the plates of the shell once broken open in a cross-tearing direction, as one tears a sheet of paper, instead of as one would break a string, or as the test samples of iron are broken in a machine. It will occur to the reader that this construction of these experimental boilers was admirably adapted to the end Mr. Lawson had in view.

The cracking of the head around the bolt of the plain boiler, at the experiments of March 7 and 8, probably rendered it impossible to get a breaking strain on the bolt, and the rupture of the iron was slow enough to prevent the pulling through of the nut in a sudden manner before the pressure fell and equilibrium of force and resistance was established.

The record of the commission appointed by the Secretary of the United States Treasury—Supervising Inspector of Steam Vessels, John Fehrenbatch, of Cincinnati, O., and Deputy Inspectors Atkinson and Batchelor, of Pittsburg, Pa.—show that which was also observed by a representative of the SCIENTIFIC AMERICAN, namely, that the pressure always fell on opening the gate valve, and then the gauge fluctuated to a point above, settling at last sometimes at apparently the same, and sometimes at a lower point than that from which it started downward—a perfectly natural and often observed result of suddenly withdrawing one-tenth of the volume of the steam from a boiler to which a sensitive spring gauge is attached.

When the gate valve was opened it was equivalent to suddenly enlarging the steam chamber of the boiler about one-tenth of its capacity; but, inasmuch as the sudden lowering of the pressure was followed by an evolution of steam from the water, which had a normal temperature of 400° Fahr. when under a pressure of 235 pounds above the atmosphere, the theoretical effect of withdrawing one cubic foot of steam would, under these conditions, be a lowering of the pressure something less than one pound, provided no heat is entering the boiler at the instant or during the oscillations of the gauge pointer.

But the gauges used upon these occasions were graduated to five pounds, having no pound or half pound marks, and they were not reliable as indicators of actual variations. It appears, first, that the pressure at which these tests were made left but little margin of strength in the boiler; and, second, that the area of the opening from which the steam was suddenly withdrawn was about one two-hundredths of the surface area of the water, and these conditions, compared with the usual manner of opening the valves, will be recognized as immense exaggerations of the most vicious practices in the use of steam boilers.

While Mr. Lawson's experiments show that a boiler may explode while it contains a full supply of water, they do not, on the other hand, show that boilers do not sometimes explode from lack of water. While they also show that a big throttle valve may be suddenly opened with impunity while a proper margin of strength remains, they do not prove that a weak boiler will or will not break at the instant the engine throttle is opened, producing a very mild shock.

On the whole these experiments, so far as they have gone, are simply confirmatory, almost a demonstration, of the opinions held and taught by the SCIENTIFIC AMERICAN for many years, as well as by many well informed writers and thinkers on the subject of boiler explosions.

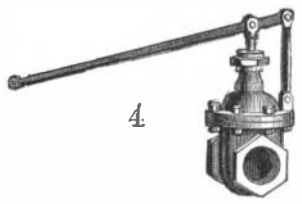


Fig. 4.—3½-INCH GATE VALVE.

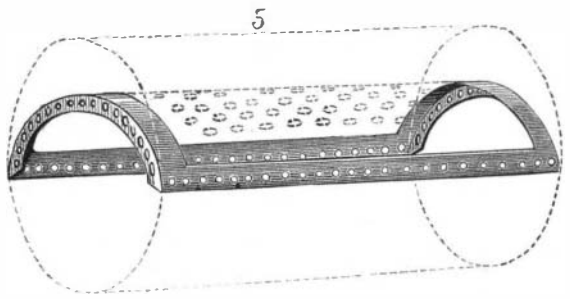


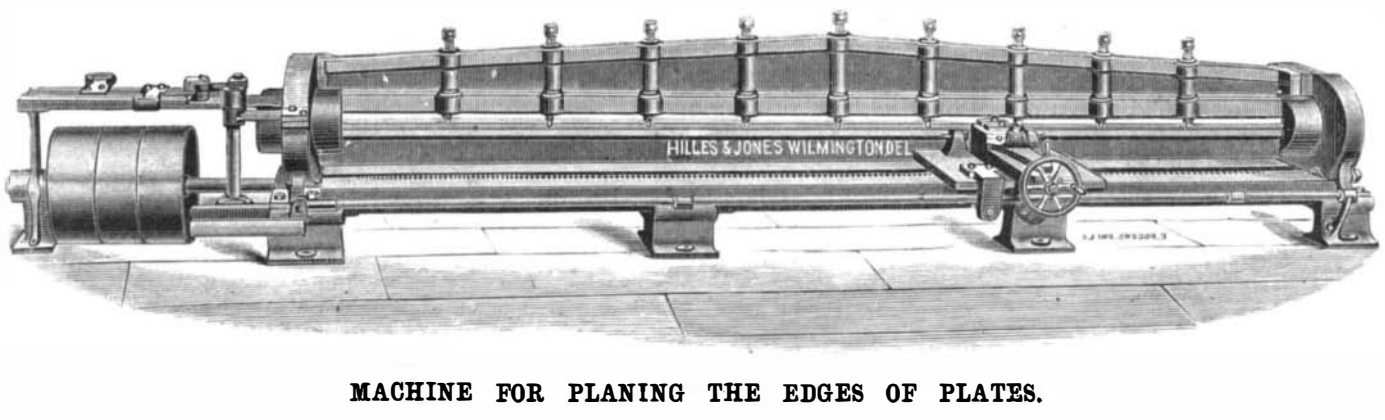
Fig. 5.—BOILER WITH DIAPHRAGM CUT OUT.

New Electrical Regulator.

M. Salignac, one of the most active electricians of Paris, has discovered a new regulator which will be one of the curiosities of the next *grande soirée* given at the Observatoire on March 13th. Each of the two carbons is supplied with a parallel rod of glass, to which it is attached in a solid manner. These two rods being placed horizontally, are pushed by a spring, and the spark is lighted between them. But between the two glass rods there is a glass stopper which is warmed by the light in such proportion that the rods yield gradually to the pressure of the springs, and the carbons can approach each other, as is required for the constancy of illumination. A correspondent of *Nature* witnessed preliminary experiments which he states have been a wonderful success.

IMPROVED PLATE PLANER.

We give an engraving of an improved machine, made by Messrs. Hilles & Jones, of Wilmington, Del., for planing the edges of plates. This machine will plane 13 feet 10 inches long at one setting, and by resetting or moving the plate endwise will plane any length of plate. There are two separate tools on the tool post, and they are arranged on the saddle for easy and independent adjustment, and the cut is taken both ways on the plate; the hand wheel shown feeds both tools at the same time.



MACHINE FOR PLANING THE EDGES OF PLATES.

The machine is so designed that the large table holds the plate and at the same time answers for a gauge for quickly setting the edge of the plate, so that no time is lost in measuring with a rule. The nine screws in the cross bridge are for straightening and taking the buckles out of the edge of the plate, and at the same time they assist in holding it securely while being planed.

The large steel screw that moves the saddle is supported its entire length, lying in a groove that keeps it always well oiled and prevents it from being sprung or bent. The belt shifting arrangement is such that a very short movement of the saddle is obtained when desired.

The manufacturers state that this machine will do as much work in one hour as the best boiler maker will chip in twelve hours. The machine will do it correctly, while the boiler maker will do it irregularly and in a great measure cut or score the adjoining sheet, thus weakening it.

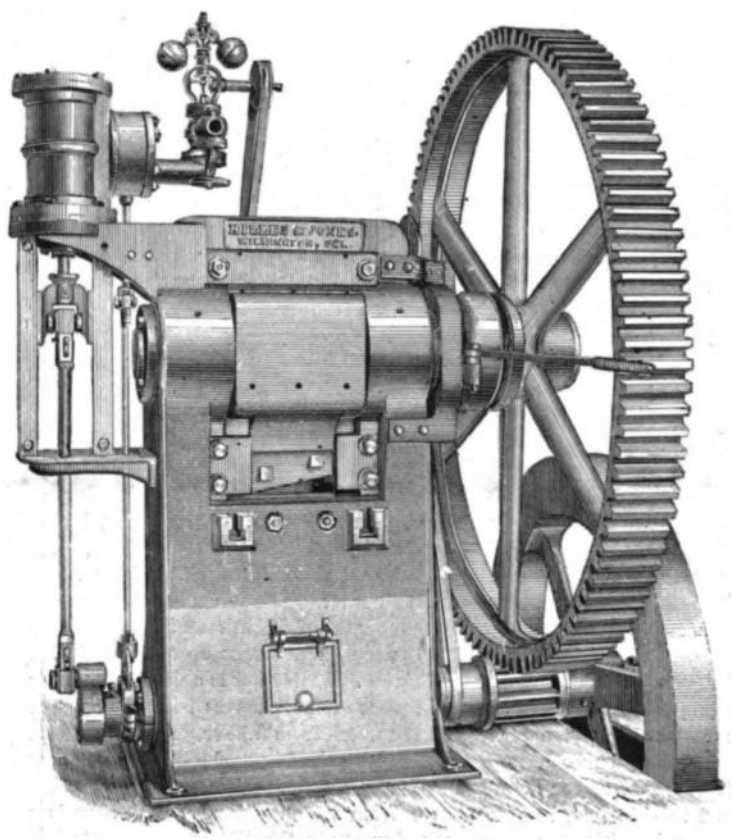
POWERFUL BAR IRON SHEAR.

The annexed engraving shows a powerful steam driven shear built by Messrs. Hilles & Jones, of Wilmington, Del. There are four sizes of this machine, the one shown in the engraving being the largest. It is capable of cutting flat iron six inches wide by two inches thick.

These machines will cut flat, round, or angle iron, and are made with a clutch for stopping and starting the cutter while the fly wheel and gearing are in motion. A bar of iron can be cut accurately to the mark, and a gauge is provided, set on the back of the machine, for cutting a number of pieces of uniform length.

This is is a most serviceable tool for locomotive builders, bolt makers, bridge builders, bar iron rolling mills, or for cutting puddle bars in sheet mills.

The machines are furnished with tight and loose pulleys for driving with a belt, or provided with a pony engine, as shown in the engraving.



HILLES & JONES' BAR IRON SHEAR.

MECHANICAL INVENTIONS.

A novel wire stretcher has been patented by Mr. Henry H. Hutchins, of Fennville, Mich. The invention consists of a hooked bar or plate carrying pivoted jaws at its hooked end, and provided near its center with a hooked lever having a pawl for securing the device to the fence post, and carrying at its straight end a clamping device for retaining the wire while a hold is being taken with the jaws, a suitable guide being provided for guiding the wire to and through the clamping device.

An improved system for transmitting motion has been patented by Mr. Antonio Samper, of Paris, France. This patent relates to improvements in a system of transmission of movement patented by the same inventor June 21, 1881, No. 243,226.

An improvement in paper pulp engines, patented by Mr. William E. Taylor, of Fulton, N. Y., consists in setting the blades of the cylinder at an angle or diagonally across the surface of the cylinder, so that they will have a shaving action or cut with the fixed blades in the bottom of the engine box.

An improved self-closing elevator door has been patented by Mr. Theodore M. Clark, of Boston, Mass. The invention consists in combining a pivoted latch bar and a bow spring on the door frame with a door having a stud and an elevator platform having a lug for engaging the spring. This device is simple and efficient. It allows the use of self-closing doors without its being necessary for the elevator attendant to hold them open.

Ordinarily in stereotyping the mould or impression is taken and dried on a steam table or heater specially constructed and used for that purpose alone. It is then placed in a casting box specially constructed for that work. These appliances are costly and occupy no little space. Mr. Marshall J. Hughes, of Jersey City, N. J., has patented a combined printing press and stereotype casting box which dispenses with these separate appliances by utilizing printing presses in the work of stereotyping and production of plates and type-high casts.

Mr. Frank A. Carnes, of Brookline, Mass., has patented an improved carriage axle box. By means of the collars or rings and the hollowing out of the nut or sleeve, the bearing surface of the sleeve upon the axle is greatly reduced, thus reducing the friction to the minimum. A hub of this construction can be made small and compact, and it is simple and cheap in construction.

Mr. Edgar H. Drake, of Newfield, N. Y., has patented a novel combination of simple and well known mechanism for applying power for domestic and other purposes. The invention consists of a combination of shafts, cranks, pinions, cog wheels, eccentrics, pitmen, walking beams, connecting rods, treadle, etc., supported in a suitable frame. The arrangement is such that the power may be applied by hand, foot, or by weights to operate a saw, churn, or washing machine.

Mr. George P. Clark, of Windsor Locks, Conn., has patented a cheap, efficient, and easily operated means for preventing backward movement of hand trucks while the load is being placed upon them. The invention consists of a spring-actuated holder or clamp placed upon the shaft or axle of the truck, the holder or clamp being adapted to be pressed down by the foot of the user to engage with the floor while the box, barrel, or other load is being tipped or pulled back or otherwise placed upon the truck.

An improved self-lubricating bearing for axles has been patented by Mr. Paul Decauville, of Paris, France. This invention provides small pieces of cane or reed, which dip continually into a reservoir of oil. The great porousness of the cane is specially advantageous in two respects for the purposes of this invention—that is to say, the oil is caused to rise by capillary attraction and by the suction caused by a vacuum. In the case of shafts revolving at a very low speed the lubrication is effected by capillary at-

traction; but in the case of shafts which revolve at a great speed—such, for example, as those used for ventilators—the lubrication is effected by a rush of oil resulting from the vacuum caused by the great speed of rotation.

Fishing reels become quickly worn at the bearings of the spool and gearing, and as usually constructed are expensive to repair when so worm. Mr. Julius Vom Hofe, of Brooklyn, E. D., N. Y, has patented an improvement in fishing reels which provides for adjustment of the bearings, so that wear can be readily compensated and the reels kept in good condition without expense.

An improved mechanism for converting rotary into oscillating motion has been patented by Mr. Julius Hornig, of Jersey City, N. J. The object of this invention is to improve the construction of the mechanism for converting rotary into oscillating motion, for which letters patent, No. 46,237, were granted to the same inventor, February 7, 1865, and reissued letters patent, No. 3,717, were granted to the same inventor, November 9, 1869, the design being to facilitate and cheapen the repairing of the mechanism should it be broken by being overtaxed.

An improvement in breech-loading firearms has been patented by Mr. Henry Scott, of Birmingham, England. This invention has reference to breech-loading small arms of the kind commonly called "drop-down guns;" and it consists in the arrangements or combinations of parts for cocking the concealed or internal hammers of the guns, and also the arrangement of safety apparatus for preventing the accidental discharge of the guns.

An improved shedding mechanism for looms has been patented by Mr. Joseph Denton, of Paterson, N. J. The invention consists in the combination with the heddle slides, crank wheel, connecting rod, rock shaft, and the rigid arms of a series of connecting rods, levers, and stop-board, by which the inward movement of the heddle slides is controlled.

Mr. Sigmund Ullman, of New York city, has patented a new machine for perforating checks and drafts. The invention consists of a plate containing a series of loose punch pins arranged in longitudinal rows marked "units," "tens," "hundreds," etc., and in transverse rows marked "0," "1," "2," "3," etc., which punch pins fit into perforations in a die plate below the punch plate, and provided with a guide or gauge for the end of the check or draft. Above each longitudinal row there is a sliding bar with a beveled notch in its under surface, and with the numerals from 0 to 9 on its upper surface, one of which numerals is visible through an aperture in the top plate, this notch being so located that it will be above the punch pin corresponding to the number showing through the aperture, and when the punch plate is depressed the punch pins under the notches will not be depressed, and consequently the corresponding numbers on a prepared check will not be punched, and will show the value of the check, whereas all the other numerals will be punched.

The Presence of Glycerine in Beer.

It has been shown by Pasteur and others that glycerine is a normal product of alcoholic fermentation; that investigator proved that out of 100 parts of sugar submitted to complete fermentation, 95 parts are converted into alcohol and carbonic acid, 1 part is added to the newly formed ferment, and 4 parts are converted into succinic acid and glycerine, and the results of his quantitative researches proved that 3·16 parts of glycerine are produced from every 100 parts of sugar fermented.

These were the results obtained by normal alcoholic fermentations, but Pasteur also found that when the fermentation is slow or is produced by exhausted and impure yeast, the amount of glycerine may be appreciably increased, and, on the other hand, when there is an excess of albuminous and mineral matters in the fermenting fluid, the production of glycerine is considerably diminished; the presence of any excess of acidity in a fermenting fluid also tends to prevent the formation of glycerine.

It may be safely said that glycerine is never absent from a fermented liquid, but the quantity varies according to the nature of the liquid submitted to fermentation. A non-nitrogenous beer wort, such as is produced when sugar or saccharines have largely replaced malt, will, during fermentation, yield a very considerable quantity of glycerine; but with a very nitrogenous and slightly acid wort, such as is yielded by malt alone, very little glycerine is produced during fermentation.

It seems, therefore, possible that if some exact method of determining the quantity of glycerin in fermented liquids were known, we should, by ascertaining the percentage of this constituent in a beer, be able to decide with some degree of certainty whether such beer has been produced from malt alone, or from a mixture of malt and sugar. Unfortunately, chemists are not at present acquainted with any exact and ready method of estimating glycerine, the one devised by Pasteur being too complicated for any but the most experienced, and even then we doubt whether extreme accuracy can be insured by it.

The following method of quantitatively testing for glycerine in beer may be found useful: The beer is mixed with powdered slaked lime and an equal bulk of fine quartz sand, and evaporated to a paste on the water bath. When cold, the residue forms a hard mass, which is pulverized and extracted with 80 to 100 c. c. of a mixture of equal volumes of absolute alcohol and ether in a small stoppered flask. On allowing the extract to evaporate, the glycerine is obtained free from sugar. If two drops of it are put in a dry test tube with two drops of phenol (previously liquefied), and the same quantity of sulphuric acid, and heated very cautiously over the flame, but so as to reach 120°, the formation of a solid brownish-yellow mass is perceived. When cold a little water is added and a few drops of ammonia, when the brownish-yellow solid dissolves with a splendid carmine red color.

The detection and estimation of glycerine and the other bye products of fermentation in beer, etc., would tend to throw further light on what is at present very obscure.—*Brewers' Guardian.*

Worm-eaten Wood.

A number of worn and worm-eaten pieces of wood were lately shown at the Public Works Department. They were specimens of wood which had been in use as piles and fenders on government wharves and breakwaters on the Atlantic and Gulf coasts, and had been sent to the department as illustrative of the necessity of the frequent renewal of timbers in these constructions.

One was a piece of hemlock timber from the railway wharf at Point Duchene, N. B. This piece, which had been in use as a fender, put on in 1873 and removed last year, was, by the ravages of worms and the incessant action of the sea, reduced to about one-half its former circumference, excepting the knots, the hardness of which had preserved them intact, giving the timber the appearance of a decayed tree, having the limbs lopped off about six inches from the stem. Another, a part of a pile taken from Digby, N. S., had in fourteen years' exposure to the worms become completely useless for strengthening purposes, while a section of a pile driven at Shediac, N. B., in 1878, had in only three years been so perfectly honeycombed as to be seemingly unable to withstand its own weight. Other pieces of spruce hemlock were also seen in various stages of destruction and decay, showing the incapability of these descriptions of wood to resist the ravages of the destructive little creatures. It is not only the weakening of the timber by the perforations of worms that renders it useless in a short time, but the wood having once become porous thereby, it is rendered susceptible to the continuous action of the water, and is thus worn down with wonderful rapidity. These worms vary in size in different waters, and the appearances of a similar wood exposed for any length of time in the waters of the Gulf and those of the Atlantic Ocean, might be compared to that between the finer and coarser varieties of sponge. Some kinds of wood are more impervious to worms than others; thus in localities where spruce and hemlock timber would, in a short time, become thoroughly worm-eaten, birch and elm would remain intact for years, yet in all cases it is but a matter of time, and only solid stone is of sufficient durability and strength to withstand effectually the ravages of these worms and the constant wearing of the waters.

Effects of Compression.

The experiments of M. Walthère Spring, a Belgian physicist of much originality of mind, upon the influence of pressure upon solid bodies, have attracted some attention. He continues to publish the results of his experiments as they are extended in new directions. The method of procedure is to subject solid or pulverulent matter to pressures reaching a maximum of 10,000 atmospheres in an apparatus constructed of steel. In this way some highly interesting results have already been attained. Coal dust, for example, was changed by simple pressure into a solid block, presenting all the characteristics of the original mineral. Peat was changed at once, by the same means, into a black block of mineral, of brilliant fracture, which did not show any sign of organic texture. At a pressure of 6,000 atmospheres this solidified peat became plastic. Several observers are said to have pronounced the solid material thus obtained to be precisely like ordinary coal; and on carbonizing it a solid block of coke was produced. It is stated that further experiments in the same direction have convinced M. Spring that heat, accompanied with a pressure of only 200 or 300 atmospheres, would have sufficed for the production of coal measures in their present condition. Soft metals in the form of fine powder, and nearly all crystalline substances in a similar condition, have been transformed by M. Spring into more or less solid blocks, occasionally of higher specific gravity than the original form of the matters so treated.

A Fan Ventilator.

The engineers of the St. Louis Bridge and Tunnel Company have, for several months, contemplated the placing of an air suction pump or pneumatic screw in the St. Louis railway tunnel, and have experimented with the old-established institutions in this line, but without satisfactory result. Finally Mr. C. Shaler Smith, of St. Louis, laid before the company the designs of an invention of his own, which met with approval, and the building of the new fan or screw was begun last summer. The screw is now in successful operation at the corner of Eighth and St. Charles streets, midway of the tunnel, and comes up to the fullest expectations of the designer. Following is a description of this new and improved piece of mechanism: First, an opening was made into the tunnel from above, and over this opening an immense circular chimney or stack was erected, 37 feet in diameter at the base and tapering to a diameter of 15 feet, 76 feet above, from which point upward there is neither increase nor diminution in the diameter. The stack is made of five-eighths-inch boiler plate, is double riveted and strengthened every 10 feet by four-inch angle bars. Its weight alone is over 92 tons and its entire length 126 feet.

At a distance of some ten feet from the base of the stack a shaft connected with a 192 horse power compound engine enters the stack at right angles and passes through the center. To this shaft is attached the fan, which is coniform, with lateral wings at the ends of the cone. These wings are eight in number, four of which are large and of equal size, and four small. The larger wings are attached to the sides of the cone, and to each of these a small wing is attached at the outer edge of the larger by means of a flange. The longitudinal diameter of the fan is 15 feet, its breadth of rim 8 feet 10 inches, and its weight 8 tons.

The whole fan is cased or boxed up, and the air cannot possibly enter the fan box, except through an opening at either side of the fan. At the top of the fan box there is another opening, through which the air is blown by the fan into the stack and up into the blue sky.

The fan, when running at a high rate of speed, exhausts the air at the rate of 500,000 cubic feet per minute, and can exhaust the amount of air in the tunnel in four minutes. It is, in fact, a wonderful piece of mechanism, and will be appreciated by all railroad men and especially by firemen and engineers.—*Age of Steel.*

Power Required for Wagons and Carriages.

At a recent meeting of the Engineers' Club of Philadelphia, President Rudolph Hering presented notes on the resistance to traction on streets giving results compiled from various authors who had experimented on the subject. Resistance varies nearly as the weight, being great for heavy loads and almost nothing for light pleasure carriages. It increases on paved streets with the velocity and as the diameter of the wheels becomes less. The width of tire has little influence on hard and smooth roads, especially for light loads, while it has considerable influence on soft and rough roads, particularly when the load is heavy. The most economical conditions for traction, therefore, are a hard and smooth surface, large wheels, and broad tires; the latter for heavy loads drawn on rough roads. To draw a load on sand requires a power equal to one-fifth its weight, on ordinary earth one-tenth, on hard clay one-twentieth, on ordinary cobble stones one-sixteenth, on good cobble pavements one-thirtieth, on ordinary Belgian blocks one-fortieth, on London blocks one sixty-second, on asphalt one one-hundred-and-thirty-third, and on iron rails one two-hundredth of the load.

The economy in horse power obtained by using the hardest and smoothest roads is clearly shown. If one horse can just draw a load, on a level, over iron rails, it will take one and two-thirds horses to draw it over asphalt, three and one-third overthe best Belgian, five over ordinary Belgian, seven over a good cobble stone, thirteen over a bad cobble stone, twenty over an ordinary earth road, and forty over a sandy road.

The Daily Swelling of Plants.

With delicate means of measurement Herr Kraus has recently proved the existence of a phenomenon in all plant organs, which is connected with their variable water-content, and consists in a periodical swelling and contraction in the twenty-four hours. Leaves, etc., decrease in thickness from the early morning till the afternoon, when they begin to swell again, attaining a greater size by night than by day (this is well seen in agave, aloe, and the like). Similarly with buds, flowers, green cones, fruits, etc., and with stems and branches. Herr Kaiser had before proved such a period in trunks of trees, and Herr Kraus shows that both wood and bark share in it, independently or unitedly. The various experiments of Herr Kraus—removal of foliage, watering, shutting out light, etc.—lead to explanation of the phenomena by the varying reciprocal action of those factors which bring water into the plant and those which carry it away. By night only the water-absorbing activity of the parts below ground operates, by day the water-consuming activity of the parts above ground besides. The water-consuming activity depends mainly on the foliage and on light (removal of leaves or of light stops the contraction) and consists essentially in transpiration. Herr Kraus states that when a plant is watered these things occur: In a short time, less than an hour, the stem begins to swell; both wood and bark take part in this, the wood always first. The swelling progresses at a pretty quick rate, upward of several meters per second. After some time, perhaps an hour, contraction gradually recurs. The contraction began at the upper part of an acacia after 10 minutes, whereas the swelling at the lower part continued 50 minutes. This shows that the contraction is due to the activity of the foliage, and is gradually extended downward.

Narrow Escape of a Steamship.

A desperate and exciting race for life was made across a part of San Francisco Bay, on March 23, by the ocean steamship Columbia. In approaching the city in a dense fog the ship grounded in the straits, but in a few moments glided off into deep water. Suddenly it was discovered that the vessel was leaking badly, and the captain determined to steer for a safe beaching ground. Under a full head of steam, and followed by a fleet of tugs, which endeavored to keep near her, to render help if it were needed, the ship rushed toward the mud flats. Her firemen stood waist-deep in water, and she was slowly sinking, but there was just time to save her, and, amid a chorus of shrieks from a hundred steam whistles, she ran high up on the soft shore near her wharf.