Correspondence.

The Ant's Instinct.

To the Editor of the Scientific American:

I sailed from Philadelphia in the winter of 1859, having on board a cargo of lumber. After being at sea some ten days or more, I discovered that we had on board a large number of passengers, ants and cockroaches. Going through the cabin one evening, our colored steward said to me, "Cap'n, jes' look a-hea'h." He was standing in the pantry door with a lamp in his hand. On looking into the pantry, I discovered on the lower shelf a number of large black ants in a huddle, and a half dozen by themselves, and on the opposite side of the shelf was some sugar which the ants did not seem to notice, which caused me to wonder; the reason, however, soon became apparent. A cockroach made his appearance and went for the sugar; and the group of ants went for him, and, before he fairly got a taste of the sugar, they had him down and killed him in less than a minute; then the six that stood apart from the rest advanced, took up the dead cockroach, and bore him off the field. The others remained on the watch, and as soon as another appeared they all pitched in and made short work, as before. In the meantime, the pall bearers had returned and took this one off the field, as they had done the other. I watched until I saw this enacted a half dozen times, and it was done as regularly as it could have been by men. The ants kept on killing the cockroaches until they had entirely cleared them out, which took but a short time.

Cockroaches do not seem to be at all warlike, but raid about in quest of something to subsist on. But as the ants do not believe in the moiety system, they went in for total annihilation, and had everything their own way.

Stratford, Conn. TRUMAN HOTCHKISS.

Hardening and Tempering Tools.

To the Editor of the Scientific American:

I desire to say a few words in rejoinder to Mr. Rose's reply to my communication on "Hardening and Tempering Tools," as he attempts, I think, to place me in a position very far from what is warranted by my letter.

To be satisfied to consider the points adduced by me as something of the chemistry of metallurgy, of an abstruse nature, and not sufficiently practical to come within the scope of his article, is for Mr. Rose to decide for himself. I am of the opinion, however, that a majority of your readers will regard these points as eminently practical; and that their observation, in the successful tempering of any cutting tool, is of very great importance. I entertain the opinion, too, that our average American mechanic will not think it something beyond his capacity to comprehend, when he is told that the color produced upon the polished surfaces of steel is due to the formation of a film of oxide, or when he is instructed as to the essential conditions governing its formation, when it is taken as a guide to him in producing a required temper in a tool he is to use.

Mr. Rose would seem to make it appear that I advocate the rapid drawing of the temper, whereas I distinctly caution the operative against it, when I say: "In drawing the temper of such a tool, the operative should be taught to be as careful as possible to dip it about far enough, and a sufficient length of time, to require a moderate time only to bring the proper color; *not too quick*, as that would defeat his object by causing the gradation of softness from the cutting edge upward, which must necessarily be the result in this method, to be very sudden, and will leave an extremely small fraction of the chisel's length sufficiently hard for his purpose." Again, the "few seconds" he quotes from me, as representing the proper time to elapse in drawing the temper of a cold chisel, will appear as not at all acute on his part, if indeed fair, when it is plain that, when using that expression, I was merely making instance of the prevailing malpractice of the shops. It will be seen, also, that I have entirely agreed with him as to the objections to hastening the drawing of the temper over a fire, and recommend, particularly, that such hastening be done under circumstances which will insure free access of the air to the surfaces. If Mr. Rose is content to accept any process which predicates the temper upon the color of the film, and which at the same time excludes the air from the surfaces upon which the film is to form, as instanced in the sand bath, he is welcome. The fact is that the time taken in the formation of the film of oxide, as well as the free access of the oxygen of the air to the surfaces, are very important points, and, moreover, extremely practical; and Mr. Rose will do well not to ignore them. JOHN T. HAWKINS.

62 Cannon street, New York city.

[For the Scientific American.]

SPECIFIC HEAT.

BY RICHARD H BUEL.

It is well known, as a matter of fact, that the amounts of heat contained in equal weights of different substances vary greatly. For instance, the amount of heat required to raise the temperature of one pound of water from 32° to 212° Fah. will raise the temperature of about 30 pounds of mercury through the same range. The reason for this fact is not known; but there are several explanations given, the most generally received being that which is based on the modern theory of heat. A short description of this explanation may not be uninteresting. Experience teaches that every known substance is divisible; but it seems reasonable to suppose that if the division be continued far enough, the ultimate particles will at last be reached, which cannot be subdivided without losing their properties as parts of the given substance. These ultimate particles are called the molecules of the body; hence a molecule may be defined as the smallest particle of a body which possesses all the properties of that body. The molecule may be broken up into its constituent elements, by some chemical process, and the particles obtained by the decomposition of the molecule are called atoms. It is supposed that the volume of a molecule is about two billionths of a cubic inch, or 0·000,000,002 cubic inches. A molecule of hydrogen is supposed to contain two atoms, so that the volume of the hydrogen atom would be one billionth of a cubic inch, and its weight, one hundred and thirteen thousand three hundred and sixteen nonillionths or 0·000,000,000,000,000,000,000,000,113,316, of a grain. Accepting this result, the weights of the atoms of other elements can be found by multiplying the weight of the hydrogen atom by the atomic weight of the given element. The reader who desires to learn more, in regard to the measurement of molecules and atoms, will find the subject clearly treated in "The New Chemistry," by Professor J. P. Cooke.

Now it is supposed that the amount of heat, required to raise the temperature of an atom through a given range, is the same, whatever the nature of the atom may be; and hence, as the weights of atoms of different substances vary greatly, the amounts of heat necessary to increase the temperatures of given weights of different substances must also vary. It has not been proved by experiment that the amounts of heat do vary precisely in accordance with the atomic weights of different substances; but the agreement is sufficiently close to justify the presentation of the theory as a plausible explanation. The amount of heat, expressed in British thermal units, required to raise the temperature of one pound of a substance one degree on Fahrenheit's scale, for various elementary and compound substances, will be found in the accompanying table. These numbers represent the specific heats of the different substances, and are generally the values as determined by Regnault. The specific heat of a substance varies with the temperature, and the values given in the table are those for ordinary temperatures. In the case of gases, they are supposed to be in such a condition as to conform sensibly to the laws affecting perfect gases.

If the specific heat of an alloy at ordinary temperatures is required, it may be found, with sufficient accuracy for most purposes, by the following rule:

Multiply the specific heat of each metal in the alloy by the percentage of weight of that metal, add the several products, and divide by 100.

Example: What is the specific heat of an alloy containing, by weight, 46·73 per cent of lead, and 53·27 per cent of tin?

Answer: Specific heat of lead	0·03065
Multiply by	46·73
	1·432
Specific heat of tin	0·05623
Multiply by	53·27
	2·996
Add	1·432
Divide by 100	4·428
Specific heat of alloy	0·04506

The specific heat of water given in the table is for water at or near the temperature of maximum density. To find the specific heat at any other temperature:

Subtract 39·2 from the given temperature, square the difference, multiply it by three hundred and nine billionths, and add the product to unity.

Example: What is the specific heat of water at 90° Fah.?

Given temperature	90·0
Subtract	39·2
	50·8
Square of 50.8	2580·64
Multiply by	0·000000309
	0·001006
Add	1·000000

Specific heat of water at 90° Fah. 1·001006

With these explanations, the table will probably be found sufficiently complete for general practice.

TABLE OF SPECIFIC HEATS, SHOWING THE NUMBER OF UNITS OF HEAT REQUIRED TO RAISE THE TEMPERATURE OF ONE POUND OF A SUBSTANCE ONE DEGREE FAHRENHEIT.

Air	0·23740	Chloride of strontium	0·11990
Alcohol (liquid)	0·61500	" " zinc	0·13618
" (vapor)	0·45340	Chlorine (gas)	0·12100
Aluminium	0·21430	Chromium	0·12000
Ammonia (vapor)	0·50830	Cobalt	0·10730
Anthracite coal	0·20100	Copper	0·09515
Antimony	0·05077	Corrosive sublimate	0·06889
Aragonite	0·20850	Corundum	0·19762
Arsenic	0·08140	Diamond	0·14687
Benzine	0·45000	Ether (liquid)	0·50342
Bismuth (solid)	0·03084	" (vapor)	0·48100
" (liquid)	0·03630	Galena	0·05088
Bituminous coal	0·20085	Glass	0·19766
Boron	0·25000	Glucinum	0·23080
Brass	0·09391	Gold	0·03244
Bromine (liquid)	0·10700	Graphite	0·20083
" (gas)	0·05550	Hydrochloric acid	0·18450
Cadmium	0·05669	Hydrogen	3·40900
Carbonic acid	0·21630	Ice	0·47400
" oxide	0·24500	Iceland spar	0·20858
Chalk	0·21485	Iridium	0·05700
Charcoal	0·24150	Iodide of mercury	0·04197
Chloride of barium	0·89570	" " potassium	0·08191
" " calcium	0·16420	" " silver	0·06159
" " lead	0·06641	Iodine (solid)	0·05412
" " magnesium	0·19460	" (liquid)	0·10822
" " manganese	0·14250	Iridium	0·03259
Iron	0·11380	Rhodium	0·05803
Iron pyrites	0·13001	Ruthenium	0·06110
Lead (solid)	0·03065	Salt	0·17295
" (liquid)	0·04020	Sapphire	0·21737
Lithium	0·94080	Selenium	0·07446
Magnesium	0·24990	Silica	0·19132
Manganese	0·12170	Silicon	0·17740
Marble	0·20989	Silver	0·05701
Mercury (liquid)	0·03332	Sodium	0·29340
" (solid)	0·03192	Steam	0·48050
Molybdenum	0·07218	Steel	0·11750
Nickel	0·11080	Sulphide of carbon	0·15700
Niobium	0·06820	" " zinc	0·12813
Nitrate of sodium	0·27821	Sulphur (native)	0·17760
" " silver	0·14352	" (purified)	0·20259
Niter	0·23875	" (liquid)	0·23400
Nitric oxide	0·23150	Sulphuric acid	0·34300
Nitrogen	0·24380	Tantalum	0·04840
Nitrous oxide	0·22380	Tellurium	0·04737
Oil of turpentine (liq'd)	0·46727	Thallium	0·03355
" " " (vapor)	0·50610	Thorinum	0·05800
Olefiant gas	0·40400	Tin (solid)	0·05623
Olive oil	0·31000	" (liquid)	0·06370
Osmium	0·03113	Tungsten	0·03342
Oxygen	0·21750	Uranium	0·06190
Palladium	0·05928	Vanadium	0·08140
Petroleum	0·46840	Water	1·00000
Phosphorus	0·18870	Wood spirit	0·64500
Platinum	0·03243	Zinc	0·09555
Potassium	0·16956		

Cast Iron---Interesting Investigations.

The fact that solid plates of cast iron may be made to float upon molten iron has been explained by the hypothesis that molten iron was denser than solid iron. At a recent meeting of the Royal Society, Mr. Robert Mallet read a paper, the object of which was to show that the evidence is insufficient, and that, with respect to cast iron and to the basic silicates constituting iron slags, the allegation of their expansion in volume, and therefore their greater density when molten than when solid, is wholly erroneous. The determination of the specific gravity in the liquid state of a body having so high a fusing temperature as cast iron is attended with many difficulties. By an indirect method, however, and operating upon a sufficiently large scale, the author has been enabled to make the determination with considerable accuracy. A conical vessel of wrought iron of about 2 feet in depth and 1·5 feet diameter of base, and with an open neck of 6 inches in diameter, being formed, was weighed accurately, empty and also when filled with water level to the brim; the weight of its contents in water, reduced to the specific gravity of distilled water at 60° Fah., was thus obtained. The vessel being dried was now filled to the brim with molten gray cast iron, additions of molten metal being made to maintain the vessel full until it had attained its maximum temperature (yellow heat in daylight) and maximum capacity. The vessel and its contents of cast iron, when cold, were weighed again, and thus the weight of the cast iron obtained. The capacity of the vessel when at a maximum was calculated by applying to its dimensions at 60° the expansion calculated from the coefficient of linear dilatation as given by Laplace and others, and from its range of increased temperature; and the weight of distilled water held by the vessel thus expanded was calculated from the weight of its contents when the vessel and water were at 60° Fah., after applying some small corrections.

We have now the elements necessary for determining the specific gravity of the cast iron which filled the vessel when in the molten state, having the absolute weights of equal volumes of distilled water at 60° and of molten iron. The mean specific gravity of the cast iron which filled the vessel was then determined by the usual methods. The final result is that, whereas the specific gravity of the cast iron when cold was 7·170, it was only 6·650 when in the molten condition; cast iron, therefore, is less dense in the molten than in the solid state. Nor does it expand in volume at the instant of consolidation, as was conclusively proved by another experiment. Two similar 10 inch spherical shells, 1·5 inches in thickness, were heated to nearly the same high temperature in an oven, one being permitted to cool empty as a measure of any permanent dilatation which both might sustain by mere heating and cooling again, a fact well known to occur. The other shell, at a bright red heat, was filled with molten cast iron and permitted to cool, its dimensions being taken by accurate instruments at intervals of thirty minutes, until it had returned to the temperature of the atmosphere (53° Fah.), when, after applying various corrections, rendered necessary by the somewhat complicated conditions of a spherical mass of cast iron losing heat from its exterior, it was found that the dimensions of the shell whose interior surface was in perfect contact with that of the solid ball which filled it were, within the limit of experimental errors, those of the empty shell when that also was cold (53° Fah.), the proof being conclusive that no expansion in volume of the contents of the shell had taken place.

It is a fact, notwithstanding what precedes, and is well known to ironfounders, that certain pieces of cold cast iron do float on molten cast iron of the same quality, though they cannot do so through their buoyancy. As various sorts of cast iron vary in specific gravity at 60° Fah., from nearly 7·700 down to 6·300, and vary also in dilatability, some cast irons may thus float or sink in molten cast iron of different qualities from themselves through buoyancy or negative buoyancy alone; but where the cold cast iron floats upon molten cast iron of less specific gravity than itself, the author shows that some other force, the nature of which yet remains to be investigated, keeps it floating; this the author has provisionally called the repellent force, and has shown that its amount is, *cæteris paribus*, dependent upon the relation that subsists between the volume and "effective" surface of the floating piece. By "effective" surface is meant all such part of the immersed solid as is in a horizontal plane, or can be reduced to one. The repellent force has also relations to the difference in temperature between the solid and the molten metal on which it floats. The author then extends his experiments to lead and solidified iron furnace slag, with analagous results.

WHY SOLID IRON FLOATS IN MOLTEN IRON.

Two explanations, says Dr. Vander Weyde, are given of the floating of solid iron in molten iron. The first is that the iron expands in solidifying, as water does, and that therefore solid iron when heated is specifically lighter than liquid iron, and floats upon it as ice floats upon water. This supposition, however, is incorrect, inasmuch as it is based upon an erroneous assumption. Iron does not expand in solidifying, a fact of which any one may convince himself by brief observation in a foundery. The fact is just the reverse; the metal shrinks during solidification, after having been cast in a mold. By casting, for instance, a long piece in a vertical mold, the solidified piece will not fill the mold to the top, as did the liquid iron. The explanation given by Dr. Van der Weyde himself is that the iron is surrounded by a film of air adhering to it, which repels the molten iron and prevents contact; on which account the solid piece displaces more liquid metal than its own weight amounts to, and consequently it floats.

PRACTICAL MECHANISM.

NUMBER VII.

BY JOSHUA ROSE.

VISE WORK—TOOLS.

The tools used by the vise hand being nearly all supplied to him ready made, but few remarks need to be made to him upon the subject of their form.

CALLIPERS.

Outside callipers, that is, those used for measuring external diameters, should have larger rivets in them than they are generally given, a fair proportion being a rivet of one half inch diameter for a pair of callipers intended to measure up to diameters of seven inches. The points of such callipers should be tapered to a wedge shape, the tapering face being on the outside edge, so that the same part of the points of each leg will touch the work, whether the latter is of small or large diameter; the points where they meet together should be slightly rounding, so that they will touch the work at the middle of each point.

Fig. A represents an excellent proportion and shape for outside callipers. For use on threads, the points must either be made very broad, and come together level and even so as to gage the tops of the thread, or be made very thin, to gage the bottom of the thread. The proper shape for inside callipers is that given in Fig. B. The points and legs being made of the form here represented enables the callipers to have a large rivet and washer, and to enter a smaller hole, and clear a longer distance, than is possible where the points are bent round in the manner commonly employed. The dotted lines denote the distance the callipers would clear when in the position shown.

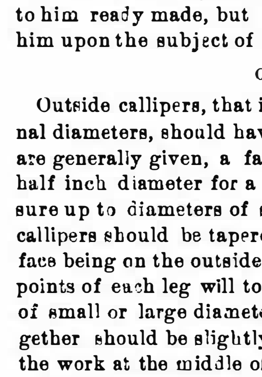
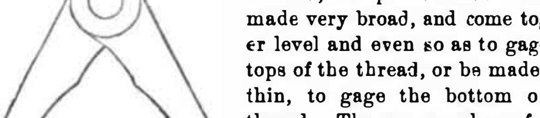


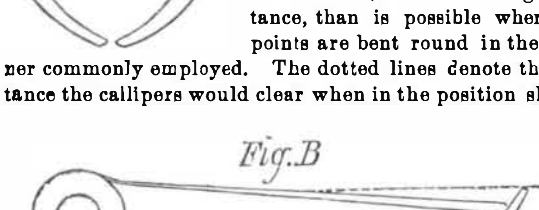
Fig. B



Another feature to the advantage of this form is that, when the legs are extended, the points are still at the extreme end of the callipers, so that the points will measure to the extreme end of the hole, even though the latter is closed by metal, that is, terminates in the metal. This is not the case when the calliper ends are bent round to the usual extent, for the curve of the bend will touch the end of the hole and prevent the calliper points from reaching it. In measuring with callipers, let the points be set to touch the work very lightly indeed, or they will spring from the pressure due to forcing them over the work.

Compass callipers, such as illustrated by Fig. C, are

Fig. C.



valuable tools. When opened in the manner here shown, they may be employed to mark off the centers of holes or to try if a center already existing is in the exact center of the hole. Or they will mark off a face, so that it will fit another face, whether it be regular or irregular, the curved point being kept against the irregular face, and the point describing (by moving the compass along) a similar line on the face to be fitted. They will answer for many of the uses to which a scribing block is put; and being lighter and more easily handled, and, furthermore, capable of doing duty without the use of a surface or scribing plate, they are in such cases far preferable.

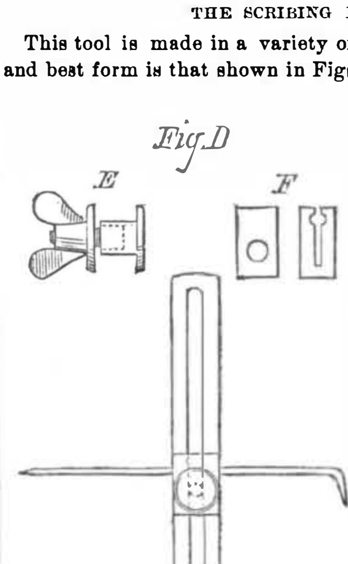
The legs may be crossed so that the curved point inclines to the straight point, in which position they will mark the centers of shafts or rods, either round, square, or any other shape, or try such centers, when they already exist, more accurately than can be done by any other tool. They will, in this case, mark off a line at the distance to which they are set, round any surface; they are employed to mark off keyways, or the taper of a gib when the key and one edge of the gib is placed, and for a variety of other uses too numerous to recapitulate, being among the most useful tools the fitter can possibly possess. The points of callipers should be tempered to a blue, and of compass callipers to a straw color.

THE SQUARE.

The square is too common a tool to require any description of its form. The best method to make one is to make the back of steel, and in two halves, one half being the thickness of the blade thicker than the other. The slot for the blade must then be filed in the thickest half, to the depth exactly equal to the thickness of the blade. The two halves composing the back must then be riveted together, and the edges surfaced each true of itself (using a surface plate to try them), and also true with each other. The blade, which should be made of saw blade, may then be put into its place, ready to have the holes for the rivets drilled. It should be placed so that the outer end is a little depressed (on the inside angle) from the right angle; this is done so that whatever there may be to take off the blade (after it is riveted to the back), to make its edges form right angles to the back, will require to be taken off the outer end of the inside angle and the end of the blade forming the corner of the outside angle, so that no work will require performing on the blade in the corner, formed by the blade entering the back on the inside angle, where it would be difficult to file or scrape without injuring the edge surface of the back. The best way to true a square is to turn up a piece of round iron equal in length to the square blade, being careful to make it quite parallel, and then true up the end of the iron, making it hollow towards the center, or cutting it away from the center to within an eighth of an inch of its diameter, so that it will stand steadily on its end. If the piece of iron be then stood on its end on a surface plate, its outline on each side, which represents its diameter, will form a true right angle to the surface of the plate, and hence a gage with which to true the square.

THE SCRIBING BLOCK.

This tool is made in a variety of forms, but the simplest and best form is that shown in Figs. D, E, and F. Fig. D is the block complete, the scriber being a simple piece of round steel wire. The dotted line on the foot is the distance to which the foot is hollowed out to make it stand firm. Fig. E is the bolt and nut; the bolt has a flat side filed on each side of it to fit it to the slot in the scribing block stem, so that the bolt cannot turn when it is being tightened. Fig. F is a face and edge view of the piece or clamp for the scriber which passes through the hole in the slot.



The advantages possessed by this form over other forms of scribing block are that it is easy to make, and that the scriber, being a piece of wire, is easily renewed. It holds the scriber very firmly indeed, and the scriber may be moved back and forth without the nut becoming slack, an object of great importance not attainable in the common form of this tool.

CHIPPING.

The chisel requires special notice, since it is frequently made of the most ill-advised shape (for either cutting smoothly or standing the effects of the blow), that is, hollow, as in Fig. 33, in which case there are two sections of metal, represented by the dotted lines, *a a*, which are very liable to break, from their weakness and from the strain outwards placed upon

Fig. 33.

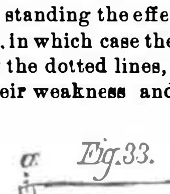
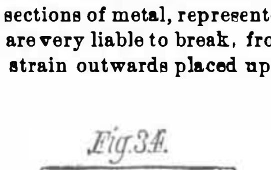


Fig. 34.



them by the cut, which, acting as a wedge, endeavors at each blow to drive them outwards instead of inwards, as would be the case in a properly shaped chisel, as shown in Fig. 34, *a* being the cutting edge.

When using, hold it firmly against the cut, and it will do its work smoother and quicker.

The cape, or, as it is sometimes called, cross-cut chisel, is employed to cut furrows across the work to be chipped, which furrows, being cut at a distance from each other less in width than the breadth of the flat chisel, relieve the flat chisel and prevent its corners from "digging in" and breaking. If a large body of metal requires to be chipped off cast iron or brass, the use of the cape chisel becomes especially advantageous, for the metal, being weakened by the furrows, will break away in pieces from the force of the blow, without requiring to be positively cut by the chisel; but care must be taken to leave sufficient metal to take a clean finishing cut, for when the metal is broken away, by the force of the blow, it is apt to break out below the level of the cut. It is also necessary to nick deeply with a chisel the outside edges of the work at the line representing the depth of the metal to be chipped off, so that the metal shall not break away at the edges deeper than the cut is intended to be.

FILING.

Large files should be fitted to their handles by making the tine of the file a low red heat and forcing it into the handle, so that it will burn its way into the handle, and thus prevent the handle from splitting, as it would do if the file tine were driven in; the file and handle should be turned in the hands occasionally to guide the eye in detecting whether the file is entering in a line with the length of the handle. Care should be taken to wrap a piece of waste around the end of the file, and to keep it wetted with water so as to avoid softening the teeth of the file while heating the tine. For small files, it is sufficient to bore a small hole in the handle and force the tine in by hand. A file should be held so that the butt end of the file handle presses against the center of the palm of the hand, the forefinger being beneath the body of the file handle.

In selecting a file, choose one that is thickest in the center of its length, and of an evenly curved sweep from end to end, so as not to make the surface of the work round by filing away the edges. Files that have warped in the hardening may be used on very narrow surfaces, or on round or oval work; or, if they are smooth files, they may be used on lathe work. Keyways or slots, especially, require an evenly rounded file; and if the keyway is long and the file parallel or uneven upon its surface, the end of the file only should be used to ease away the center of the keyway or the high spots. It is also highly advantageous to rub chalk on the teeth of the file, so that, after a little using, the eye can detect the part of the file which is highest, and govern its use accordingly.

Half round files should be rounded lengthwise of the half round side of the file, because it is difficult to file out a sweep evenly, even with a well shaped file, and it is impossible to do so with a file whose half round surface is hollow in the direction of its length.

These files must be used with a side sweep, caused by gradually bending the wrist at every stroke of the file, so that the file marks are not at a right angle to the curve, the sweep of the file being varied occasionally from right to left or from left to right, so that the file marks cross one another, otherwise there will be high ridges or waves in the curve.

In drawfiling, be careful to note the higher parts of the file and use them only for flat surfaces, also to clean the filings out occasionally to prevent scratches in the work, and to rub chalk upon the file, which will prevent the filings from getting locked in the teeth; then, after every few strokes of the file, brush the hand over it to loosen the chalk and filings, and strike it lightly against the screw box or other soft part of the vise, which is more expeditious than, and equally as effective as, using the file card every time; when, however, the file requires chalking again, which will easily become apparent, the file card may be advantageously applied before applying the chalk.

Rough or bastard files are used to take off metal in quantity; but if the surface of the work is unusually hard, a second cut file will better answer the purpose. For finishing work very finely, cross file it with a smooth file and then draw file it with the same; then cross file it with a dead smooth file, and draw file it with the same, using very short strokes of the file and applying chalk to it.

A worn dead smooth will finish finer than a new one, and better results will be obtained by finishing the work crosswise of the grain than in a line with it, because any inequality in the texture of the metal will usually run with the grain, and the file teeth will cut the softer parts more readily when following in their length than when merely crossing them.

EMERY PAPER.

In applying the emery paper, use at first No. 1 paper both along and across the work, and repeat the process with No. 0, No. 00, No. 000, or No. 0000, according to the fineness of the polish required, bearing in mind that, the more the emery cloth or paper has been used, the finer is the polish it will give, the reason being that it becomes coated with a glazed surface, composed of particles of the metal it has been rubbing; and all metals polish finer and brighter with such a surface than with any other. If the finer grades of emery cloth or paper cannot be readily obtained, take the finest grade at hand, and wear it down by using it on a rod or piece of metal in a lathe at a high speed, wiping the rod once during the latter part of the operation with a piece of rag or waste slightly oiled, which will cause the oil to pass to the emery paper, and the latter to retain the particles of metal upon its surface. If this method of polishing be carefully executed, the work may be kept very true and even, and possess a finer finish and polish than by applying oil stone or by any other known method.

Before commencing any piece of work, measure it all over; and if it has a rectangular part, apply the square to it so as to be assured, before any work has been done to it, that it will clean up to the required dimensions.

MANUFACTURE OF LAMP BLACK.—J. H. Bottenberg, Ravenna, O., provides a revolving cylinder, which is kept cool. Within is a series of gas jets, which deposit carbon on the interior of the cylinder, which carbon is removed by scrapers by the turning of the cylinder.