Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year, postage included....................................$3 20

One copy, six months, postage included.................................. 1 6,

Club Rates.

Ten copies, one year, each $2 70, postage included......................$27 00

Over ten copies, same rate each, postage included...................... 2 7.

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VOLUME XXXIII., No. 13. [NEW SERIES.] *Thirtieth Year.*

NEW YORK, SATURDAY, SEPTEMBER 25, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

Air, compression of (37)	203	Horses, drugging	192
Air, human consumption of (39)	294	Hydraulic press power (38)	204
American Institute Fair, the	201	Ice water, to preserve	194
Answers to correspondents	203	Idees, stray	193
Antiseptic, another new	197	Insect-eating plants	192
Appreciation	201	Inventions patented in England	202
Aurora, an experimental*	197	Iron, protosulphide of (30)	203
Ballooning at night	196	Lamp and oil can, combined*	198
Balloons, hot air (12)	203	Life-saving apparatus*	194
Barnacles on the Great Eastern	197	Lightning, properties of (6)	203
Battery, power of Callaud (2)	203	Lightning rods (4)	203
Birds' nests, edible	201	Mississippi improvements, the	197
Bleaching gums (49)	204	Mississippi, new jetties of the	200
Bleaching mineral oils (20)	203	Moon's revolution, the (50)	204
Boats, flat-bottomed (17)	203	New books and publications	202
Boiler phenomena, steam	193	Oleaginous seed, a new	197
Boilers, rubber joints on (14)	203	Pakfong	201
Brakes, screws for (13)	203	Patent decisions, recent	201
Business and personal	203	Patents, American and foreign	202
Buttons, steatite (42)	204	Patents, list of Canadian	204
Canal, projected French	191	Patents, new commissioner of	193
Cap, reversible*	198	Patents, official list of	204
Catarrh, remedy for (46)	204	Peach borer, the (25)	203
Celluloid	193	Perfuming wood (44)	204
Cementing gutta percha (45)	204	Phosphorus, luminous (28)	203
Centennial buildings, the*	199	Planchette (36)	203
Centennial, machines at the	194	Porous cups (3)	203
Charcoal, doses of (46)	204	Potash from corn cobs (40)	203
Chimneys on lamps (24)	203	Railways, safety of	199
Cider, to clarify (48)	204	Rubber plates, electric (7)	203
Collodion	197	Safety valve, a mercurial*	198
Cotton seed as fodder (29)	203	Safety valve tests	191
Disinfectants	193	Salycilic acid in infusions	197
Earth's rotation visible, the (19)	203	Scientist, a model	200
Electric alarm, wire for (5)	203	Shell, the water	201
Electric force, what it is*	196	Soapstone, Pennsylvanian (43)	204
Engineering, ancient	199	Steam at 500 lbs. pressure	199
Engineering, progress of	199	Steamers, small (16)	203
Engines for boats (18, 26, 35)	203	Stone arrow heads, etc., (27)	203
Engines, power of (34)	203	Telegraphy	199
Engine, testing an (15)	03	Textile industries	199
Flies on a wall (23)	203	Torpedo trials at Newport, R. I.	195
Floodway for warehouses*	191	Tree protection, national	197
Flues, proportions of (8)	203	Varnish, paraffin (46)	204
Foil, Japanese variegated	198	Vis , improved*	198
Gages, pressure, errors in (10)	203	Water, compressible (11)	203
Galvanizing wire (1)	203	Waterfalls, power of (33)	203
Glass, frosting (21)	203	Water pressure engine*	195
Gutter pipes, tin (31)	203	Waterproofing paper (22)	203
Hay, a shower of	197	Yeast compressed (47)	204
Hell gate excavations completed	192		

INSECT-EATING PLANTS.

The SCIENTIFIC AMERICAN for July 3, 1875, contained a page of engravings representing the principal plants which capture insects, with a summary of what had been published in regard to their strange habits. An immense addition to this new and marvelous department of knowledge has just been made in Mr. Darwin's "Insectivorous Plants," in which he sums up the results of some fifteen years of observation and experiment: a contribution to Science as noteworthy as his work on "The Fertilization of the Orchids," or that on "The Structure and Distribution of Coral Reefs," works which the most determined adversaries of Darwinism have not presumed to denounce as unscientific. More than half the volume, which comprises nearly five hundred closely printed pages, is devoted to the study of the common sundew of England, *drosera rotundifolia*. Six other species of drosera from various parts of the world were also brought under observation; also the Venus fly trap (*dionæa muscipula*) of North Carolina; the aquatic *aldrovanda vesiculosa*; the fly catcher of the Portuguese, *drosophyllum lusitanicum*: *roridula dentata*, from Cape of Good Hope; *byblis gigantea*, from Western Australia; several species of *pinguicula*, and a number of *urticularia*. The *nepenthes*, studied by Dr. Hooker, are merely noticed incidentally.

The characteristic feature of *drosera rotundifolia* is the abundance of gland-bearing filaments—tentacles, Mr. Darwin calls them, from their manner of acting—which cover the upper surface of its round leaves. There are on the average about two hundred of these tentacles to each leaf; and as their terminal glands are always surrounded by drops of extremely viscid secretion, which glitter in the sun like dew drops, the plant gets from them its poetical common name. It gets more—and that is its living; for its short and simple roots are capable only of absorbing water. It is by means of the secretion of the glands and the inward bending of the tentacles that its prey are caught, digested, and absorbed. The glands are wonderfully sensitive to pressure and repeated touching; and when excited, the tentacles bend inward to the center of the leaf and remain inflected over the captured object according to the amount of nutrition it affords. Extremely minute particles of glass, cinders, hair, thread, etc., when placed on the glands, cause the tentacles to bend; but the inflection is not so energetic nor so persistent as when the exciting substance is organic and soluble. So sensitive are the glands that a bit of human hair, exerting a pressure of not more than a millionth of a grain, suffices to induce a movement of the tentacles. The pressure of the delicate feet of gnats causes them to be quickly and securely embraced. The tentacles are indifferent, however, to single touches and even hard blows; also to the repeated blows of drops of rain; greatly to the plant's advantage, Mr. Darwin remarks, for it is thus saved from much useless movement. The absorption of animal matter and various fluids, heat, and galvanic action, also cause the tentacles to become inflated, the movement beginning in about ten seconds when a bit of raw meat is applied to a gland.

The bending of the tentacles is effected by a process of aggregation of the protoplasmic contents of the glands and tentacles. This aggregation is excited by all the stimulants which produce movement: the quickest and most energetic of the many stimulants tried being carbonate of ammonia, a dose of $\frac{1}{134400}$ of a grain sufficing. The process of aggregation goes on only as long as the protoplasm is in a living, vigorous, and oxygenated condition. Immersion in warm water causes the leaves to be inflected and increases their sensitiveness to the action of meat. Inflection is rapid at temperature between 115° and 125° Fah. Temporary paralysis ensues on exposure to 130°, but the leaves recover on being left for a time in cold water. Exposure to 150° causes death: so does prolonged exposure to 145°. Different leaves, however, and even separate cells in the same tentacle, differ considerably in their power of resisting heat.

By testing the leaves with various nitrogenous and non-nitrogenous fluids, Mr. Darwin found them able to detect with almost unerring certainty the presence of nitrogen. Results so obtained led to the enquiry whether the plant possessed the power of dissolving solid animal matter, that is, whether it really had the power of digestion like that that possessed by animals. Numerous experiments proved conclusively that the leaves of drosera are capable of true digestion, and that the glands absorb the digested matter: the most interesting, Mr. Darwin thinks, of all his observations on this remarkable plant, as no such power had previously been known to exist in the vegetable kingdom. The resemblance of drosera digestion to that of animals is singularly close. The digestive secretion is more copious in the presence of nutritive material, and is distinctly acid, like that of the animal stomach. It also contains a ferment closely analogous to or identical with the pepsin of animals, which is secreted only when the glands are excited by the absorption of already soluble animal matter. Albumen (hard-boiled egg), roast meat, fibrin, areolar tissue, cartilage, fibro-cartilage bone, milk, casein, legumin, and other substances were found to be acted on by the plant secretion precisely as by the gastric juice of animals. Fresh gluten was too strong for the plants but after the starch was removed by treatment with weak hydrochloric acid, it was digested rapidly. Starch is indigestible, and so are epidermic substances, such as human nails, hair, quills of feathers, fibro-elastic tissue, mucine, pepsin, urea, chitine chlorophyll, cellulose, gun cotton, fat, and oil: all of which are similarly unaffected by gastric juice, though some of them are acted on by other secretions of the animal alimentary canal. The plants are also, to a limited extent, vegetable feeders, having power to digest some parts of leaves, and to partially dissolve pollen and living seed. Like animals, too, these plants suffer grievously from dyspepsia, in case of surfeit, even of the most digestible substances.

The sensitiveness of the leaves to carbonate of ammonia has already been mentioned. Like effect, in varying degree, is produced by all the other salts of ammonia. The citrate is least, and the phosphate most, powerful. Of the latter, less than one twenty-millionth of a grain in solution, applied to a gland, is sufficient to cause the tentacles bearing the gland to bend to the center of the leaf. Many other salts were experimented with, the nature of the base proving, as in the case of animals, far more influential than that of the acid. Nine salts of sodium all caused well marked inflection, and none were poisonous in small doses; whereas seven of the nine corresponding salts of potassium produced no effect, two causing slight inflection. Some of the potassium salts were poisonous. The so called earthy salts produced little effect; on the other hand, most of the metallic salts caused rapid and strong inflections, and were highly poisonous. To this rule there were some odd exceptions; for example, the chlorides of lead and zinc and two salts of barium did not cause inflection, and were not poisonous. Twenty-four acids were tried, much diluted: nineteen caused the tentacles to be more or less affected. Most of the acids were poisonous. Benzoic acid is very poisonous, though innocuous to animals. Many of the poisonous acids caused the secretion of an extraordinary amount of mucus, long ropes of it hanging from the leaves when they were lifted out of the solutions. Allied acids act very differently, formic acid, for instance, producing but slight effect, while acetic acid of the same strength is poisonous and acts powerfully.

A large number of vegetable alkaloids and other substances were experimented with, developing some very curious results. Substances like strychnin, nicotin, digitalin, and hydrocyanic acid, which act poisonously on the nervous system of animals, are also poisonous to drosera, but probably excite inflection by acting on elements in no way analogous to the nerve cells of animals. The poison of the cobra, so deadly to animals by paralysing their nerve centers, is harmless to these plants, though causing quick and strong inflection. The absence of nerve elements is made still more probable by the indifference of the plant to morphia, hyoscyamus, atropin, veratrin, dilute alcohol, and other substances which produce a marked effect upon the nervous systems of animals.

To summarise the physiology, so to speak, of the plant's sensitiveness, and the manner of its manifestation, would expand this article beyond limits. The structure and movements of six other species of drosera have been studied though less extensively than those of the common sundew. They are all insect-catchers, using very nearly the same means.

More wonderful in its adaptation to a carnivorous life is the Venus flytrap, found only in the eastern part of North Carolina. Its poorly developed roots, like those of drosera are capable only of absorbing water, so that, lacking its predaceous habit, it would soon cease to exist. Its manner of catching insects and general behavior have already been described in this paper in the observations of Mrs. Treat. Like the sundew, it is extremely sensitive to the touch of edible matter, yet indifferent to rain drops and gusts of wind. This is the more remarkable in the case of the Venus flytrap, since it captures its prey, not by means of a viscid secretion, but by a sudden shutting of its leaves, trap-fashion. The digestive power of this plant varies somewhat from that of drosera. The secretion from its glands dissolves albumen, gelatin, and meat, if too large pieces are not given. Fat and fibro-elastic tissue are not digested: nor is chemically prepared casein or ordinary cheese. The mechanism of the dionæa trap is such that minute insects escape, while the relatively large ones are retained: an arrangement which Mr. Darwin regards as very beneficial to the plant, inasmuch as it would manifestly be a great disadvantage to the plant to waste many days in remaining clasped over a minute insect, and several additional days or weeks in afterwards recovering its sensibility. The amount of nutriment would not compensate for the effort. There is evidently room, however, for further investigation in this direction, since, owing to the limited digestive power of the leaves, a single large insect is often too much for them. As in the drosera, the impulse which causes motion in the leaf travels in all directions through the cellular tissue, independently of the course of the vessels of the leaf. It was in this connection that Dr. Burden-Sanderson made his wonderful discovery that there exists a normal electric current in the blade and foot stalk of these leaves, and that, when the leaves are irritated, the current is disturbed in the same manner as during the contraction of the muscle of an animal.

The characteristics of the less known insectivorous plants will be summarized in another article.

COMPLETION OF THE HELL GATE EXCAVATIONS.

On July 4, 1876, the great explosion which is to shatter the submarine rocks at Hallett's Point and open a navigable channel for vessels of large draft, coming and going through Long Island Sound, to and from New York city will take place; such, at least, we understand to be the present intention of those in charge of the work. The excavations were completed about two months ago, and the operation now in progress consists in the boring of the holes in which the heavy charges of nitro-glycerin are to placed. These borings are about half finished, and will require the labor of two or three months longer, after which two months more will be occupied in inserting the charges.

The entire surface undermined measures 2¼ acres, and the cuttings aggregate 7,542 feet in length, varying in hight from 8 to 22 feet, and in width from 12 to 13 feet. There is a roof ten feet thick between the mine and the water; and the latter, at the outer edge of the excavation, is 26 feet deep at low tide. Between the headings and galleries heavy piers are left, which now sustain the immense weight of rock and water above. In each pier from ten to fifteen 2 and 3 inch holes are being drilled, and in the roof similar apertures are being made at intervals of 5 feet apart. All of these openings will be filled with nitro-glycerin, in charges of 8 and 10 pounds, and all will be connected together by gas pipe filled with the same explosive. This will be done during the cold weather, when the danger of hauling the nitro glycerin is greatly diminished.

Previous to the explosion, the coffer dam will be broken away and the water allowed to fill the entire excavation, so that it will serve as a tamping. Then, by means of an electric fuse, the nitro-glycerin in the gas pipe will be fired, which will determine the blowing up of the whole affair. No fear is apprehended as to the result, since it has been determined that the explosion of half the charges will be sufficient to cave in the roof, and cause it to fall to the sunken floor, deepening the water at once to a proper depth, or necessitating but little dredging to complete the work.

The new operations at Flood Rock will involve still greater cuttings than at Hallett's Point. The shaft is now down to a depth of 50 feet. The Hallett's Point work has been under way since 1869, but has been greatly delayed by the failure of Congress to provide sufficient appropriations; if the same course is to be followed with reference to the Flood Rock excavations, it will be manifestly impossible to form any estimate of their time of completion.

DRUGGING HORSES.

There is a subject in connection with our four-footed servants, which is worth more attention than ordinarily is accorded it; and since it is an abuse, a remedy or means of prevention is needed. We allude to the drugging of horses, either to give them temporarily the appearance of being in fine condition, or to have the opposite effect, by making them ill to defeat their chances of success in a race. Both of these practices are cruel and inhuman, as well as criminally fraudulent, and hence commend themselves to the notice of societies for the prevention of cruelty to animals, while at the same time indicating a possible necessity for severe penalties.

An act of Parliament has recently been passed in England, the object of which is summarily to put a stop to these nefarious practices. It provides that if any one, other than a member of the Royal College of Veterinary Surgeons, shall give any animal any of the drugs contained in a given schedule without the consent of the owner, he shall be liable to fine or imprisonment. The drugs and preparations enumerated are as follows: Arsenic and its preparations, prussic acid