which we have already described. Like these, they are also furnished with machinery and gearing to render their working convenient and rapid. The tyre, for we may now so call it, is re-heated in one of these furnaces, and placed horizontally upon a large plate or disc, in the centre of which there is a cylinder, constructed of segments. The action of an hydraulic press causes this cylinder to gradually enlarge its circumference, and consequently to stretch the tyre until the required dimensions are accurately obtained. While the tyre is still undergoing the above tension—to speak metaphorically, while it is still on the rack—it is subjected to the *peine forte et dure*, consisting of a series of numerous and heavy blows, having for their object the discovery of any flaw, crack, or other unsoundness which might have happened to the metal during the vicissitudes it underwent in its manufacture. A searching examination is made when it is cooled down, and if satisfactory, it is handed over to those whose duty it is to give it the finishing touches by cleaning it of scales and clinging *débris*, in which last process the labour of children is employed, a very unusual spectacle in the premises at Essen.

It must not be supposed that the tyres of wheels constitute the only item of railway mechanism turned out of the workshops of M. Krupp; on the contrary, every description of constructive detail, whether fixed or movable, is there manufactured. For several years M. Krupp was engaged in conquering the difficulties and combating the obstacles attending the construction of solid or disc wheels of cast steel, as the rapid solidification of this metal renders it unsuitable for any complicated description of manufacture. In the premises at Essen there is now a foundry especially devoted to the manufacture of disc wheels in a single operation, and the casting has arrived at such a state of perfection that, beyond the usual amount of dressing, no after process is necessary to render the fabrication complete. As they are taken out of the moulds so are they ready for service. One advantage of this principle of construction is that all welds and joints are avoided, and the chances of fracture considerably diminished. Notwithstanding these manifest advantages, several railway companies decline to adopt them, and M. Krupp, in order to to be ready for any emergency, has appropriated a workshop for the production and forging of the spokes, naves, and felloes of wheels in iron.

There is very little doubt that cast-steel axles, whether straight or cranked, are becoming generally substituted for those of iron, either in wagons, locomotives, or marine engines. The remarkable feature in their manufacture is that they require machinery of tremendous power. An idea of the immense strength of the rolls may be gained by the fact that after leaving them the bar has sometimes a thickness of more than 10 in. Among the steel axles turned out at Essen, some have evinced proof of extreme solidity, and we select an example which was supplied to the Orleans Railway. It appears from a table compiled by order of that company, and giving accurately the number of miles run by the axles of several of their locomotives, that the one in question ran upwards of 170,000 miles during a period of nine years. The engine to which it belonged weighed 30 tons. In another table equally interesting is recorded the distances run by the tyres of the locomotives. M. Krupp has a rule of his own, according to which he guarantees that all the tyres coming from his establishment shall do a certain amount of work before being injured or requiring repair. The following formula will give in English measures M. Krupp's rule. Let W represent in pounds the weight of one of the steel tyres, M the distance in miles it is guaranteed to run, then,

$$M = \frac{W \times 248{\cdot}55}{2{\cdot}2048}.$$

As an approximate rule sufficiently near for practical purposes, it may be stated that for every pound's weight of metal in the tyre it will run 113 miles. The following examples are mentioned. One tyre ran 43,000 miles and another 46,006, without requiring to be returned. It is recorded, as a just tribute to the excellence of the work at Essen, that England, for self and colonies, ordered, in 1865, 11,396 tyres and 564 axles. Among the largest orders are those from the Great Eastern Railway, the Patent Shaft and Axletree Company, the London and North-Western Railway, the Great Northern Railway, R. Morrison and Co., of Newcastle, the East Indian Railway, and Prosser & Son, of New York. The last quoted ordered over 2,000 tyres. In close proximity to the premises where the solid steel wheels are cast, is the workshop where the manufacture and testing of the steel blades destined for the springs of locomotives and carriages are conducted. There is nothing peculiar, or to call for especial notice, in this process, the only exception to the usual routine consisting in the employment of a huge lever worked by hand power in lieu of the vertical steam press more generally in vogue. A little to the right of the above are situated large rooms in which all the operations necessary for the production of cast steel rails are executed. Rolling, planing, boring, cutting, and other machines are disposed in an order the most favorable for rapidly and effectually doing their own share of the work. In the foreign mines a large demand for steel pump rods has arisen, and some have been sent from Essen forged in one solid piece 66ft. long. With few and rare exceptions, iron in the ingot or in bar never goes out of M. Krupp's establishment; it is all utilised there, and is only sent out in a form and condition fit to serve immediately some mechanical or scientific purpose. Railway plant and machinery, mining gear and marine machinery, constitute about three-fifths of the products of the steel cast at Essen; the remaining two-fifths are appropriated to less pacific objects, and necessarily demand an especial study. They comprehend the construction of cannon of all calibres, from the smallest specimen of light artillery to others throwing a projectile weighing upwards of 1,100lb. In our next we trust to give a *resumé* of what the efforts of M. Krupp have accomplished towards the production of implements of war.

Fibre of Stalk of the Hop Plant.

If as soon as its flowers have been gathered, the stalks of the hop-plant are made into bundles, and well steeped in water, then dried in the sun and beaten like hemp, a fibre will be obtained which, after having been combed, is admirably adapted for being spun into cordage.