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Contents:

(Illustrated articles are marked with an asterisk.)

Subscriptions to our new Volume are pouring in from every direction far beyond our expectations, and we desire to thank our host of friends for their very generous co-operation in promoting our circulation, which is now much larger than at any time since the SCIENTIFIC AMERICAN began its existence. We shall endeavor not to disappoint the expectation of our readers. Five Editors are constantly employed on the Scientific, Mechanical and Literary departments of the paper, and are prepared to discuss all questions that belong to the character of the paper, in a plain practical manner.

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Owing to the great number of claims of patents—covering about six pages—we are compelled to issue with the present number a four-page supplement. We would have gladly avoided the trouble and expense attending the supplement, but we did not feel willing to deprive our readers of the amount of excellent matter which will be found in this issue. The list of claims embraces the issues of two weeks; something that is not likely to occur again this year.

HANDLES---THEIR VARIETY AND ADAPTABILITY.

Does any one who uses some of the multifarious tools which pertain to the manipulation of the mechanic arts—to labor in all its branches—ever note the almost infinite variety of the appendages adapted to them to fit them for effective use? The handles differ as widely as the tools themselves. Without noticing the different manner in which the tools are attached to the handles, the variety in form and structure of the handles themselves, is surprising. Many of these appendages show plainly the object of their peculiarities. For instance, the scythe snath has a very crooked appearance viewed as a piece of timber, but every curve has its object. Where the handles proper are attached, it approaches a horizontal, when in use. Below the lower handle it descends at an angle, with a curvature intended to present the blade to the grass near the ground and to swing clear of the body in using. A straighter snath would compel the mower to stoop uncomfortably and add greatly to his labor.

Some handles are long, as that of the hand rake and hoe; others short, as the ax, the hammer, the mallet. But each one has its peculiarities. The handle of the carpenter's hammer is very different from that of the machinist's hammer. Those not acquainted practically with the details of the business of the carpenter and joiner and of the machinist, might not be able to distinguish, at first sight, in what that difference consisted. The carpenter's hammer is used for driving nails into a readily yielding substance. The handle is rigid; it gives a dead blow. The machinist's hammer is used on comparatively unyielding substances. If rigid it would jar and partially paralyze the muscles of the arm. For "chipping"—cutting iron by means of a cold chisel—the blow is received on the end of a steel chisel and transmitted through it to the rigid surface of wrought or cast iron. It may be called a spring blow. Soon as the hammer face strikes the chisel head it rebounds. All good chippers understand the necessity of having the hammer handle elastic. To produce this proper elasticity and graduate it exactly to the work to be performed, the workman will sometimes spend hours in rasping, scraping and sand-papering the wood. The blacksmith's hammer, on the contrary, has a stiff, unyielding handle, although used on the same material as that of the machinist. But in this case the material is soft and malleable.

Why do the handles of the sledge and the ax so widely differ in form? The ax may be nearly as heavy as a light sledge hammer and the handles of about the same length, but in no other respect have they any similarity. The sledge handle is straight and the ax handle curved. But the sledge and ax are not only used on different substances, but in a different manner. The striker grasps his sledge, one hand at the end of the handle and the other advanced, holding each to its place while the blow is delivered. He does not change the relative positions of his hands in striking. Even in delivering a swinging blow both hands remain together at the end of the handle. But see how the wood chopper handles his ax. With one hand at the end and the other in advance he swings his ax, bringing the advanced hand, with a quick, sliding movement, back to the end hand as the ax descends. Only women, unaccustomed to the ax, use it as the striker does the sledge. Now we see the reason of the downward, inward curve of the ax handle. The curve facilitates the downward movement of the hand by making the position of that portion of the handle more perpendicular as the blow is given. It is notorious among blacksmiths that the country lad, accustomed to the use of the ax, requires long practice and repeated instructions before he becomes a good striker. We recollect a laughable incident, that was nearly a serious accident, in illustration. A farmer's boy in a smith's shop was requested to aid in "upsetting" a bar at the end, the bar being laid across the anvil and held by the forger. He gave a blow ax fashion in this unusual, horizontal manner, and missing the bar, struck the stooping blacksmith full in the forehead, instantly "upsetting" him.

The advantage of a handle adapted to the work to be performed is exemplified in the difference between that of the modern shovel and spade, and that of the ancient mattock, or a spade of fifty years ago. This last was perfectly straight with a cross piece at the end. Being straight, the labor of pressing the blade into the soil was greater than it is with a curved handle, as the hand and foot were compelled to act in the same line. Besides, to retain the load on the spade or shovel, or to carry it, required a very strong grasp to prevent tilting. The downward curve of the shovel handle raises the point of suspension of the load, so that the center of gravity falls below the lifting force. The wooden grain shovel with its spoon-like scoop is a case in point. The advantage of this position of the load beneath the point of suspension can be easily tested by attempting to carry a shallow pan full of water by grasping the rim and a pail filled by using the bail.

Real science is shown as much in the form and adaptability of handles as in any mechanical device; and science is necessary: for if we examine the simple tools of savage peoples we shall see that it is not often the handles are well adapted to the work for which the tool is designed.

REMEDY FOR SMOKY AND DANGEROUS FLUES.

We are under obligation to Dr. Alex. H. Stevens of Huntington, L. I., for valuable suggestions relative to the construction of chimneys and fire flues in buildings. Most fires originating in flues, may be referred directly to the unphilosophical shape in which they have been constructed from the first, in deference to the rectangular form of bricks, and with the object of flattening them into thin walls. A given area for draft is obtained, by this form, with an excessive inner surface of masonry to abstract the heat of the ascending draft and thus diminish its force. At the same time, the corners, detaining warm air by their frictional resistance, invite counter currents of fresh air down the chimney, which not only diminish the draft proper, but increase the danger from the detention of fire, and materially assist combustion within the flue whenever a heated beam is ready to receive oxygen and burst into flame. Worst of all, the broad flat flues cannot well be avoided far enough by the timber ends set in the wall, to prevent frequent fires from their close proximity to the hot draft.

Dr. Stevens has constructed the fire flues of a number of dwellings with reference to these considerations, and as he informs us, with remarkable success. His flues were made in the form affording a given draft area with the least inner surface to abstract heat and oppose frictional resistance to the draft; leaving no corners as channels for counter currents; from each of these causes giving better draft with flues of less size; and by the size and shape of the flues permitting the floor timbers to be inserted in the wall at a safe distance from their inner surface. This form, it is unnecessary to state, is cylindrical. His experience indicates that eight inches would be sufficient diameter for the largest flues, while six-inch and even four-inch flues of this form, for ordinary dwellings, will give better drafts than those generally in use. An arrangement of three six-inch flues for one chimney, allowing four-inch timbers with the corners bevelled off to be set four inches into the wall between them, at a distance of six inches from each flue, would require an enlargement of the wall to twelve or fourteen inches in thickness, for a breadth of not more than three and a half feet. The expense of constructing a cylindrical flue need be no greater than that of a rectangular one: the mason needs nothing more than an old joint of stove-pipe to work around.

A simple contrivance for at once strengthening the draft of a smoky chimney, and so applying abundant fresh air as neither to exhaust that in the room nor reduce its temperature, was observed by Dr. Stevens in Paris when a medical student there, as long ago as 1812. It is called a *ventose*, and is nothing more than a tube of properly adjusted diameter, let down the chimney from a hole in its side near the roof, and opening directly under the fire. The descending current of cool fresh air supports a vigorous combustion, and leaves the atmosphere of the room undisturbed by currents, for the use of the occupants.

ANOTHER GREAT WORK PROJECTED.

Damming the St. Lawrence, is the topic of the day with the citizens of Montreal. Monstrous as the undertaking seems, engineers have laid it out, and capitalists are about to apply to parliament for a charter incorporating a capital of two millions of dollars for the purpose. It is needless to remark that the waterpower to be obtained by a successful accomplishment of this work would be many times greater than any other in the world, and could not fail to build up a mighty manufacturing metropolis around the present nucleus called Montreal. At the same time, the city would acquire what it must soon have by some means, a head of water and a pumping power adequate to its own supply.

The arrangements of nature to facilitate the gigantic work, are quite interesting. The Lachine rapids, just above the city, are said to afford a fall of twenty-five feet in about a mile. They are divided longitudinally by a series of islands running their entire length, and forming with the northern bank of the river a natural enclosure, lacking only the proposed dam at its lower end to make an enormous basin and to convert the rapids into a smooth mill-pond or rather lake, with a semi-Niagara at its outlet, and a hydraulic power estimated as two millions of horses. There is also another natural channel running between the islands, which admits of being made into a mill-stream of seventy-five thousand horse power. To complete the work of nature in this way, requires a dam two thousand eight hundred feet in length, leaving the southern and only navigable channel open for commerce, and the shoal rocky bed of the river below the dam, besides the shore, for the accommodation of a city of mills and factories. A great canal is also to be led inland from the new lake, to supply other factories and conduct an abundance of water to the city.

EXPLOSIONS FROM OVERHEATING BOILERS.

We have a communication from an able correspondent relative to the causes of steam boiler explosions, in which he reckons the following as a prolific cause: "The sudden formation of steam caused by a change in the position of the boiler, the sudden starting or stopping of a locomotive, the rolling of a steamer, or any sudden shock given the boiler. This formation of steam is caused by the water in the boiler being thrown suddenly on the sides of the boiler not before covered by water. An immense volume of super-heated steam is thus formed, as it were in an instant, exerting a greater pressure than that which the boiler is calculated to withstand."

We do not entirely agree with our correspondent in his views. If they were correct, explosions of the boilers of sea-going steamers should be much more frequent than they are. An article in the London *Mechanics' Magazine* puts the subject in a more reasonable light, we think. This article says:—

A great number of boiler explosions are attributed to overheating: in fact some theorists go so far as to assume this as the general cause of such catastrophes. Now this theory, taken in a broad sense, is a false one, although it is possible that a boiler may be exploded by the formation of a great quantity of steam from water thrown upon red-hot plates. But a consideration of some of the phenomena of heat places this possibility at the farthest limit, and the occurrence of an explosion from such a cause only just within its bounds. We quench the heat of a railway tire in a cistern, and why may we not as safely fill a red-hot boiler with cold water? It is surprising to see how small a quantity of steam is disengaged when a large body of wrought iron is plunged into twice or thrice its weight of cold water. Now if we reverse the operation and dispose the same weight of metal in the form of a boiler, heat it to the same degree, and throw the same quantity of cold water into it, is it not reasonable to expect that exactly the same amount of steam will be produced? If so, where would be the harm done to the boiler beyond the damage inflicted upon the iron by burning?

If we look into the matter a little more closely, we shall find that the metallic plates of a steam boiler are not capable of containing sufficient heat to change a very large quantity of water into steam. The total quantity of heat which would raise the temperature of 1 cwt. of iron through one deg. would, according to the best authorities, impart the same additional temperature to 12 1-2 lbs. only of water. And this makes it clear that overheating is not the sole cause of an explosion, although it may lead to a rupture by weakening the plates.

The writer fortifies his position by the following account of an experiment:—

An empty boiler 25 feet long and 6 feet diameter, and with the safety valve loaded to 60 lbs. per square inch, was made red hot. While in this condition the feed was suddenly let on and the boiler filled up. The experimenters expected a mighty explosion, for which they were fully prepared, but no such event occurred, the result being simply a sudden contraction of the overheated iron, which allowed the free escape of the water at every seam and rivet as high as the fire mark extended. Although we were not witnesses of the occurrence, yet arguing upon the hypothesis regarding the action of heat already referred to, we cannot hesitate to accept the fact; the more so in that we have heard of other experiments of a similar character having been made, and which were attended with similar results.

Charles Wye Williams maintained that steam in a boiler under pressure is as much in the water itself as in the steam space. He contended that in the case of an explosion the globules of steam contained in the water and confined by pressure in a medium over eight hundred times denser than the steam alone, fly into the steam space when the pressure is removed, and expand in volume in proportion to the density of the two mediums, or over eight hundred times. The *Mechanics' Magazine*, however, adopts the theory of Mr. Zerah Colburn, and says:—

In all boiler explosions, the pressure of steam is instantaneously liberated from the surface of the hot water present

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Assuming the boiler to be at work at a pressure of 45 lbs., the water will be at a temperature of about 290 deg. Now fresh water cannot for an instant be maintained at a temperature much greater than 212 deg., under the ordinary atmospheric pressure. If, therefore, the pressure upon it be suddenly liberated when heated to (say) 290 deg., a most violent disengagement of steam, and projection of water along with it, must inevitably take place. The shells of boilers are constantly liable to rupture from original unsoundness of the iron, bad riveting, corrosion by bad water, or furrowing. This being the case what are we to expect when the opening of a weak point suddenly liberates the steam pressure from 30, 40 or even 60 tuns of heated water, which are waiting below to burst partly into steam? To render the matter perfectly intelligible, we will state the distinct and consecutive operations into which, according to Mr. Colburn, a boiler explosion, although practically instantaneous, may be resolved. They are first, the rupture, under hardly if any more than the ordinary working pressure, of a defective portion of the shell of the boiler—a portion not much, if at all, below the water line. Second, the escape of free steam from the steam chamber, and the consequent removal of a considerable part of the pressure upon the water, before its contained heat can overcome its inertia and permit the disengagement of additional steam. Third, the projection of steam, combined, as it necessarily must be, with the water, with great velocity, and through a greater or less space, upon the upper sides of the shell of the boiler, which is thus forced completely open, and perhaps broken. Fourth, the subsequent disengagement of a large quantity of steam from the heated water now no longer confined within the boiler, and the consequent projection of the already separated parts of the boiler to a greater or less distance. This unique theory harmonises so well with the circumstances of steam boiler explosions, that we can admire and accept it. It is so consistent with all the phenomena attending these explosions that it leaves no room for doubt or questioning as to its soundness. It receives support from the well-known fact that boiler explosions frequently take place at the starting of the engine, when there is a sudden withdrawal of pressure in the boiler. The most conclusive evidence of the soundness of the theory, however, would be suddenly to condense steam in the steam chamber of a boiler at work, and to watch the results. If a boiler were half filled with water, and the steam got up to 30lb. or 40lb., and if a quantity of water were suddenly thrown into the steam space, the steam would be suddenly condensed, and an explosion of the boiler would doubtless follow. Such an experiment would of course be attended by considerable danger, and the object gained would probably after all be very inadequate to the risk involved. It seems to us, however, that the question has just been practically solved, and the only evidence wanting actually supplied, although under most distressing circumstances. We allude to the recent loss of the *Ceres*, in the reports of which catastrophe it is stated that the sea rushing suddenly in upon the boilers caused them to burst with fearful results. If this be correct—and all accounts agree upon the point—here is a singular though melancholy confirmation of Mr. Colburn's theory. The cold water suddenly cooled the boiler plates, condensed the steam in the steam space, relieved the pressure on the lower part, and forthwith the steam and water from below burst forth with resistless energy upon their errand of destruction.

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THE COTTON MANUFACTURE---CARDING AND DRAWING.

In our last issue we traced the manufacture of cotton from its gathering to its preparation for carding, describing the preliminary process, intended mainly for cleaning it from foreign substances.

The next process is the carding. The cotton as it comes from the picker is wound, as a bat, on a core of wood. It is of a width calculated for the carding machines upon which it is to be placed. The "lap", as it is called, is placed in a frame over rollers which insure its rotation, the lap being guided by the journals of the core, in slots made in side pieces attached to the carding machine. The lap is fed into the card by fluted rollers as in the "picker," and is received by a small cylinder called the "licker-in," which is covered with card—fine wire teeth held in leather. This cylinder revolves with great rapidity, taking the fibers of cotton as presented by the lap and depositing them on the teeth of a large cylinder similarly covered with card. This larger cylinder is enclosed in a frame that supports on it, for about one-third of the circumference of the cylinder, cross lags of wood, having on their inner surfaces a layer of card, the teeth of which are bent in a direction contrary to the revolution of the cylinder. These lags are removable, being held in place by pins and adjusted to hight by set screws on which their ends rest. They must be often cleaned from the coarse and dirty fibers, which is done by an operative called a "stripper," who lifts the lags and with a hand card removes the accumulation of dirty cotton. The centrifugal motion of the large cylinder throws the heavy particles of dirt to the outside, and what is not deposited on the claw-like teeth of the lags is left in a receptacle under the cylinder. All this is "waste," of a dark gray color and filled with dust. It is used for the manufacture of coarse bagging and for similar purposes.

In the front of the carding machine and in close connection with the surface of the large cylinder is a smaller cylinder, larger however than the "licker-in," and called the "doffer," because from that the cotton is delivered after being carded. This delivery is effected by the action of a vibrating bar, armed with saw teeth, which has a vertical and horizontal movement by the action of a crank. This "comb" takes the film of cotton from the surface of the "doffer" and throws it down into a flat funnel that delivers it in an endless cylindrical belt, under a roller actuated by an endless belt, on which the cotton travels to its debouche at the end of the train. Usually this train of cards consists of a number of machines—a dozen or thereabouts—each in its own action independent, but in the delivery of their products acting in harmony. These streams, one from each card, meet and mingle together and debouch at the end of the train between iron rollers which compress them together into two flattish ribbons of white cotton.

But this product must be again submitted to the operation of carding. To do this the ribbons are combined in another "lap," by means of a winding machine, technically denominated a "lapper," and then are placed into another set of cards called "finishers," the first being known as "breakers." In these no rollers are necessary to give rotation to the "lap," as the ribbons of which it is composed have considerable tenacity and can turn the "lap" by their own strength, as it is gradually drawn into the card by the fluted feeding rollers.

The operation on the "finishers" is precisely or very nearly like that on the "breakers," and the result is similar, the cotton being delivered in ribbons, but much purified by this second operation. It looks beautiful as it pours from between the rollers at the end of the train of cards in an endless stream of snowy purity.

Now comes an operation which acts directly upon the fibers. Hitherto the object of the different processes—differing only as regards the means used, but all aiming at one result, the cleaning and purifying the material—has been to fit the cotton for its ultimate work. Now it is to be tested as to its tenacity. Machines called "drawing frames" do this work. The cotton in deep cylindrical cans is placed in front of the "drawing frames." It goes through rollers which deliver it to another series of rollers, revolving at an accelerated speed, thus drawing out the fibers and depositing the cotton in semi-cylindrical ribbons in other cans. This process is repeated on additional "drawing frames" until the cotton is drawn into delicate strips of perhaps an inch or less in width The union of the ends of the ribbons, as they empty from the cans, is readily secured by rolling them together with the hands, the union being facilitated by a slight moisture on the fingers.

In this form of a slight, untwisted ribbon, it is placed at the "speeder" or the "jack" to be drawn and slightly twisted into "roving." The "speeder," of which there are several varieties, is only a modification of and an improvement upon the "drawing frame." Neither the "drawing frame" nor the "speeder" are intended to clean the cotton: that has been done by the "picker" and the cards. The object of these is to straighten and thus elongate the fibers, and reduce the cotton in proper form for the spinning operation. The "roving," when prepared for the "mule" or the "spinning frame," is a slightly twisted thread of cotton about the diameter of a straw, wound on bobbins adapted in form to the machines upon which it is to be spun.

All these preliminary processes must be watched with great care. If the lags on the cards are too high above the cylinders they do not properly cleanse the cotton, and specks and knots and dirt in various forms combine with the product, and do not leave the material in all its future processes but show their injurious presence in the finished cloth or the thread, as the case may be. The carding department is by all odds the most important in a cotton factory. The card teeth may become dull and straightened, and it is a great responsibility to keep them in proper shape. At times they must be ground and inclined to the proper angle. This is effected by the operation of a cylinder covered with emery revolving against the surface of the cylinders of the carding machine. No less important are the results of the drawing machines. Changes of gears are provided for the sections of rollers which "draw" the cotton as it passes through, so that the weight of a given amount of cotton can be tested, and its proper "drawing" secured at any time, to insure a grade suited to the yarn that is to be spun.

In our next we shall take up the process of spinning into yarn.

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[For the Scientific American.]

STOVES VS. GRATES---FRICTION NOT A FORCE.

BY PROFESSOR CHARLES A. SEELY.

STOVES VS. GRATES.

I desire to give my voice very distinctly in favor of stoves. All my considerable practical experience, and all the science I can bring to bear, unequivocally urge me to the decision I have made. Grates ought to be considered relics of the past: at the best they are only compromises between the vast fireplaces of the last century, and the perfected plans for warming houses of the present day. The advocates of grates are generally either very old fogies whose sympathies cling to what is antiquated and musty or misinformed sanitarians, whose theories are inspired by their own infirmities. But all this is not argument.

Stoves are more economical of fuel. This proposition, perhaps, was never doubted, yet I find few people who know how great the saving actually is. At least nine tenths of the heat from a grate goes up the chimney: of what earthly use to mankind are these nine tenths? I have recently made a practical test at my own house. I have two rooms of equal size, and similar in other respects; but one is warmed by a grate, the other by a stove. I find that the stove does better service than the grate with less than one fourth the fuel. A stove will generally pay its cost in a single season. The saving in kindling wood is a small item, but in the city it amounts to some dollars in the course of a winter, when a stove is used which keeps the fire all night. It is a common thing to have a stove running for weeks without ever lighting the fire.

The stove is more cleanly. All the coal, ashes, smoke and dust are snugly corked up in the stove, while the grate being open to the room, all of these have frequent chances of getting where they are not desired. The dirt from a grate ought to be intolerable to the tidy housewife.

Grates are more dangerous on account of fire, and require more attention and labor to operate them and keep them going. It is never safe. night or day, to leave the fire in a grate. The labor of carrying coal and ashes is something formidable, especially when it is to be performed by women, and the grate is up several flights of stairs. In the use of the grate, the difficulties incident to any plan of artificial warming are more than quadrupled. The consumption of four times the amount of coal by the grate, involves more than four times the amount of ashes and dirt and labor and bad temper.

But the friends of the grate plume themselves on sanitary considerations: they claim that grates are needful for ventilation. I have seen people who even pretended that there was danger of suffocation in rooms warmed by stoves. A few simple figures will show that the fundamental facts are not understood by these gentlemen. A robust man consumes 2 lbs. of oxygen in a day: 1 lb. of pure coal in burning consumes $2\frac{1}{4}$ lbs. oxygen: $2\frac{1}{4}$ lbs. oxygen represent say 150 cubic feet of air. The pound of coal therefore, burning in a stove, withdraws from the room at least 150 cubic feet of air, which of course is replaced by the air sucked in from the outside. In fact, however, the burning pound of coal brings into the room two or three times that amount. Assume that each pound of coal brings into the room 300 cubic feet of fresh air, is not that enough to expect or desire from it? Moreover in the cold season, the difference between the external and internal density being greater than in summer, the ordinary ventilating currents are more vigorous and efficient, and would probably be sufficient without the assistance of the coal. I hear very little complaint about ventilation from those who warm their houses by steam, or even from the sanitarians on those days when it is not quite cold enough to keep a fire, and yet it is prudent to have the windows and doors closed. In this last case there is little provision for ventilation by nature or art.

On the other hand, I indict the grate as being dangerous to health. It compels us to be in a gale of chilling air. On a very cold day it roasts one part of our bodies, while another may be freezing. The grate is one of the fruitful sources of coughs and the consequent diseases of the lungs.

There are those who pretend that the grate is highly ornamental, and that they like to look at the cheerful fire, etc. These are questions of taste and are not to be argued. For myself in all such cases I fall back on that homely old maxim: "Handsome is as handsome does."

FRICTION NOT A FORCE.

The new doctrine of the conservation and correlation of forces, which is now almost universally accepted, makes sad havoc with many dogmas which have prevailed for centuries. Thus our old notions of friction need complete remodelling to be made consistent with the present status of science. We now know that a force is never lost or destroyed, and consequently there can be no such thing as a resistance of force. All that can be done with acting force is to change its direction or to put it into the condition of "potential energy."

Friction does not destroy or diminish in the least the force which starts out from the prime mover. It simply changes the direction or form of the motion: the visible motion of the machine takes the form of heat, and this heat in amount is precisely equivalent to that motion which has disappeared to the eye. If friction may in any sense be considered a force, it can be only from the fact of its changing the direction or form of other forces, and thus perhaps might be brought under the category of the lever and the other so-called mechanical powers. And if in this way we regard friction as a force, how shall we measure it?

Practically it is perhaps sufficient to consider friction as simply indicating a leakage of force. A machine may be regarded as a device for conveying power from its source to a place where it is to be utilized, and friction a hole in the conductor. But the force is thereby no more destroyed, than the water which leaks out of an aqueduct.

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Razors---How They Are Made.

The inquiry is sometimes made, "why does one razor cost so much more than another?" Both blades are made of steel and there seems to be but little difference in the cost of the handles. Razors are usually made of the very best quality of cast steel, properly tilted, hammered, and rolled—worth in England about $300 per ton, in gold. The forging of razors is performed by a foreman and striker in the same manner as the making of table knives.

"The bars or rods, as they come from the tilt and rolling mill, are about half an inch broad, and no thicker than sufficient for the back of the razor. The anvil on which the razor-blades are forged is rounded at the sides: by dexterously working the blade on the rounded edge of the anvil, a concave surface is given to the sides, and the edge part thus made thinner, which saves the grinder a deal of labor. The blade having been cut off the bar, the tang is formed by drawing out the steel. The blade is then properly hardened and tempered. The last and most important process which the razor-blade has to undergo is that of grinding. The difference in the prices of blades, made all of them of the same material, is owing entirely to the circumstance that stones of much smaller diameter are used for grinding the higher priced blades, and much more time and labor are given to the operation than is the case with the cheaper sorts. Thus, the best kind of razor-blades are ground hollow on stones measuring one and seven-eighths to two inches in diameter. The two-shilling English razors are ground on seven-inch diameter stones; the common shilling razors, on ten-inch diameter stones. The difference in the labor is very considerable. A grinder will turn out per week from twenty to twenty-four dozen of the common shilling razors, whilst he can manage only about five dozen a week of the better, and only a couple of dozen of the best, sort.

"The razors ground on a six-inch diameter stone are more suitable for hard, those ground on a two-inch diameter stone for soft, beards. The more common sorts are after grinding lapped on the glazer, and the backs glazed and polished.

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