The first help earns about three-and-sixpence per diem; and his assistant has between half-a-crown and three shillings per diem. A fourth workman generally completes the staff of an ordinary Parisian bakery. This last is the drudge; he chops the wood, fetches the water, counts the loaves, and, in short, does all the needful drudgery, for something under two shillings per diem. The poor bakers are, I may observe, paid for overwork in this way. When they have to bake more than seven batches of bread, each batch containing seventy loaves, the workmen receive fivepence each for the eighth batch, and a penny each for the ninth. In addition to these money-payments, each workman is allowed to take away two pounds of bread daily, and it is this two-pound loaf that we have so often seen under his arm, as he trots away through the morning cold to his bed. He is allowed, moreover, to eat as much bread as he pleases during the night. There are indulgent masters, who give the poor fellows a sip of white wine before they start home in the morning; but these are, I fear, rare exceptions.—*Chamber's Journal.*

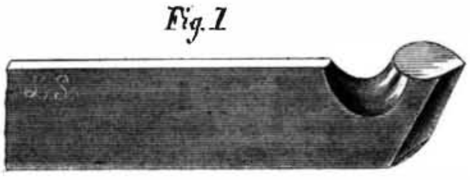
TURNING TOOLS.

PART FIRST.

There is no branch of the machinist's trade which is more interesting or important than that relating to the lathe and its management. Of two men working side by side with the same lathes, and on the same kind of work, the same feed and speed, one will do much more than the other. We see this exemplified on piece work. Here the earnings of the workman are exactly in proportion to his skill, and though his comrades may take every opportunity to discover the secret of his success, he still outstrips competitors.

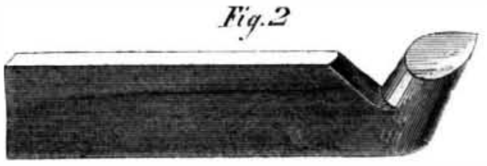
This is owing in most cases to the tools the skillful man works with. The unreflecting workman cannot appreciate some small matter in the construction of a tool, and suffers accordingly. He will most probably be contented to work with a clumsy tool, like the one shown in Fig. 1, instead of the more

Fig. 1



efficient one illustrated in Fig. 2, and he is perpetually wondering how it is that he is always behind hand.

Fig. 2



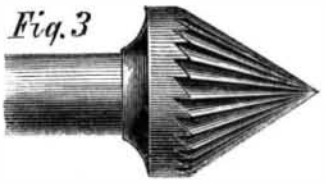
There is no mystery about the matter. A lathe tool works on one principle, as do all cutting instruments, and this principle is simply that of the wedge, as we have remarked in a previous article on boring tools, in the last volume of the Scientific American.

If a man has a heavy stone to raise, or a tough block of wood to split, he does not take a wedge which is thick and blunt, and almost as wide at the base as it is long. He uses instead a long, thin and easy one, which does the work with facility and celerity. The case is exactly the same when we cut iron or metals of any kind. To sever the fibers or crystals we must have sharp thin-edged tools, as thin as they can be made with economy. With these, and proper feed and speed, the work will be well done if intelligence superintend the operations. It is most essential that the tools be made sharp and kept so. If they are not, the work will be poorly executed. It is also of the first importance that the work be truly and properly centered. The center is the point on which the accuracy of the whole job depends, and it will be apparent to even the unprofessional reader that it should be perfect.

Very many workmen are content to take a center punch and make some sort of a cavity in the end of the rod, and "let it go at that," as the saying is. No good workman does this, but shiftless and indifferent ones do, and their work always shows badly compared with that done in a proper manner.

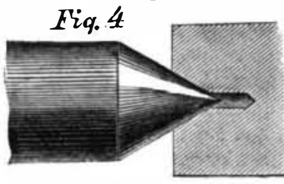
Every center should be drilled. The drill need not be larger than the tenth part of one inch, in ordinary work, and the object of drilling is to keep the point of the center in the lathe from bottoming. The centers in the work should be enlarged with a countersink, like the one shown in Fig. 3. But when the

Fig. 3



shaft is too heavy to be used in this way a square center is put in the place of the dead center of the lathe, a dog put on the shaft, and the job set revolving. The back end of a tool is then put in the tool post and screwed up tight, and the tool brought in contact with the running shaft. If the work has been drilled properly the sharp square corners make a countersink like the head of a screw, so that when the working center of the lathe is put in the spindle it will have a fair, solid bearing in the job, as shown in Fig. 4.

Fig. 4



The way a center, made with a center punch alone, acts, is shown in Fig. 5. Even if the punch is ground to an exact conformity with the lathe center, which is by no means likely, the center will not be true, as a rule, when the work is run over many times. For as the work revolves the orifice in the end of the shaft wears, where it bears on the lathe center. When the center comes to the bottom of the cavity, as it soon will, it stops there because its point can go no farther, while the larger or outer diameter of the centers wear away on the lathe center. This causes the work to be untrue; when a rough cut is taken off from the shaft and a finishing cut is to follow, the work runs "out," and not only spoils the looks of the job by leaving rough marks in one side, but ruins the work, for it is not round, and can never be made to fit in its place. There are many ways of making countersinks for enlarging centers. One commonly used, quite as efficient, and much cheaper than the former one, is shown in Fig. 6. Having thus made a brief but necessary digression from the subject of turning tools, let us resume the consideration of them.

Fig. 5

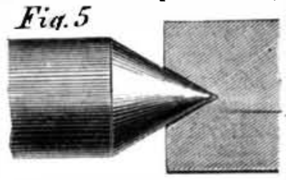
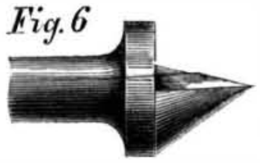
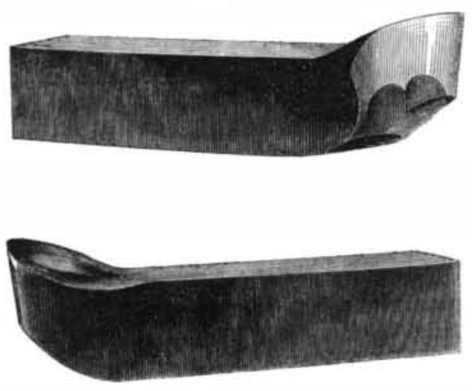


Fig. 6



The tool shown in Fig. 2, is a good roughing tool; it is called a diamond point, but there are very many turners who do not consider it the best for the purpose. It would be hard to say *why* precisely, for there is sometimes a great deal of whim exhibited in the matter of tools. Men will use, in spite of argument or reason, the tools they have been in the habit of employing, and prefer them to all others, even when they know they are not so good.

Figs. 7 and 8.



The cutter shown in figures 7 and 8 is a most excellent one; its virtues have been well tried and not found wanting. It is stout, cuts well, when properly made, holds a good edge, and will carry a heavy or a light cut with equal facility. These are the chief requisites of a good roughing tool. The management of it depends on the workman.

EXPANSION OF STEAM.

To the Editors of the Scientific American:—
Gentlemen,—

As I see that in the Scientific American of the 15th of October, you make some reference to a work of mine, I beg leave to make the following remarks on the subject of your article.

The circumstances under which steam undergoes expansion may be classed under five heads:—I. When the steam expands without performing work. II. When it expands and performs work, the temperature being maintained constant by a supply of heat from without. III. When it expands and performs work, being supplied from without with just enough of heat to prevent any liquefaction of the steam, so that it is kept exactly at the saturation point. IV. When it expands and performs work in a non-conducting cylinder. V. When it expands and performs work in a conducting cylinder, not supplied with heat from without.

I. When steam expands without performing work (as in rushing out of a safety-valve or through a throttle-valve) it becomes superheated, as is well-known; the temperature falling very slightly in comparison with the boiling-point corresponding to the diminished pressure. The precise rate at which the temperature falls is not yet known; but it will probably be soon ascertained through some experiments by Prof. Thomson and Mr. Joule.

II. When steam expands and performs work, the temperature being maintained constant by supplying heat through the cylinder, the law of expansion at first deviates from Mariotte's law by the pressure falling *less rapidly* than the density; but as the expansion goes on, the law approaches more nearly to that of Marriotte, as recent experiments by Messrs. Fairbairn and Tate have shown.

III. When the steam expands and performs work, *being maintained exactly at the temperature of saturation*, the law of expansion, as you observe, is perfectly definite. In the treatise to which you have referred I have shown what it is; and also that it is expressed nearly enough for practical purposes by taking the pressure as being proportional to the 17th power of the 16th root of the density; a function very easily calculated by means of a table of squares and square roots. In many actual steam engines, the circumstances of this case are practically realized, as is shown by the agreement of their performance with the results of calculation

IV. When steam expands and performs work in a non-conducting cylinder, it was shown by Professor Clausius and myself, in 1850, that the lowering of the temperature, through the disappearance of heat in performing work, goes on more rapidly than the fall of the boiling point corresponding to the pressure, so that part of the steam is liquefied. This result was experimentally verified by Mr. G. A. Hirn, of Mulhouse, a few years afterwards (see his Treatise on the Mechanical Theory of Heat). The mathematical law of the expansion in this case can be given with perfect precision; but its circumstances are not accurately realized in practice, because the cylinder is always made of a rapidly-conducting material.

V. Lastly, when the steam expands and performs work in a conducting cylinder, which receives no supply of heat from without, but is left to undergo a great alternate rise and fall of temperature through its alternate connection with the boiler and the condenser, the law of expansion becomes very variable, and the problem of determining it extremely complex. It is certain, however, that a great waste of heat occurs in every case of this kind, as Mr. Isherwood's experiments have shown. In a paper read to the Institution of Engineers in Scotland, about two years ago, I discussed some of Mr. Isherwood's earlier experiments, and showed that they gave proof of a waste of heat increasing with the fall of temperature due to the expansion of the steam, with the extent of conducting surface of the cylinder, and with the duration of the contact between the hot boiler steam and that conducting surface.