four being commonly employed. The sheets are wrapped so as to break joints around a cylinder, and the last one or shell is lapped and riveted. Then all are made into a solid cylinder by means of pure tin, which is melted and worked in from the inside with the aid of gas blowpipes. The heads are made of cup-shaped pieces of steel, placed one within the other and sweated together with tin. The lengths of the flasks vary from 7 to 4 feet, and the diameters are 12 inches along the body and 13½ inches at the heads. One flask which was tested to destruction gave way under a pressure of 3,136 lbs. per square inch. The total strains borne are calculated as follows: At 1,200 lbs., longitudinal strain, 19·104 lbs.; tangential strain, 38,800 lbs. At 1,365 lbs., longitudinal strain, 21,731 lbs.; tangential strain, 44,152 lbs.

Very probably it will yet be found that liquid carbonic acid will receive many applications as a source of motive power. It has only to be made cheaply, and it will be extensively used.

The Palace Hotel.

Visitors to San Francisco will hereafter be struck with a new and conspicuous feature in the face of the young giant town. Seven stories high, with a base of 96,250 square feet, at the corner of Market and New Montgomery streets, now looms up the Palace Hotel. Its huge brick walls are ribbed from top to bottom with tiers of bay windows, and spotted like the sides of an ironclad with bolt heads that clinch the great rods running over and under and through and through the building, making it a kind of Cyclopean open work iron safe, filled in and lined with fireproof brick, where all treasure of human life and limb should be secure against fire or earthquake while the Peninsula stands. It is, indeed, to this element of security that we would draw special attention, while so many buildings are going up today in our great cities, which are a disgrace in flimsy and tawdry pretension, and a danger in their inflammable and carelessly thrown together materials.

The whole work of constructing this hotel was done by the day's work and not by the piece, and so done carefully and well. Seventy-one partition walls of brick run from the foundation up through the roof, and two feet above it, and the roof is of tin. There are four artesian wells, two in each outer court, with a tested capacity of 28,000 gallons of water per hour. Under the center court is a 630,000 gallon reservoir, with walls of brick and cement five feet thick and buttressed. On the roof are seven tanks of boiler iron, with an aggregate capacity of 138,000 gallons. Seven steam pumps force this water through the whole house by a system of arteries and mains, with 392 outlets in the corridors, provided in each case with three inch hose, from 10 to 100 feet in length, with nozzles. Under the sidewalks without the building, there are eight four inch fire mains connecting with the city water, by means of which the city engines can, if found necessary at any time, force water into the hotel mains.

In every room and passage there is an automatic fire alarm, by which any extraordinary heat will be instantly and noisily known at the central office of the hotel; and six watchmen will patrol day and night every part of the structure, and touch, half hour by half hour, at seventy-nine stations, which will report by electricity and fix the place and time of a dereliction of duty.

Through the heart of the hotel from top to bottom runs a fire brick tunnel, within which is a solid brick and iron staircase opening on each floor. In five like tunnels are five elevators, run by hydraulic power, besides six additional stairways from garret to basement. Wood is avoided where possible. In the construction of kitchen, oven room, bakery, store rooms, steam pump room, water heating room, coal vaults, ash vaults and shafts, and corridors, wood is supplanted by asphaltum and marble, iron beams, and brick arches. If the Palace Hotel can burn, the lessons of Chicago and Boston are lost, and all human precaution is vain against fire in this year of our Lord eighteen hundred and seventy-five.

Architect J. P. Gaynor was instructed by the owners to travel and study the best hotels elsewhere before submitting his plans for the Palace Hotel, and Warren Leland—mine host of the old New York Metropolitan Hotel, of the Leland family, famous as hotel keepers—was appointed lessee of the house, and manager of all things. The sunning and ventilation of the 755 rooms for guests are excellent, every room opening on the open light, having a fire place, and a separate flue of four by eight inches running clear through to the roof. Every second room has a bath room attached, most rooms are twenty feet square, and none of a less size than sixteen by sixteen feet. Two thousand and forty-two ventilating tubes open outward on the roof of the hotel.

Three great cañons or courts, cut down from roof to base, air and lighten the mountain building. The center court measures 144 by 84 feet, is covered with glass, made brilliant by the lights of the pillared verandahs surrounding it, floor above floor; with a tropical garden, fountains, statues, an instrumental band of music in the evenings, and a circular carriage drive fifty-four feet in diameter. Opening upon this "garden floor" there is an "arcade promenade," four yards wide, with a show window looking on the promenade from each of the stores under the hotel. Letter tubes, pneumatic dispatch tubes, and electric bells knit all this miniature Palais Royal and the hotel into one body of wonderful life

Ministering to the 1,200 guests that can be accomodated are four clerks, two book keepers, a French head cook who is a brilliant particular star in his profession, five assistant cooks of rising name, and three specialists—namely, a chief confectioner from Milan, a chief baker from Vienna, and "Muffin Tom" from New York, an old negro the fame of whose egg muffins and corn bread has made him the aristocrat of his race for the last half century from Charleston to Long Branch. The 150 waiters are to be negroes also. Forty chambermaids and a host of Chinese will see that the beds and bed linen are white and fresh. This is the kind of hotel we keep in San Francisco.

From China and India and Japan a stream of invalids and visitors pours yearly in upon this city, the great sanitarium of the future for the languid oriental world. From the islands of the peaceful sea, from our own east and north, from Spanish America, a great host shall make a Babel of the Palace Hotel, whose builders have not been confounded. Its white towering walls, dotted with the gilded iron bolts that bind the great rods of the building together, shall be familiar to strange eyes from far lands. The sick down easter shall abandon his nutmegs of wood and satisfy his soul with the grapes and the oranges of our State; yellow aristocrats from Siam and tawny revolutionists from Bogota shall join hands and pass the sirup over the steaming triumphs of Muffin Tom.

We have seven big world wonders now: the Bay of San Francisco, the Central Pacific Railroad, the Big Trees, the Bonanza, Yosemite, the Geysers, the Palace Hotel—and Assessor Rosener.—*Overland Monthly.*

Scientific Courtship.

Young Molly met Christopher down by the farm,
With his analysis
And his catalysis
And his dialysis.
What would he do there!
He came down to woo there,
He came down to sue there,
To bill and to coo there,
Not to fill all her soul with alarm.

O! Science, 'tis thus that a fair maid you win,
With parthenogenesis
And alterogenesis
And heterogenesis
And other such things;
For Love, he has wings
And with him he brings
Full many such things
In the ears of fair maidens to din.

Young Christopher came with his finest brochures,
On trilobites
And troglodytes,
Theodolites
And such delights,
And he said, my dear, these are yours,
Yes, they're yours.
Love may come and love may go,
Science endures.

The heart is a stubborn thing,
And conical in shape;
A remnant which with us we bring
From our ancestral ape.
It drives the blood to Molly's cheeks,
She opens her ruby lips and speaks;
Her mitral valve plays
In the wildest of ways;
Her columna carnea,
Gives her an idea
By the way that it acts;
And, accepting the facts,
She then and there agrees to become
The partner of his scientific home.
—*Journal of Applied Chemistry.*

Correspondence.

Steam Boiler Phenomena.

To the Editor of the Scientific American:

In your article on this subject on page 193 of your current volume, you give a very interesting account of the result of injecting water into overheated boilers. The account is more valuable than usual, for the conditions seem to have been carefully observed and the results noted; and although, as you observe, they seem to be contradictory, I believe they can be explained.

In calore, vis—in heat is force or energy This has been for many years my maxim; and from this point, I will endeavor to explain the two phenomena.

In the first case, the boiler was absolutely dry, and heated to from 600° to 1,000° Fah., the steam pressure being 0. Water was injected, and the pressure suddenly rose to 190 lbs. per square inch. The conditions are then as follows: An unknown quantity of water is brought in contact with an unknown quantity of iron heated to from 600° to 1,000° Fah. If, now, the arrangement of the injection pipe and pump were such that 1 lb. water injected at the first stroke would come in contact with 9 lbs. iron heated to 600° Fah., the water would absorb the heat and cool the iron. The resultant temperature would be 300° Fah. As each square foot of the iron in such boilers weighs about 12 lbs., and as the water injected by the first stroke may, and usually would, come in contact with a much larger surface than 1 square foot to each lb. of water injected, it is evident that the water would be heated to a higher degree of temperature, and steam of a higher pressure would be formed. If the quantity of water injected is small, and the heated surface with which it comes in contact large, an enormous pressure can be suddenly created in a confined space. If, on the other hand, the quantity of water is large, and the surface of the iron with which it comes in contact small, the water will be heated less; and, if heated below the boiling point, no steam is formed, as the limit of the capacity of the water to absorb heat is not reached. If, therefore, the first boiler were set so that the injected water could spread over a large surface, a sudden and high pressure would be the result; and if set so that the water could come in contact with a small quantity of iron, that is, lower at the end at which the water is injected, very little pressure would be produced, and the heat in the iron would be gradually absorbed by the water without any injurious results.

In the second case, the conditions were similar, and "an independent pump was at hand, and was put on with a full supply of feed. The steam rose to 20 lbs. by the gage, and as suddenly fell, the steam gage indicating a complete or partial vacuum." Reasoning from numerous practical experiments, I conclude that, at the first stroke of the pump, a quantity of water was driven over sufficient surface to heat the same suddenly, and thus produce the steam pressure indicated by the gage; and the second or subsequent stroke injected a quantity of water into the steam, and condensed the same, thus producing a vacuum. If the feed end of the second boiler were lower (as it should be) than the other end, and the feed pipe entered the end of the boiler some distance above the plate, a full supply of water would produce this result.

If heat be force, a boiler heated to 1,000° Fah. contains an immense quantity of stored-up energy; and a quantity of water less than one tenth in weight of the heated iron will become the agent through which this energy is exerted, by absorbing the heat and being changed from a cohesive fluid to an expanding gas, and thus exert an enormous and (if suddenly liberated) dangerous force. When, however, the same quantity of heated iron is brought in contact with a much larger quantity of water, the great capacity of water for heat compared with that of the iron (12 to 100) will absorb the heat without producing even steam.

Experiments of the above kind should never be attempted, as it is criminal to thus risk life and property; the fires should have been hauled in both cases, and the boilers gradually cooled.

Boston, Mass. JOSEPH A. MILLER.

The Keely Gas.

To the Editor of the Scientific American:

In the communication headed "The Keely Gas," the author is laboring under some mistakes. I will endeavor to correct his statements.

He states: "It is well known that the molecules of all substances increase or decrease in size in proportion to the specific gravity of the substance, the lighter substance containing the larger molecules." I need hardly say that, if this were true, and were known to be true, it would at once dispose of the atomic theory.

As for his experimental proof: If (as I suspect) he uses oil as being lighter than water, I am not at all surprised at his result; for the adhesion of oil to a smooth surface is far greater than that of water; so that, on pouring on the oil, it would immediately flow to the glass and cause overflow of the contents. Your correspondent may try the experiment of filling two equal and similar glass vessels with oil and water respectively. He will find that he will be enabled to add more water than oil before overflow. Let him, however, use absolute alcohol (specific gravity 0·8), and he will find that, to two similar glassfuls of water, he will be able to add more alcohol than water before overflow.

In the case of heavy liquids, the heavier the liquid, the greater the volume which may be added without altering the apparent volume. Let him try mercury, and the result will be the same as if he had added an equal volume of water.

In his last paragraph he says: "For it is plain that it would be impossible for the larger atoms of molecules of the cold vapor to pass between the smaller molecules of metal.' However, unfortunately for this conclusion, it is known that hydrogen penetrates iron, that the products of combustion in a stove pass through the iron casing, and that gold is pervious to water.

I do not intend this to be in any way a defence of the Keely motor. W. B. M.

Hoboken, N. J.

A Water Motor.

At the Sulzbach Altenwald Colliery, near Saarbrucken, Prussia, machinery has been established for the transmission of power from a steam engine at the surface, by a column of water circulating under pressure, the circumstances of the case not admitting of the establishment of a direct-acting steam pump under ground. The mine is sunk 306 yards below the surface. The piston rod of the high pressure engine above is connected with the pressure plungers, each of which plungers is connected with the underground engine by a tube filled with water. The last mentioned engine consists of four pressure pumps arranged in pairs, and between each pair is placed the working plunger of one of the mine pumps. When the engine on the surface acts, the power is transmitted by one pressure plunger through one water tube to a pair of pressure pumps under ground, and thence to one working plunger, which either aspirates or forces air, according to its position. The opposite pair of pumps and connections work conversely. The water is forced into an air vessel, and thence through the rising main 303 yards in hight, in one lift to the surface. On the change of stroke, the water in the cylinder of the pressure pump rises in the second water tube and follows the retiring pressure plunger at the surface, the power supplied by the descent of water in one column being sufficient, with the exception of a slight allowance for friction, to effect its return in the other. If the cataract pauses of the engine at the surface are not too long, the discharge is practically continuous. *The Engineering and Mining Journal*, from whose translation of the German description we condense the above, adds that, at the Phœnix mine in Cornwall, England, an arrangement of simi lar description, consisting of a plunger attached to the main pumping engine, connected by a length of tube with a water pressure engine in another shaft, has been at work for the last ten years

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

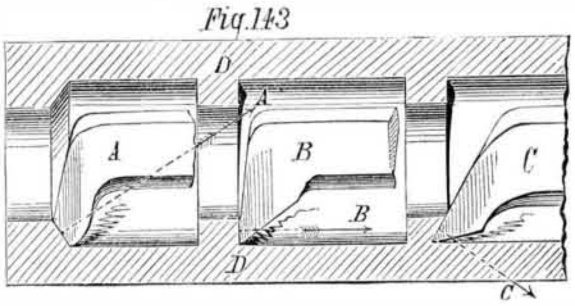
NUMBER XXXIII.

BORING TOOLS FOR LATHE WORK.

Boring tools for use on lathe work require to be shaped with greater exactitude than any other lathe tools, for the reason that they are slighter in body in proportion to the duty required of them than any other; and as a rule, the cutting edges standing further out from the tool post or clamp, the body of the tool is more subject to spring from the strain of the cut. It is obvious that, if the hole to be bored out is a long one, the cutting edge of the tool will become dull at the end of the hole as compared to what it was at the commencement (a remark which, of course, applies to all tools); but in tools, stout in proportion to the duty required of them, and held close in to the tool post, the effect of the slight wear of the cutting edge, due to a finishing cut, is not practically appreciable. In the case of a boring tool, however, the distance of the cutting edge from the tool postrenders the slightest variation in the cutting capability of the tool sufficient to affect the work, as may be experienced by boring out a hole half of its length, and then merely exerting a pressure on the body of the tool, as near the entrance of the hole as possible, with the fingers, when the size of the last half of the hole will be found to have varied according to the direction in which the pressure was placed. As a result of this extreme sensitiveness to spring, the tool is apt to spring away from the cut as the boring proceeds, thus leaving the hole smaller at the back than at the front end. To remedy this defect, several very fine finishing cuts may be taken; but a better plan is to so shape the tool that its spring will be in a direction the least liable to affect the size of the bore of the work.

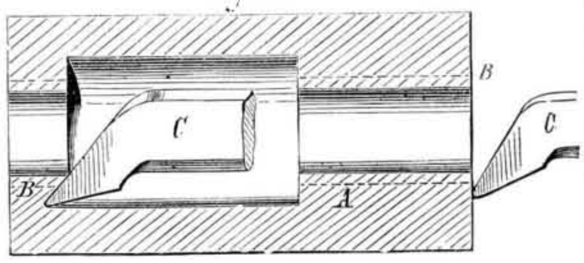
The pressure on the cutting edge of a tool acts in two directions, the one vertical, the other lateral. The downward pressure remains at all times the same; the lateral pressure varies according to the direction of the plane of the cutting edge of the tool to the line or direction in which the tool travels: the general direction of the pressure being at a right angle to the general direction of the plane of the cutting edge. For example, the lateral pressure, and hence the spring of the various tools, shown in Fig. 143, will be in each case in the direction denoted by the dotted lines. D is a section of a piece of metal requiring the three inside

Fig. 143

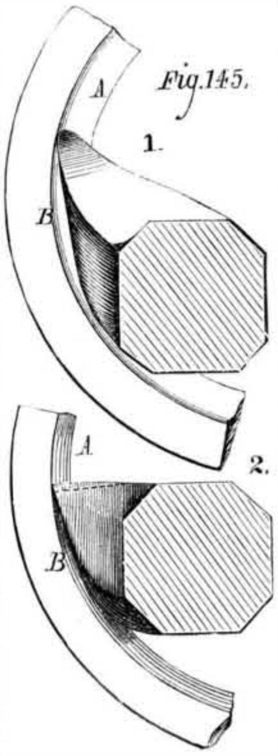


collars to be cut out; A, B, and C are variously shaped boring tools, from which it will be seen that A would leave the cut in proportion as it suffered from spring, which would increase as the tool edge became dull, and that the cut forms a wedge, tending to force the tool towards the center of the work. B would neither spring into nor away from the cut, but would simply require more power to feed it as the edge became dulled; while C would have a tendency to run into the cut in proportion as it springs; and as the tool edge became dull, it would force the tool point deeper and deeper into the cut until something gave way. Now, in addition to this consideration of spring, we have the relative keenness of the tools, it being obvious at a glance that (independent of any top rake or lip) C is the keenest, and A the least keen tool; and since wrought iron requires the keenest, cast iron a medium, and brass the least keen tool, it follows that we may accept, as a rule, C for wrought iron, B for cast iron, and A for brass work. To this rule there are, however, variations to be made to suit exceptional cases, such for instance as when a hole terminates in solid metal and has a flat bottom, in which case the tool, B (slightly modified towards the form of tool, C), must be employed. Or suppose a hole in cast iron to be, as is often the case, very hard at and near the surface of the metal. Tool, A, would commence cutting the hard surface and, becoming dull, would spring away from the cut in spite of all that could be done to prevent it; while tool, B, would commence to cut both the hard and the soft metal together, the cutting edge wearing rapidly away where it came into contact with the hard surface of the metal; and these conditions would, in both cases, continue during the whole operation of boring, rendering it difficult and tardy. But if the tool, C, were employed, the point of the tool would commence cutting the soft part of the metal first, and would undermine the hard surface, and (from the pressure) break it instead of cutting it away, as shown in Fig. 144, in which A represents a piece of metal to be bored, the bore being hard to the depth of the dotted lines, B. C is the tool shown as it would commence to cut, and also as it would operate while in full operation. After the hard surface is removed, tool B, in Fig. 143, may be employed to finish the boring, the point being ground a little more rounded. The objection to tool, C, in Fig. 143, for employment upon cast iron or brass, is that, in consequence of its excessive keenness, it is liable to jar or chatter. Tool, B, in Fig. 143, may be given top rake and employed to cut out a square corner, or it may, if not ground too keen, be used upon brass; but it is liable, in such case, to jar or chatter, unless the top face is ground away. Here, then, we come to the consideration of top rake, that is, the shape of the top face of the tool, our previous remarks hav-

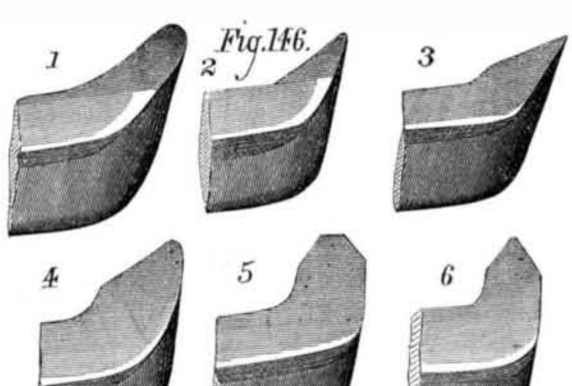
Fig. 144.



ing had no reference to that part of the subject. The application of top rake or lip to a boring tool lessens the strain due to severing the metal; by presenting a keener cutting edge, it lessens the tendency to lateral spring, and increases that to vertical spring, and is beneficial in all cases in which it can be employed. Upon wrought iron and steel it is indispensable; upon cast it may be employed to a limited degree; and upon brass it is inadmissible by reason of its causing the tool to either jar or chatter. In Fig. 145, B represents a section of the work, No. 1 represents a boring tool with top rake, for wrought iron, and No. 2 a tool without top rake, for brass work, which may be also used for cast iron when the tool stands a long way out from the tool post or clamp, under which circumstances it is liable to jar or chatter. A tool for use on wrought iron should have the same amount of top rake, no matter how far it stands out from the tool post; whereas one for use on cast iron or brass requires to be the less keen the further it stands out from the tool post. To take a very smooth cut on brass work, the top face of the tool, shown at 2 in Fig. 146, must be ground off, as denoted by the dotted line.



We have now to consider the most desirable shape for the corner of the cutting edge. A positively sharp corner, unless for a special purpose, is very undesirable, because the extreme point soon wears away, leaving the cutting qualification of the tool almost destroyed, and because it leaves the work rough, and can only be employed with a very fine feed. It may be accepted as a general rule that, for roughing cuts, the corner should be sufficiently rounded to give strength to the tool point; while, in finishing cuts, the point may be made as round as possible without causing the tool to jar or chatter. Now, since the tendency of the tool to jar or chatter depends upon four points, namely, the distance it stands out from the tool post, the amount of top rake, the acuteness or keenness of the



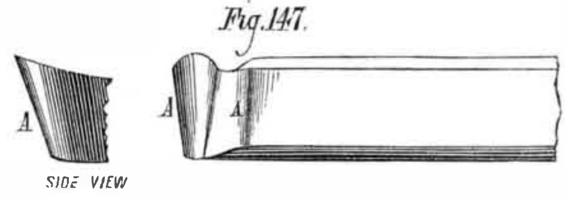
general outline of the tool, and the shape of the cutting corner, it will readily be perceived that considerable judgment is required to determine the most desirable form for any particular conditions, and that it is only by understanding the principles governing the conditions that a tool to suit them may be at once formed. In Fig. 146 will be found the various forms of boring tools for ordinary use. No. 1 is for use when the conditions admit of a heavy cut on wrought iron. No. 2 is for use on wrought iron when the tool stands so far from the tool post as to be necessarily subject to spring. No. 3 is to cut out a square corner at the bottom of a hole in wrought iron. No. 4 is for taking out a heavy cut in cast iron. No. 5 is for taking out a finishing cut in cast iron when the tool is proportionally stout, and hence not liable to spring or chatter: the point being flat, the cutting being performed by the front corner, and the back part being adjusted to merely scrape. No. 6 is for use on cast iron under conditions in which the tool is liable to jar or spring. No. 7 is for taking out heavy cuts in brass when the conditions are favorable. No. 8 is for brass work, either roughing out or finishing, when the tool stands far out from the tool post, or is slight in proportion to its duty. No. 9 is for taking out a sharp corner in brass work. No. 10 is an end view of No. 7, and No. 11 an end view of Nos. 8 and 9. The tools for wrought iron will answer equally well for steel or for copper.

An inspection of all these tools will disclose that the tool point is more rounded for favorable conditions, that is, when the body of the tool is stout, and the cutting edge is not held far out from the tool post; that, to prevent jarring, the point of the tool is made less round, which is done to reduce the cutting surface of the tool edge (since it is apparent that, with a given depth of cut, the round pointed tool will present the most cutting edge to the cut); and that, to further prevent jarring or chattering, the leading part of the cutting edge is ground at an angle; while, as another precaution against that evil, the general form of the tool is varied from that of tool, C, in Fig. 143, towards that of tool, A, in the same figure; while for brass work, no top rake or lip is employed, but the tool is beveled off to suit those cases in which it is liable to excessive spring. It is obvious that the feed may be coarser for a round-nosed than for a more acute tool, and that, the rounder the nose, the smoother the cut (with the same rate of feed) will be.

All boring tools for heavy duty may be hardened right out, that is, not tempered at all, while those slight in form at the cutting edges should be tempered to a straw color.

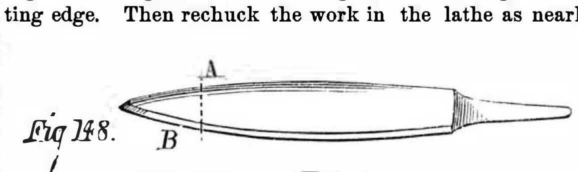
The side faces of the tool marked A, in both views of Fig. 147, may be beveled just sufficiently to well clear the feed of

Fig. 147.



the cut when used on wrought and cast iron, and ground further back, that is, with more angle, for use on brass, especially if there is a tendency to jar or chatter. The straighter, however, these side faces can be kept, the better the cutting edges are supported by the metal behind them, and the longer they will stand without regrinding. When boring light brass work, it is well to hold a brush near the entrance of the hole, to prevent the turnings from flying about the shop; while cutting tools for outside brass work may have a split leather washer forced over the body near the cutting end for the same purpose. After a piece of brass or cast iron work has been bored and taken out of the lathe, and is found on trial to fit a little too tight, it may, if it is difficult to chuck it true again, be eased by a half round scraper, as follows: Take an old half round smooth file and grind the edges at an angle, as shown in Fig. 148, B forming the cutting edge. Then rechuck the work in the lathe as nearly

Fig. 148.



true as possible, and revolve the work at such a speed that the scraper will cut at about 380 feet per minute; then apply the scraper by hand in the position shown in Fig. 149, A A representing the work revolving in the direction denoted by the arrow, and B the scraper shown in section. If the flat face and the beveled edge of the scraper is ground true and even, and care is taken in using it to take out the metal only where required, this tool will perform excellent duty and cut very smoothly. It may be also used to advantage to ease out by hand the narrow places of a hole that is oval, or the small end of one that is taper and requires to be made parallel. The smoothness of its work is much improved by smoothing its edge upon an oilstone. Here it may be well to state that the application of an oilstone to the cutting edges of a boring tool increases its tendency to chatter; if, therefore, a hole requires to be made unusually smooth, the tool must be given less top rake and may then be oilstoned. In many cases a tool may be prevented from chattering by holding it with the fingers as near the entrance of the hole as possible.

Fig. 149