as if we had witnessed the wonderful performances of the mpossible furniture of the average pantomime. At one in staat, we observed an individual stretched upon a bed; we looked again, and the bed had vanished and its occupant was calmly sitting by a table. Another person launched himself at an inoffensive couch and dragged fiercely on handles and pulled on strings, and behold, a bookcase developed itself. Then there are pieces of furniture which are riddles in themselves; one never knows when he is through finding things in them. For instance, there is an affair which looks like an overgrown book case. On each side you discover a swinging rack of paper files; then you lift up a flap and pull out some legs, and there is a writing desk with a pivoted inkstand swung in it. You pull aside the flaps, and a series of closets and drawers appear. At the ends you discover more writing desks, with sunken inkstands and receptacles for pencils, more doors and pigeon holes, more cupboards underneath, until you depart, lost in admiration at ingenuity which leaves such simple affairs as Chinese puzzles far in the shade.

A PUFFING MACHINE

is something new for the ladies. There is a corrugated bed piece, and a kind of hand iron having a bottom similarly corrugated to fit into the indentations of the bed. The bottom of the iron is, however, V-shaped in section, the apex of the V being in line parallel with the direction of the handle, which resembles that of the common flat iron. Both bed piece and iron are heated, and the gathered material is dampened and pressed between the two until dry. The work is very neatly accomplished. The same machine may also be used, for fluting, in which case a corrugated comb not heated is substituted for the iron.

A NEW FIRE ESCAPE

is exhibited, which seems to us one of the best of the many similar inventions which have appeared. It consists of a swing ladder, with hickory rounds and wrought iron links. Between each pair of rounds is a light frame of iron which keeps the ladder out from the building. A hook on the upper end sustains the whole when in use. It can be folded into a very small parcel, and weighs about one pound to the foot.

We defer reference to the

MACHINERY DEPARTMENT

for a time, until further novelties appear; as the present contents, though numerous, are almost entirely composed of machines already well known to our readers.

SCIENTIFIC AND PRACTICAL INFORMATION.

PROGRESS OF THE MILLION DOLLAR TELESCOPE.

Mr. Lick has fixed on Mount Hamilton, in Santa Clara county, Cal., as the most eligible site for the establishment of the observatory in which the great telescope is to be located, and he has notified the county supervisors that he will begin the erection at once, if they will construct a road to the summit of the mountain. As Mr. Lick offers to advance the necessary money to begin work on the road, and accept its bonds in payment, it is probable that his proposals will be adopted, and hence there is an excellent prospect of the much-talked-of telescope becoming ere long an accomplished fact.

Mount Hamilton is 4,448 feet high. The summit is higher than any land within 50 miles, and consequently below the level of the plane of the observatory, which, in an astronomical point of view, is the desideratum sought. The beautiful valley of San José, the snowy ridge of the Sierra Nevada, and a boundless area of mountain scenery are in the scope of vision, and the elevation is so high as to be above the fogs of summer, and is not so high as to be much disturbed by the storms of winter.

ABOUT BITTERS.

The Board of Health of the city of Boston, Mass., not long ago appointed Professor W. R. Nichols, a celebrated chemist of that city, to examine into the various concoctions enormously advertised and sold to an unsuspecting public under the mild name of "bitters." Mr. Nichols is continuing his investigations, and up the present time has elicited enough to warrant a wholesale condemnation, certainly, of the most popular of these disguised drinks. He says that, out of twenty samples, only one did not contain alcohol, and that had the least sale.

IMPROVED SUGAR MACHINERY.

Messrs. Morris, Tasker & Co., of Philadelphia, are now shipping a large amount of machinery to be used in Louisiana in a new process of manufacturing cane sugar. The method is what is known as the diffusion process, as distinguished from the maceration process, which is that of all previously constructed sugar machinery. The cane is passed between rollers by the old method and the juice squeezed out. In the new, the cane is sliced and the saccharine matter is dissolved out of it.

PARLOR MAGIC.

The following beautiful experiment in instantaneous crystallization is given by Péligot in *La Nature:* Dissolve 150 parts, by weight, of hyposulphite of soda in 15 parts boiling water, and gently pour it into a tall test glass so as to half fill it, keeping the solution warm by placing the glass in hot water. Dissolve 100 parts by weight sodic acetate in 15 parts hot water, and carefully pour it into the same glass; the latter will form an overlying layer on the surface of the former, and will not mix with it. When cool there will be two supersaturated solutions. If a crystal of sodic hyposulphite be attached to a thread and carefully passed into the glass, it will traverse the acetate solution without disturbing it, but, on reaching the hyposulphite solution, will cause the latter to crystallize instantaneously in large rhomboidal prisms with oblique terminal faces. When the lower solution is completely crystallized, a crystal of sodic acetate, similarly lowered into the upper solution, will cause it to crystallize in oblique rhombic prisms. The appearance of the two different kinds of crystals will not fail to astonish those not acquainted with this class of experiments.

FLAT SURFACES.

The following rules, for determining the thickness of boiler heads, cylinder covers, and other flat surfaces, are taken from *Des Ingenieur's Taschenbuch,* being adapted to English measures, and the constants being chosen so that the working pressure is one eighth as much as the breaking strain. These rules have never before been published in English, so far as we know, and we judge that they will be of interest to the engineering profession. They were deduced by Dr. R. Grashof, and the reasoning on which they are based will be found in *Die Festigkeitslehre, von Dr. F. Grashof,* Berlin, 1866. Being purely theoretical deductions, which have not, we believe, been verified by experiment, it is possible that they may be somewhat incomplete; but we are confident that, with the constants we have chosen, they will give proportions that are at least as safe as those determined by the empirical methods in common use. It is worthy of notice, in this connection, that so high an authority as Professor De Volson Wood remarks in a recent publication (as we understand him) that, in the present state of our knowledge of the strength of materials, it is impossible to solve the problems under consideration without additional experimental data. We believe, however, that the results of Dr. Grashof's investigations are generally accepted by German engineers—certainly they are by the distinguished editors of *Des Ingenieur's Taschenbuch.*

A. To find the necessary thickness for a flat plate exposed to a given pressure in lbs. per square inch (all dimensions in inches):

1. A circular plate, supported at the edges: Multiply the product of the square root of the pressure, and radius of the plate, by 0·018257, for a cast iron plate; by 0·11785, for a wrought iron plate; and by 0·0091287, for a steel plate.

2. A circular plate, secured at the edges, such as a boiler head, or cylinder cover: Multiply the product of the square root of the pressure, and radius of the plate, by 0·01633, for a cast iron plate; by 0·010541, for a wrought iron plate; and by 0·0081649, for a steel plate.

3. A flat plate, supported by stays, at a given distance from center to center: Multiply the product of the square root of the pressure, and distance between stays, by 0·0094281, for a cast iron plate: by 0·0060858, for a wrought iron plate; and by 0 0047141, for a steel plate.

4. A rectangular plate, secured at the edges:

(1) Divide the pressure by the sum of the fourth powers of the two adjacent sides of the rectangle.

(2) Take the square root of the quantity obtained by (1).

(3) Multiply the product of the square of the long side of the rectangle, the short side, and the quantity obtained by (2), by 0·014142, for a cast iron plate; by 0·0091287, for a wrought iron plate; and by 0 0070711, for a steel plate.

5. A square plate, secured at the edges: Multiply the product of the square root of the pressure, and the side of the square, by 0 01, for a cast iron plate; by 0 006455, for a wrought iron plate; and by 0·005. for a steel plate.

B. To find the working pressure, in lbs. per square inch, for a flat plate of given thickness (all dimensions in inches):

1. A circular plate, supported at the edges: Divide the square of the thickness by the square of the radius of the plate, and multiply the quotient by 3,000 for a cast iron plate; by 7,200, for a wrought iron plate; and by 12,000, for a steel plate.

2. A circular plate, secured at the edges: Divide the square of the thickness by the square of the radius of the plate, and multiply the quotient by 3,750, for a cast iron plate; by 9,000, for a wrought iron plate; and by 15,000, for a steel plate.

3. A flat plate, supported by stays: Divide the square of the thickness of the plate by the square of the distance between centers of stays, and multiply the quotient by 11,250, for a cast iron plate; by 27,000, for a wrought iron plate; and by 45,000, for a steel plate.

4. A rectangular plate, secured at the edges.

(1) Take the sum of the fourth powers of the adjacent sides of the rectangle.

(2) Multiply the quantity obtained by (1) by the square of the thickness of the plate.

(3) Multiply the fourth power of the long side of the rectangle by the square of the short side.

(4) Divide the quantity obtained by (2) by the quantity obtained by (3), and multiply the quotient by 5,000. for a cast iron plate; by 12,000, for a wrought iron plate; and by 20,000, for a steel plate.

5. A square plate, secured at the edges: Divide the square of the thickness of the plate by the square of the side of the plate, and multiply the quotient by 10,000, for a cast iron plate; by 24,000, for a wrought iron plate; and by 40,000, for a steel plate.

A few examples are added, to illustrate the foregoing rules.

1. What is the proper thickness for a steel boiler head, the pressure of the steam being 60 lbs. per square inch, and the diameter of the boiler 24 inches?

The product of 7·746 (the square root of 60), 12, and 0·0081649 is 0·78, or $\frac{25}{32}$ of an inch, nearly, the thickness required.

2. Required the thickness for the sides of a cast iron box 20 inches long, 15 inches high, exposed to a pressure of 20 lbs. per square inch.

Dividing 20 by 210,625 (the sum of the fourth power of 20 and 15), and extracting the square root of the quotient, we obtain 0·0097445. The product of 400, 15, and 0·0097445 is 0·83, or about $\frac{5}{6}$ of an inch.

3. What is the safe pressure for a flat plate, supported by stays, 10 inches from center to center, the plate being of wrought iron, $\frac{3}{8}$ of an inch in thickness?

Dividing 0·140625 (the square of $\frac{3}{8}$) by 100, and multiplying the quotient by 27,000, we obtain the pressure, about 38 lbs. per square inch.

4. The side of a rectangular box, 25 inches long, 20 inches high, is of steel, $\frac{1}{4}$ of an inch thick. What is the working pressure?

The sum of the fourth powers of 25 and 20 is 550,625. The product of 550,625 and 0·0625 (the square of $\frac{1}{4}$) is 6 882, 812,700. The product of 390,625 (the fourth power of 25) and 400 is 156,250,000. Dividing 6,882,812,700 by 156,250,000, we obtain the working pressure, 44 lbs. per square inch. Below will be found the analytical expressions for the rules given in this article.

Thickness (T) in inches for a plate exposed to a uniform pressure (p) per square inch.

Form of the plate. (Dimensions in inches.)	Thickness (T) in inches. Cast iron.	Wrought iron.	Steel.
Circular plate, of radius R, supported at the edges.	$0·018257R \times \sqrt{p}$	$0·011785R \times \sqrt{p}$	$0\ 0091287R \times \sqrt{p}$
Circular plate, of radius R, secured at the edges.	$0·01633R \times \sqrt{p}$	$0·010541R \times \sqrt{p}$	$0·0081649R \times \sqrt{p}$
Plate strengthened by stays, a inches from center to center.	$0·0094781a \times \sqrt{p}$	$0·0060858a \times \sqrt{p}$	$0·0047141a \times \sqrt{p}$
Rectangular plate, sides a and b, ($a > b$), secured at the edges.	$0·014142a^2 \times b \times \sqrt{\frac{p}{a^4+b^4}}$	$0·0091287a^2 \times b \times \sqrt{\frac{p}{a^4+b^4}}$	$0·0070711a^2 \times b \times \sqrt{\frac{p}{a^4+b^4}}$
Square plate, side a secured at the edges.	$0·01a \times \sqrt{p}$	$0·006455a \times \sqrt{p}$	$0\ 005a \times \sqrt{p}$

Safe pressure (p) in pounds per square inch for a plate of given thickness (T) in inches.

Form of the plate. (Dimensions in inches).	Safe pressure (p) in pounds per square inch. Cast iron.	Wrought iron.	Steel.
Circular plate of radius R, supported at the edges.	$3,000 \times \frac{T^2}{R^2}$	$7,200 \times \frac{T^2}{R^2}$	$12,000 \times \frac{T^2}{R^2}$
Circular plate, of radius R, secured at the edges.	$3,750 \times \frac{T^2}{R^2}$	$9,000 \times \frac{T^2}{R^2}$	$15,000 \times \frac{T^2}{R^2}$
Plate strengthened by stays, a inches from center to center.	$11,250 \times \frac{T^2}{a^2}$	$27,000 \times \frac{T^2}{a^2}$	$45,000 \times \frac{T^2}{a^2}$
Rectangular plate, sides a and b ($a > b$), secured at the edges.	$5,000 \times \frac{T^2 \times (a^4+b^4)}{a^4 \times b^2}$	$12,000 \times \frac{T^2 \times (a^4+b^4)}{a^4 \times b^2}$	$20,000 \times \frac{T^2 \times (a^4+b^4)}{a^4 \times b^2}$
Square plate, side a, secured at the edges.	$10,000 \times \frac{T^2}{a^2}$	$24,000 \times \frac{T^2}{a^2}$	$40,000 \times \frac{T^2}{a^2}$