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.*

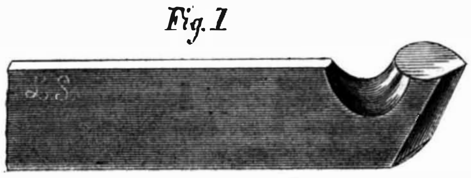
TURNING TOOLS.

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.

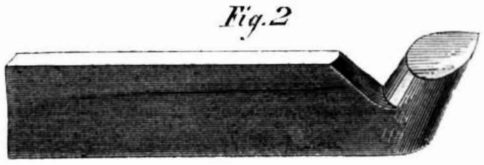
This is owing in most cases to the tools the skillful man works with. The unreflecting workman cannot appreciate some small matter in the construction of a tool, and suffers accordingly. He will most probably be contented to work with a clumsy tool, like the one shown in Fig. 1, instead of the more

Fig. 1



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

Fig. 2



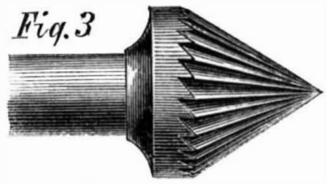
There is no mystery about the matter. A lathe tool works on one principle, as do all cutting instruments, and this principle is simply that of the wedge, as we have remarked in a previous article on boring tools, in the last volume of the SCIENTIFIC AMERICAN.

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.

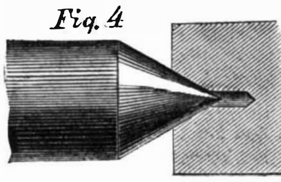
Every center should be drilled. The drill need not be larger than the tenth part of one inch, in ordinary work, and the object of drilling is to keep the point of the center in the lathe from bottoming. The centers in the work should be enlarged with a countersink, like the one shown in Fig. 3. But when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

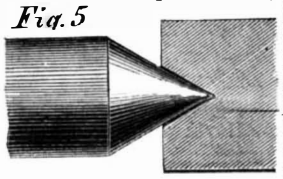
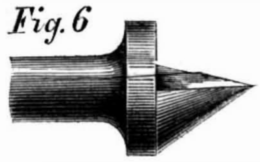
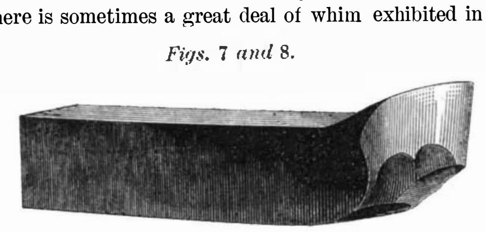


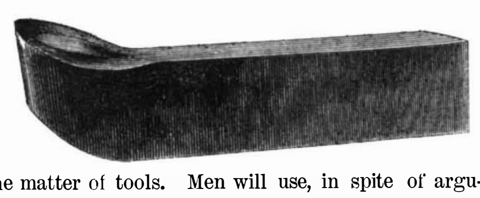
Fig. 6



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.

As to the value of indicator-diagrams, I have always held that they gave a good approximation to the whole *work done* by the steam during each stroke, though not to the pressures at particular instants, which, in ordinary indicators, are affected by oscillations and other disturbing causes; but that defect I consider to be nearly, if not entirely, overcome in the indicator of Mr. Richards; and I hope for very valuable results from the extension of its use.

W. J. Macquorn Rankine.

Glasgow University, Nov. 18th, 1864.

SEASONING OF LUMBER AND TIMBER.

[For the Scientific American.]

It is evident that the seasoning and drying of lumber is not properly understood by the community. If there ever was a time in which the best mode was needed it is now. Every manufacturing establishment in the country is taxed to its utmost capacity, and must, for years to come, to supply the demand for buildings, carriages, wagons, reapers and mowers, rail cars, bridges, sash blinds and doors, cabinet, cooper, chair, tub and rail, and other work, with gun carriages, gun stocks, pianos, melodeons, organs, ships, etc., all of which require seasoned lumber.

The question is, how can this seasoned lumber be obtained, when the demand for lumber follows close to the saw? Indeed, it is very difficult to manufacture lumber as rapidly as it is needed for immediate use.

Four years in the open air is none too much time to prepare even two-inch lumber for good work. Oak lumber, such as is used for gun carriages, car sills, etc., will not be properly seasoned by an exposure to the air for ten years, while a large portion of it will be destroyed by eramacausis, or dry rot, long before that time. I have extracted at the rate of over 600 pounds per M feet, board measure, from this kind of lumber that had been dried under cover 19 years, and, at the same time caused a shrinkage in its size of $\frac{1}{4}$ inch to the foot.

I have made the seasoning and drying of lumber a study for more than eighteen years, and I now propose to make a few suggestions, in a sufficiently brief manner to come within the rule of brevity which you have adopted, and if the matter is not sufficiently explicit for your readers I will answer inquiries by mail.

To season lumber is to coagulate its vegetable albumen, and render it insoluble in cold water. Lumber may be seasoned and not dried, and dried and not seasoned. It requires both to be perfect.

All wood contains albumen more or less. This albumen is precisely like the albumen of the egg, except a trace of sulphur in the egg. If this albumen is simply dried in the air it will shrink and swell with every change of atmosphere. Common air drying will never fix albumen, nor will it in any length of time perform the most thorough shrinkage. Cold water, hot air, and steam may extract albumen, and the air may do the drying. But all lumber and timber is injured in its strength and in its beauty of finish by the loss of its albumen. The albumen properly coagulated and left in the pores of the lumber is as valuable as paint or varnish for its preservation or beauty of finish. Besides, no lumber that has lost its albumen by soaking or steaming can ever be reduced by air drying to its smallest possible size, since the air dries the outside first and forms an enamel that will not further shrink when the inside becomes dry. It must all shrink together, in order to make the lumber solid for a fine finish. If the pores of the lumber are dried open it cannot make a good finish.

Now, what seems to be desirable, is, to be able to put a tree in the forest, manufacture the lumber, season it thoroughly, dry it sufficiently to reduce it to its smallest possible size, and be able to manufacture it into anything, from a clothes-pin to a ship, during the same week it is taken from the stump.

I have discovered precisely such a mode, and can now direct or show any one, so that they can have better seasoned lumber in a week than they can make in the air in a week of years. And what is still more surprising, it has the following rare combination of qualities, to wit: greater rapidity, more thorough seasoning and drying, and cheaper than any other process known to science, whether natural or artificial. If needs be, the whole may be creosoted for its preservation, at the same time, and at a merely nominal expense.

The process is simply the use of superheated steam—superheated in particles, or one particle at a time—and used in a moderately tight room, requiring no more pressure than simply to balance the atmosphere and exclude the air. This steam may be made from the moisture of the drying substance, or in any other cheap and convenient way, to be used in the place of air for conveying caloric to the substances to be seasoned or dried. This steam also keeps the pores of the lumber open, penetrates to the center without forming an enamel on the outside, and when the whole is sufficiently hot the lumber is not only seasoned, but the drying commences at the center, which is the last place reached by any other mode of drying, if, indeed, it is ever reached at all by such modes. Besides, steam has 90 times the power of motion and absorption that common air has. Steam also holds 1,000 degrees of latent heat, which assists in preventing waste of fuel. When this process is properly arranged and managed there is scarce a possibility of any escape of heat, unless it be in the steam generated from the drying lumber, and which only passes out when it is in excess in the drying room. It will, therefore, readily be seen that lumber which is continually surrounded by such a steam atmosphere cannot be dried in one part more rapidly than it can in another, and must shrink alike.

By this process the shrinking of the lumber is all done before the lumber is entirely dry, and the more moisture there can be left in any lumber, after the seasoning and shrinking are completed, the stronger, tougher, and more durable the timber. This process, therefore, is capable of seasoning and shrinking the lumber, and still leave more moisture in it, or it may leave it drier than any other mode.

Having already expended nearly $200,000 in experiments with this new principle of seasoning and drying lumber, grain, flour, meal, fruit, vegetables, tobacco, salt, wool, flax, etc., I should be pleased, if I had the time and room, to give you the result of experiments with each, such as the drying of flax in an hour directly from the water-rotting tank, so that it will dress better in any machine than by air-drying any length of time, but this article would soon be too long to come within the sensible rule of brevity established by the Scientific American.

H. G. Bulkley.

Cleveland, Ohio. Dec. 14, 1864.

Water Engines in Europe.

Messrs. Editors:—I notice in your last issue a reply of yours to a correspondent, saying that you see no reason why water should not be made to act by direct pressure, and that there existed such an engine in Washington. Lest your correspondent should go to all the trouble, work and expense of re-inventing this motive power, I wish to inform him, through your columns, that there are dozens of these engines in operation in Germany, Belgium, France and England, and that I for one have the drawings of several kinds of these water column engines as they are called. I have also seen one in operation; this was near Berchtesgaden, Bavaria, in the salt mines. This engine had been running continually, with hardly any repairs, for over thirty years, with only one and the same old man to attend to it all that time. It was used to pump the brine over a hill of several hundred feet in hight. As engines of this sort work neeessarily very slowly, only three or four strokes per minute, they are peculiarly adapted for driving pumps, for which work they are considered the best motive power when there is a sufficient fall of water on hand to drive them, and so far they have been used for that purpose only.

Clemens Herschel, C.E.

No. 6 Joy's Buildings, Boston, Mass.

Work on Cotton Spinning Wanted.

Messrs. Editors.—Please to inform me of the best work on the practical operation of cotton machinery. I have a work entitled the "American Cotton Spinner," but it does not explain the point I wish to understand, which is:—Suppose a man was about to start a mill; he wishes to produce cloth that shall weigh four, five or six yards to the pound, that will require a certain number of yarn according to the sley and pick of the goods. Now, what weight of cotton shall be spread on a given space on the lapper apron, so that after it has passed through the different machines with whatever draught they may have, the result shall be the number of yarn required? If you know of any work thorough enough to explain those points, please to inform me. J. H. H.

[Perhaps some of the cotton spinners among our readers will answer this.—Eds.

An Iron Letter by Post.

The Birmingham correspondent of the London, *Engineer* says :—

"An original specimen of iron-rolling was placed in the Midland Institute, in Birmingham, by the proprietors of the *Birmingham Journal and Post.* It is no other than a letter written upon iron, rolled so thin that the sheet is only twice the weight of a sheet of ordinary-sized note paper of the same surface dimensions. It weighs two pennyweights and twenty one grains. Tested by one of Holtzappfel's gages, the thickness of the sheet is found to be one-thousandth part of an inch. A sheet of Belgian iron, supposed, hitherto, to be the thinnest previously rolled, is the six hundred and sixty-sixth part of an inch thick ; and the thickness of an ordinary sheet of note paper is about the four hundredth part of an inch. The letter, which is dated, 'South Pittsburgh, Pa., November 6, 1864,' explains the object of the manufacturer. It runs thus:—'*To the Editor of the Birmingham Journal*—Sir : In the number of your paper dated October 1, 1864, is an article setting forth that John Brown & Co., of the Atlas Works, Sheffield, has succeeded in rolling a plate of iron 7 feet long, 6 feet wide, and $13\frac{1}{2}$ inches thick. I believe that to be the thickest plate ever rolled. I send you this specimen of iron made at the Sligo Ironworks, Pittsburgh, Pa., as the thinnest iron ever rolled in the world up to this time, which iron I challenge all England to surpass for strength and tenacity. This, I believe, will be the first iron letter that ever crossed the Atlantic ocean; and if you should think it worthy of notice in your widely-circulated paper, please send me a copy of the same.—Yours, &c., John C. Evans.' Fourteen years ago some iron was rolled very thin at the Bankfield Ironworks, Bilston, and afterwards bound up as a book ; and previously to the rolling of the Belgian iron referred to above, and shown at the Exhibition in 1863, it was the thinnest iron which, up to that time, was supposed to have been rolled, for it was only a little thicker than ordinary note paper, but it could not compare with the specimen which our American friends have turned out."

The Patent Stone Bricks.

At a recent meeting of the South Wales Institute of Engineers, Capt. J. J. Bodmer read a paper "On the Nature and Manufacture of Patent Stone Bricks." The writer described the process adopted by Messrs. Bodmer Brothers, Newport, in the manufacture of the patent stone bricks. When they considered that labor was now about 100 per cent. higher than it was about eighty years since, anything which tended to lower the price of so useful and general a commodity as bricks, must be considered a timely invention. The stone bricks, he said, had fulfilled these requisites. Another very great advantage which these stone bricks had over the common bricks was, that they improved by age; whereas the common bricks skinned and deteriorated. Some of the bricks were exhibited to the members. Some had been made of Aberthawe lime and sand; others of sand and cinders; and some others had been made out of slags, which were particularly hard and durable. Some of the bricks made by the patent process were stated to have borne a weight of three tuns per brick, after having been made but fourteen days; others, which had been longer made, were capable of bearing about thirty tuns per brick. The chief difficulty in the manufacture was that of reducing the material employed to the fineness of sand, or, better, to that of powder.

A Mr, Alex. Cuthell, of Doncaster, England, sends a tracing of a slide valve and cut off to the *Engineer*, said cut off being operated by the governor. The arrangement is not new, having been used in "Boyden's" engine in this country for many years.