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.

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.

[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 2¼ lbs. oxygen: 2¼ 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.

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.