The results were that a quarter of an ounce of steel was ground from the bar by the artificial grindstone in *sixteen minutes*, while to remove the same quantity by the Newcastle stone occupied *eleven hours*, and this notwithstanding that the surface speed of the latter was, as we have stated, more than 20 per cent. greater. Taking the 20 per cent. greater speed of the Newcastle stone into account, it will be seen that the 11 hours run by it were equal to 13¾ hours at the same speed as the artificial stone, and the proportional times occupied by the two stones were thus as 16 minutes to 13¾ hours, or as 1 to 52, nearly!

Such a result as this is something more than remarkable, and it is one which would scarcely have been credited, even by those who made the experiments, if it had not been fully corroborated by subsequent experience in the working of the artificial grindstones. Since the experiments above described were tried, Messrs. Donkin have set another pair of the artificial stones to work, and these which are now in regular use, have given more satisfaction than those first tried. The saving in time, and consequently, in labor, effected by the use of the artificial grindstones is, in fact, so great that Messrs. Donkin have determined to use these stones exclusively in future; and we may add that the artificial stones are so much preferred by the workmen that those men, even, who are employed in shops at some distance from that in which the stones at present in use are situated prefer taking the trouble to go to them to using the Newcastle stones in their own shops. In addition to their great efficiency, the artificial grindstones possess the advantages of being able to be manufactured of any size, and of any degree of coarseness of grain, and they can thus be specially adapted to any particular class of work, while the process of their manufacture insures their being of uniform texture throughout, and free from the flaws and hard and soft places found in natural stones. Altogether, we believe that the general adoption of the artificial grindstones is merely a matter of time.

Machinery and Manufactures.

Steel under the Microscope.

An experienced steel-maker can estimate very closely the precise quality, chemical composition, tensile and compressive strength, and even the mode of treatment which steel has undergone, by looking at its fracture. The appearance of the crystalline texture, which is more or less discernible by the naked eye, and the method in which the reflected light gives certain variations of lustre, are the scanty yet very important indications from which, by a series of guesses as to probabilities, an opinion may be formed which has every chance of being correct. This being the case, it seems very obvious that by the assistance of the microscope, we should be capable of observing the texture of steel and iron fractures more correctly and more minutely, and a smaller amount of experience or nicety of observation should be sufficient—should enable us to form a correct opinion of the qualities of any given sample of steel. This is the case, and to such an extent that it is most astonishing how metallurgists could have neglected the use of the microscope to such an extent as it generally has been. We have already drawn attention in this journal to the interesting researches made by M. Schott, the manager of Count Stöllberg's foundry, at Ilsenburg, upon the appearance of liquid and solidifying cast-iron under the microscope, and we can quote the experience of this able metallurgist as to the advantages to be obtained from microscopic observation of various kinds of steel. M. Schott, at his visit to the Paris Exhibition, made some most remarkable "guesses," as some steelmakers would call his conclusions, with regard to the qualities and method of manufacture of many hundreds of steel samples exhibited there, and of which he, in many cases, had no other knowledge than that which he could gather through the aid of a small pocket microscope, made of two pieces of rock crystal, formed into a very powerful single lens. A pocket microscope of this kind ought to be the companion of every man interested in steel or steel manufacture. Lenses of the usual kind, even if piled up in sets of three or four, are entirely insufficient. The lens must be of a very small focus, and properly achromatic. A little practice is sufficient to enable the user to "see" through this lens; but it is, of course, not quite so easy to learn the meaning of what is thus seen, and to estimate from the appearance the quality of the steel inspected.

M. Schott has established for himself a kind of theory which, we believe, will be useful to those of our readers who desire to use the microscope in their researches upon the qualities of steel. M. Schott contends that each crystal of iron is an octahedron, or rather a double pyramid raised upon a flat square base. The hights of the pyramids in proportion to their bases are not the same in different kinds of steel, and the pyramids become flatter and flatter as the proportion of carbon decreases. Consequently, in cast-iron and in the crudest kinds of hard steel, the crystals approach more to the cubical form from which the octahedron proper is derived, and the opposite extreme, or the shaft of wrought-iron, has its pyramids flattened down to parallel surfaces or leaves which, in their arrangement, produce what we call the fiber of the iron. Between these limits, all variations of hights of pyramids can be observed in the different kinds of steel, in which these crystals are arranged more or less regularly and uniformly, according to the quality and mode of manufacture. The highest quality of steel has all its crystals in parallel positions, each crystal filling the interspaces formed by the angular sides of its neighbors. The crystals stand with their axes in the direction of the pressure or percussive force exerted upon them in working, and consequently the fracture shows the side or sharp corners of all the parallel crystals. In reality good steel under the microscope shows large groups of fine crystals like the points of needles, all arranged in the same direction, and parallel to each other. If held against the light in a particular direction, each point reflects the light completely, and a series of parallel brilliant streaks are shown all over the surface. Now, the exact parallelism of the pointed ends or of the streaks of light is one of the most decisive