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Contents.

(Illustrated articles are marked with an asterisk.)

THE GEOLOGICAL IMPORTANCE OF OUR WESTERN EXPLORATIONS.

In no period of the world's history has there been a greater activity displayed in enterprises to increase the knowledge of our globe and its history than at the present day: as instances of which may be cited the explorations in Central Africa, those of the ruins of the cities of antiquity, such as Nineveh, the expeditions to the north pole, intended for settling the mystery of an open polar sea, the deep sea soundings in the Pacific Ocean, proving the existence of a sunken continent, and, last but not least, American explorations in the Great West, now in progress, which have already contributed to our knowledge of geology facts of greater importance than any obtained during the previous half century. It is especially in the region of the Yellowstone River, abounding as it does with hot springs and geysers, and in the valley of the Colorado, that the most instructive features have been discovered. While, in the last few decades, the importance and universality of slow upheavals have been demonstrated, the explorations have shown that a second agent, namely, erosion, is of the utmost importance, and results in a variety of features, varying with the nature of the soil, the climate (wet, dry, or rainless), presence or absence of winter frosts, etc.

In Colorado, the erosion by the rivers produces cañons in the comparatively easily worn-out rock of thousands of feet in depth; while the aridity of the climate prevents the rain from destroying the results of the erosion, as is the case in countries where rainfall is of ordinary occurrence. If is evident, therefore, that the arid regions around the Colorado river give specially favorable opportunities for studying the effects of erosion, and the recent researches in that country have resulted in classification of these effects, as 1, the erosion of water gaps, 2, the cliff erosion of cañons, 3, hogback erosion, and 4, hill and mountain erosion. The second and third classes are due to the undermining action of water in arid climates; while in the first and last, this action is modified by surface washings in rainy or moist climates.

When another topographical feature is added, namely, the eruption and outpouring of molten matter from below, its overflow covering the eroded lands, and its subsequent erosion in its turn, a new field of investigation is opened, especially instructive in arid climates, where surface washings do not destroy the prominent points of interest. This makes the region of the Colorado particularly rich in peculiar features, such as cañons and cañon valleys, volcanic caves and volcanic mountains, cliffs and hogbacks, buttes and plateaux, naked rocks and drifting sand, bluffs, valleys, etc. All the mountain forms of this region are due to erosion, being carved out by the running waters; but notwithstanding the aridity of the climate in many localities, beds hundreds of feet in thickness and hundreds of thousands of square miles in extent, beds of schist, granite, limestone, sandstone, scale, and lava, have slowly yielded to the unseen powers of the air, crumbled away into dust, and been washed away by the rivers. It is an illustration on a gigantic scale of the return of the lands to the ocean depths from which they once arose.

It appears, however, that the climate there has not always been so arid as it is now; so the basin of the Great Salt Lake, which is now so depressed that its waters have no outlet to the sea and are entirely disposed of by evaporation, leaving all dissolved matter behind, had once a moist climate and so much rain that the valley was filled with water to its brim, forming a large and deep fresh water lake, which had its outlet into the Columbia River. Mr. G. K. Gilbert, who studied the features of this outlet, considers its epoch identical with the glacial period; and from a further study of the deposited soils, he has proved that, before the glacial epoch, an arid climate prevailed there of many times longer duration than the present epoch of 100,000 years, which followed it.

The period of time required to form successive deposits of thousands of feet in thickness, which the erosion of the Colorado River has brought to light, in its deep cañons, are enormous, and we cannot suppose that here the erosion was less than that of other rivers, although in moist climates the evidences of this erosion have been destroyed; while in the arid climates of our West, they were preserved.

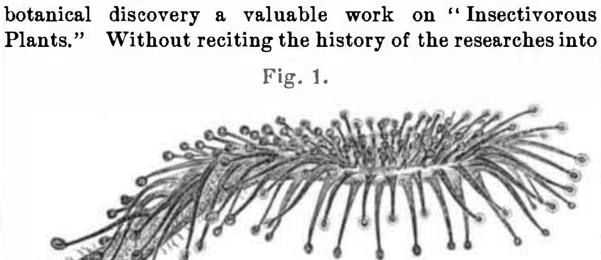
The evidences are that that region was lifted up from the ocean's bosom three times; that three times the rocks were fractured, that three times the lava poured out of the crevasses, and that three times the water carved out valleys in their course seawards. The first of these periods was after the formation of the granite rocks: the second succeeded the red sandstone formation; the third period is the present. The remnants of the first and second periods are buried; but we know that, unnumbered centuries ago in the past, the granites and schists, now on the bottom of the grand cañon, were formed as a sedimentary bed beneath the sea, that then an upheaval took place, after which thousands of feet of beds were washed away in the sea by rains; then a depression took place, sinking the whole region some 20,000 feet beneath the ocean's surface, and allowing the formation of sandstone, at least 10,000 feet in thickness, as a sediment; then a second upheaval came, changing it again into dry land; then the rains washed away channels in the sandstone 10,000 feet deep, requiring countless years of gentle but unrelenting energy. Again the sea rolled over the land, which became its bottom, and received a new deposit of more than 10,000 feet of rocky bed; and lastly, this ocean bed was again upheaved, and for 100,000 years the atmospheric influences and the running streams, gathered from the clouds in the high-est mountain tops, have been making gorges, cañons, and valleys, and carrying the *débris* back to the sea, from whose bottom the material all came

We ask: Will the sea, at some future period, invade that land, by the sinking down of the latter, and will coral reefs be formed, and serve perhaps for the burial of the bones of the beings which shall then exist? Will the surrounding continents or islands be washed into that sea and form new beds of rock, which, when again upheaved, will form a new land, and cañons again be formed, and reveal in their walls, to another race of intelligent beings, some of the features of the time in which we live at present?

CARNIVOROUS PLANTS.

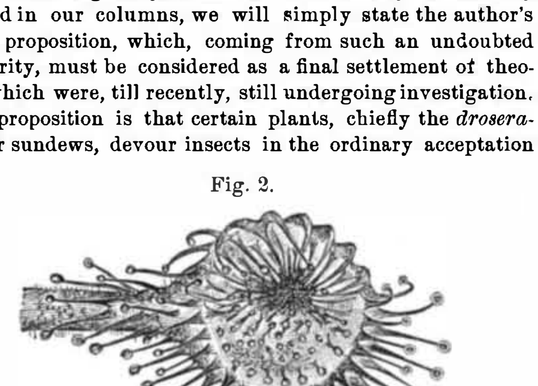
Mr. Darwin has recently added to the literature of modern botanical discovery a valuable work on "Insectivorous Plants." Without reciting the history of the researches into

Fig. 1.



this interesting subject, which has already been fully treated in our columns, we will simply state the author's broad proposition, which, coming from such an undoubted authority, must be considered as a final settlement of theories which were, till recently, still undergoing investigation. This proposition is that certain plants, chiefly the *droseraceæ* or sundews, devour insects in the ordinary acceptation

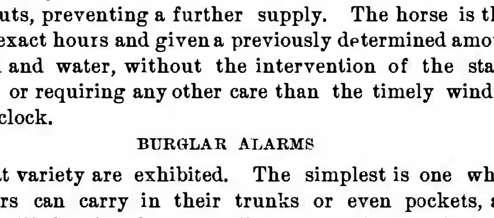
Fig. 2.



of the term, that is, they kill, swallow, digest them, and absorb and assimilate their juices. Some (such as the *drosophylla*) secrete and exude a viscid fluid, to which insects adhere as they do to the buds of the horse chestnut and the corollas of the Cape heaths; but these are not insectivorous. But the *drosera rotundifolia* shows a higher organization, being endowed with sensitive tentacles, of which we give a representation in Fig. 1 Each of these tentacles terminates in a knob, from which issues a glittering secretion, on account of which the plant has been called the sundew; and each tentacle can bend over towards its prey, either independently or conjointly with the adjacent tentacles. Fig. 2 shows one half of the tentacles bent over and the other half erect. Almost any kind of interference with the tentacles, such as lightly touching them, placing inorganic substances upon them, or especially putting organic matters (particularly such as are nitrogenous) on them, will set the sundew in motion; and the more soluble the matter enfolded by the tentacles, the longer do they remain inflected over it.

In our third engraving are shown the magnified cells of the tentacles, exhibiting the various forms assumed by the

Fig. 3.



protoplasm. Mr. Darwin says: "If a tentacle is examined some hours after the gland has been excited by repeated touches or by inorganic or organic particles placed on it, or by the absorption of certain fluids, it presents a wholly changed appearance. The cells, instead of being filled with homogeneous purple fluid, now contain various shaped masses of purple matter, suspended in a colorless or almost colorless fluid; and shortly after the tentacles have re-expanded, the little masses of protoplasm are all re-dissolved, and the purple fluid within the cells becomes as homogeneous and transparent as it was at first."

Mr. Darwin's investigation also comprised an elaborate study of the digestive apparatus of the plants, and of the secreted fluids, which, beyond any doubt, perform the functions of the gastric juice and of a kind of pepsin, the latter being necessary to the complete direct assimilation of animal matter to a vegetable body.

THE FAIR OF THE AMERICAN INSTITUTE.

There is an ingenious device in a rather out-of-the-way corner of the fair, which will prove interesting to owners of horses, inasmuch as its object is to benefit the animals in a variety of ways, and principally by protecting them from negligence on the part of stable men. It is

AN AUTOMATIC HORSE FEEDER,

consisting of a simple clock, the works of which are connected by a cord with the hinged bottom of a grain hopper or water receptacle. At certain hours to which the clock mechanism is adjusted, the cord is slackened, and the bottom of the hopper or water vessel falls, allowing of the escape of the contents into the manger, This escape takes place for a certain time, regulated by suitable mechanism, so that a certain quantity of material is measured out, and then the bottom shuts, preventing a further supply. The horse is thus fed at exact hours and given a previously determined amount of food and water, without the intervention of the stable people, or requiring any other care than the timely winding of the clock.

BURGLAR ALARMS

in great variety are exhibited. The simplest is one which travelers can carry in their trunks or even pockets, and which will be found an excellent protection against the entry of thieves into an hotel room. It is a small wedge-shaped case of metal, containing a gong, the hammer of which is actuated by clockwork. The latter is wound, and the device is placed on the floor with the edge of the wedge just in front of the door. When the door is opened, however gently, from the outside, it strikes against the wedge, and suitable mechanism therein frees the spring of the clock train so that the gong is loudly and continuously sounded. The noise is sufficient to arouse the soundest sleeper. The invention might easily be adapted for windows as well as doors.

A NEW INDUSTRY

bids fair to be set on foot, through the utilization of the fir and pine tree leaves. Mr. Charles Fulton has devised a process by which the coherent parts, such as resin, wood, tannin, etc., from the fibers of the needles or acicular leaves, are dissolved and removed by boiling in suitable chemicals. The result is a substance resembling cotton, or perhaps more nearly wool, of a dark greenish brown color It is prepared in four qualities, adapted for stuffing mattresses, pillows, etc., and for weaving. For the latter purpose, the fibers of the material are separated and treated in machines similar to fulling mills. Other processes follow, which result in the production of an excellent thread, which can be woven alone or mixed with wool, cotton, silk, or other fibers Cloth of very close and fine texture is exhibited, made of the thread. It is soft and pliable, and resembles a fair quality of flannel. There is an enormous amount of raw material for this manufacture in the country, which now is of no value, and which can be obtained at simply the cost of transportation. By the process above described, it is rendered available both for textile and for paper industries, and hence may form a new and valuable supply.

The needs of dwellers in the narrow quarters of our city flats must be uppermost in the minds of inventors, if we may judge from the quantity of

COMBINATION FURNITURE

that is displayed. We spent an amused half hour in watching agile exhibitors put bedsteads and couches through astonishing transmutations, and departed as much entertained as if we had witnessed the wonderful performances of the impossible furniture of the average pantomime. At one in stant, 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 pro portions 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.	$10,000 \times \frac{T^2}{a^2}$	$24,000 \times \frac{T^2}{a^2}$	$40,000 \times \frac{T^2}{a^2}$