about 6d. per chair, and the cost was about 1s. per chair, including all expenses except the metal, which weighed about 50 lbs. The expense of casting was much diminished as the men got more experienced in managing it. At first they could only cast 40 chairs per day, but the rapidity of casting increased with practice to 80 per day; and now 120 per day were cast by common plate-layers, who had never before had anything to do with melted iron.

Mr. Slate said he had seen the first of these chairs one and a

half years since, and had then an unfavorable opinion of their standing in work from the great contraction of the melted metal in cooling on the rigid rail: but it appeared that the wrought iron rail was expanded by the heat of the melted metal sufficiently to make the chair safe by its contraction again in cooling. He thought the new chair made a very perfect coupling of the rail ends, and was a great improvement on fishings and other plans, which he could only regard as makeshifts; and though they had a very good effect compared with the previous plan of having nothing to couple the rails together at the joints, they were still far removed from perfection. The new chair might be said to be quite perfect, if it could be made quite fast on the rail without allowing it to slide.

Mr. Norris observed, that only every third or fourth joint was made a slip joint for expansion; he was aware what a great advantage it would be to have no slip-joints, and by no means maintained that to be impracticable; the expansion of the rails successively by the heat of casting the chairs on, would perhaps elongate them sufficiently to make provision for the expansion from the highest temperature they would be afterwards exposed to, and the tension would then resist the contraction from cold.

Mr. May remarked, that Mr. Brunel had now many miles' length of Barlow's rail on the South Wales Railway, all rivetted fast together, without any provision for expansion and no difficulty was experienced in consequence. There was some misconception on this point, respecting the action of expansion; it was limited in amount of force, and if opposed by a greater force, no amount of expansion or contraction could take place. Wrought iron raised in temperature 15° was expanded 1-10,000th of its length, and exerted a force of 1 ton per square inch of section by the expansion; consequently, no expansion of the rails would take place if a resistance were opposed of 1 ton per square inch for each 15° rise of temperature. He thought it probable that Mr. Norris's plan ultimately would require to have no expansion joints to perfect it, and in many cases he did not doubt the plan being an excellent one.

Mr. James Nasmyth said he had witnessed the whole process of casting the chairs, and fitting on the iron moulds, and considered it a very successful plan, and of the utmost value and importance to the durability of the line as well as to the safety of the public. The trains ran full speed over the red hot chairs directly after they were cast. He thought the slight tortuosities of all roads, even in the straight parts, would be probably found sufficient to allow for the effect of expansion, without making any provision of slip joints.

Mr. May suggested, that an experiment could readily be tried to ascertain the actual amount of expansion of the rails, by having a number of thin graduated wedges, to be dropped into the joints at the hottest part of the day and at night, to measure the amount of expansion over a considerable length of rail. It would probably be found to be very insignificant, as the ordinary chairs offer a considerable resistance to a longitudinal motion of the rail, by the hold of the keys on the rail, the chairs on the keys, and the ground on the sleepers; though of course the resistance in Barlow's rail was a different case, where the rail, chair, and sleeper were all one.

Mr. Woodhouse remarked, that in laying the rails the men place small wooden or iron packing pieces, 1-16th of an inch thick, between the rail ends at the joints, to make the ordinary allowance for expansion; and they always find that if these pieces are put in early in the day, they become so tight in the