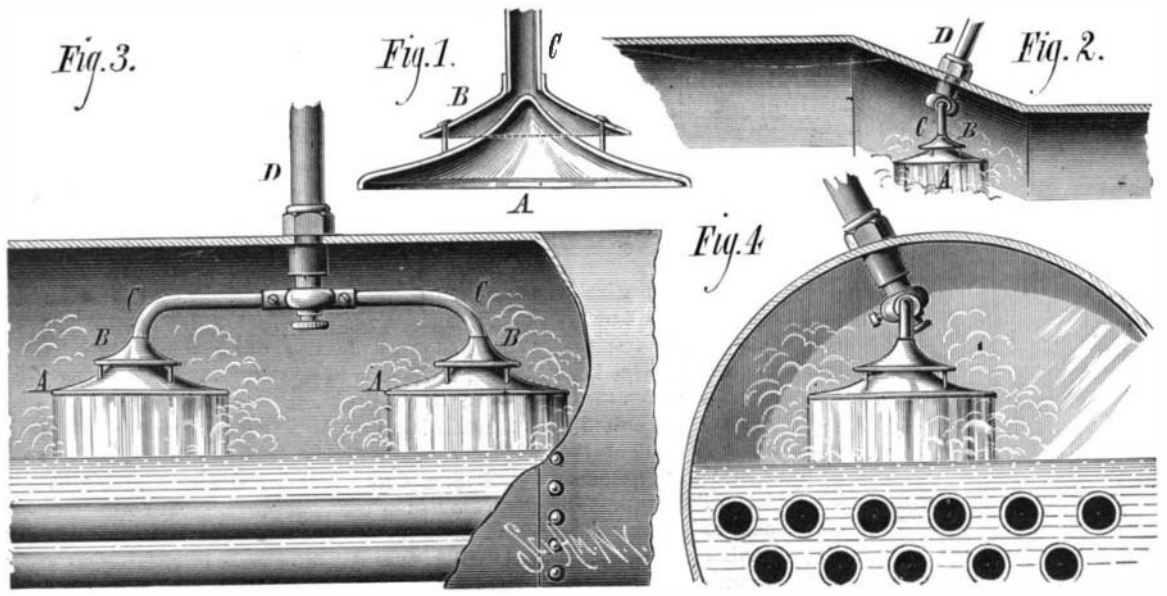
A USEFUL STEAM BOILER APPLIANCE.

Aside from defects in the construction of boilers, undoubtedly the greatest source of expense and danger is the accumulation of sediment and incrustation on the heating surfaces; and while special preparations in some instances prevent the accumulation of scale, the use of such preparations is, to say the least, inconvenient, and, as a rule, they make the water in a boiler to all appearance dirtier than it could be made by natural causes.

Our engraving illustrates a device which obviates the difficulties arising from the use of bad water, by precipitating the mineral salts and other impurities in the feed water before it joins the body of the water in the boiler. This important result is secured by allowing the water to enter the boiler through the steam space in a thin sheet or spray, which is instantly heated to the boiling point, precipitating the impurities before it reaches the surface of the water contained by the boiler. The precipitate goes immediately to the bottom of the boiler, whence it is removed by blowing out two or three times daily. This is a new departure in steam engineering, and it is looked upon with some suspicion on the part of steam engineers who have never investigated the subject, but actual experiment has proved that no more loss is experienced in introducing feed water in this way than any other, while the advantages attending this method are very great.



MOREHOUSE'S ANTI-INCRUSTATOR.

The device by which water is introduced into the boiler is clearly represented in the engraving, Fig. 1 representing the peculiar nozzle for spreading the water injected into the boiler; Fig. 2 shows the application of the device to a locomotive boiler, and Figs. 3 and 4 are respectively longitudinal and transverse sections of a cylindrical boiler provided with the anti-incrustator.

The water distributer consists of a conical plate, A, suspended beneath the flaring end, B, of the pipe, C, by three bolts, which may be adjusted so as to vary the distance between the plate, A, and the flaring pipe end, B, and thus regulate the amount of water entering the boiler. The inventor prefers to arrange two water distributers as shown in Fig. 3, the two pipes, C, being connected with a T whose shank projects through the boiler shell and connects with the feed pipe, D.

With this device, either hot or cold feed water may be used. Among the many important advantages arising from the use of this improvement, the most prominent are, the entire prevention of scale, the absence of foaming or priming, and the obviation of that class of injuries to boilers resulting from the contact of cool feed water with hot iron surfaces.

Further information concerning this useful invention may be obtained by addressing the patentee, Mr. Wm. Morehouse, 147 Mariner street, Buffalo, N. Y.

NEW CEILING AND WALL.

The ordinary method of lathing and plastering the ceilings and interior walls of buildings consists in nailing wooden laths to the joists or studs, then applying two separate coats of mortar; and, lastly, a white coat or "finish," composed of slaked lime and plaster of Paris, the latter being put in to give strength and solidity to the work. This method is objectionable on account of the time required for each coat to become dry before the succeeding one can be applied, and the mortar is liable to crack and become detached; and the inflammable character of the lath is another objection to this method.

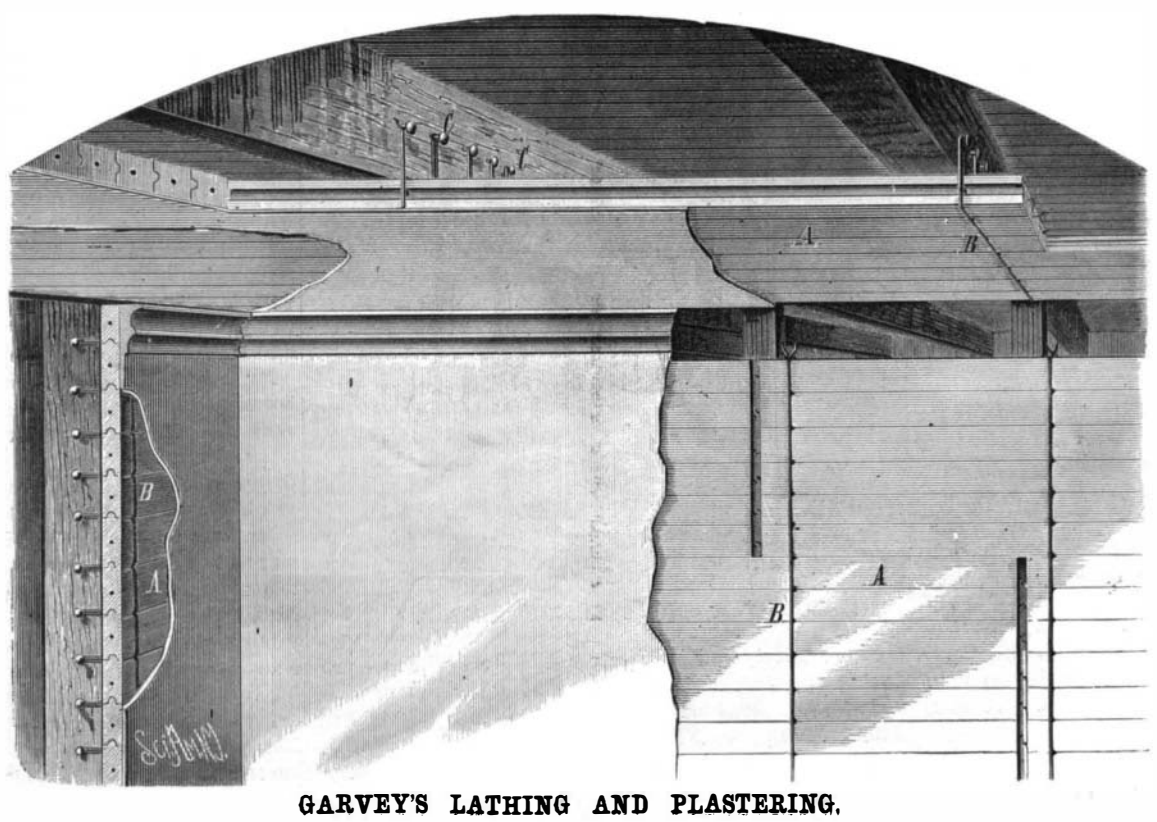
Our engraving shows a novel lath recently patented by Mr. Walter J. Garvey, of 407 Chestnut street, St. Louis, Mo. This lath consists of a bar of plaster of Paris cast in a mould around a stiffening and strengthening wire. The edges are tongued and grooved so that the entire series of laths may be locked together. These laths are made in lengths of 12, 16, 32, or 48 inches, as may be required. In width they may vary between 1½ and 2 inches.

Referring to the engraving, the laths, A, are secured in place by wires, B, looped over nails driven into the sides of the joists or studs. The contiguous ends of the laths are separated a short distance, and the intervening space is filled with plaster, making a smooth joint and at the same time fastening the laths by enveloping the wire core which is allowed to project beyond the end of the lath. As soon as the laths have been thus applied and fastened the white plaster coat or finish may be at once put on, when the work is complete.

This style of wall and ceiling may be made much quicker than by the ordinary methods, thereby saving three fourths of the time required to finish the walls of a house, and when done it is harder and more durable than ordinary lath and plaster walls and ceilings, besides being entirely fireproof.

The inventor informs us that this wall will not crack, as its peculiar construction admits of considerable change in the frame of a building without affecting the walls.

The lath may be manufactured where it is used, or it may be readily shipped to any point where needed.



GARVEY'S LATHING AND PLASTERING.

ENGINEERING INVENTIONS.

Messrs. Gustav Ripp and John Mueller, of Jersey City, N. J., have patented a new and improved automatic apparatus which will shut off the motive element from the engine in case the belts or machinery break or become disordered.

Mr. John H. Gable, of Shamokin, Pa., has patented an improved pipe cleaner for cleaning deposits of sediment from the inner surfaces of the column or pump pipes of mine shafts and slopes, and for cleaning out other pipes. The invention consists of a pipe cleaner formed of a cylinder or frame provided with cutters to loosen the sediment, wheels to crush and pulverize the sediment, and a brush to sweep the inner surface of the pipe.

Mr. Orlo H. Drinkwater, of Cedar Point, Kan., has invented a car coupling which consists mainly of a draw bar having a hook or shoulder and a link or clasp, which is pivoted and adapted to receive and lock with the shoulder or hook of a draw bar attached to the opposite car. The links or hinged clasps are held engaged with the respective draw bars by means of a spring or other suitable devices, and may be opened to allow uncoupling by means of rods, levers, or other means. The hinged loop or clasp is held open by a spring catch until the latter is acted on automatically, thus causing it to release the clasp.

IMPROVED MILL PICK.

The annexed engraving represents an improved mill pick patented by Mr. Edgar F. Lemoine, of Emmerton, Va. The novel feature of this pick is the employment of a thin blade tempered throughout its entire length, and capable of being entirely used up without forging or retempering. The invention consists in a pair of serrated clamping jaws, which receive the thin picking blades, the latter being provided on their inner ends with two or three ratchet teeth for engaging the serrations of the clamping jaws. The outer jaw is perforated with a screw threaded hole for receiving the threaded portion of the handle; the inner jaw has a plain hole through it fitting the plain portion of the handle. By turning the handle, by means of a lever or wrench, the jaws are brought firmly down upon the picking blades, which are as efficient as if they were an integral part of the jaws, having the advantage of being adjustable as they become worn.

LEMOINE'S MILL PICK.

The inventor proposes, in some instances, to put ratchet teeth only on one side of the blade, when two blades may be placed in each jaw.

The jaws may be conveniently used to hold the blades while grinding. This improved pick seems to possess many advantages over the ordinary form, it is easily kept in order, and is much cheaper, if the expense and trouble of sharpening and retempering are considered.

Railways and Population.

A table constructed by Prof. Stürmer, of Bromberg, shows the length of railway in several of the chief countries of the world and its proportion to the population. In Europe, on the average, there are 4·9 kilometers of railway to every 10,000 inhabitants. Greece has the least proportion to the population, having only 0·08 kilometer to every 10,000 of the population. Next comes Turkey, with 1·6; Portugal, 2·3, Roumania, 2·4; Russia, 2·8; Italy, 2·9; and so upward in the scale, France having 6·3; Germany, 7·1; Great Britain, 8·1; and Sweden heading the list with 10·8, though its total mileage is not a fifth of that of Great Britain. In Asia it appears that only 0·16 kilometer is averaged to every 10,000 inhabitants; and in Africa the proportion is only 0·17. In the United States the proportion is heavy—32·9 to every 10,000 of the people; while the whole of America has the average of 17·2, and in Australia the proportion is already 10·6. The thinly-peopled countries, the *Pall Mall Gazette* remarks, necessarily come to the front in this instance; but the table is of some interest as showing the effect of a large or small length of line in effecting

comparisons of this nature, and also in indicating the comparative density of population to that of the facilities for its conveyance by rail.

THE CRINOIDS OF CRAWFORDSVILLE.

BY H. C. HOVEY.

The rocks of Indiana are generally hidden by heavy drift and lacustral deposits. Their nature and contents are ascertained by the exposure of strata along the line of streams, and more recently by quarries, mines, and other artificial excavations. Of the latter there were few in those early days when Prof. E. O. Hovey—for whom, in behalf of science as well as from filial regard, a place is claimed among the pioneer geologists of the West—began to explore the resources of that region. The extensive cabinet of Wabash College is a memorial of his diligence; but those who admire its specimens can hardly realize the weary rambles on foot and hazardous voyages by raft or canoe by means of which many of them were secured.

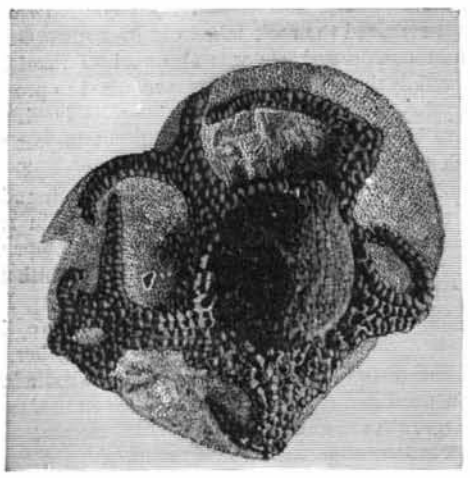
Here and there, along Sugar Creek, as it cuts its way through the woodlands and wheat fields of Montgomery county, my father discovered, as early as 1836, banks made up of rings and stems mingled with shells and geodes. Public attention was first called to these singular deposits in Owen's preliminary geological report (1838), on account of their economic value as material for the manufacture of lime. He merely says: "Four miles below Crawfordsville, at the mouth of Aufield's Creek, a stratum, some four to eight feet thick, of encrinital limestone is exposed." The next notice taken of the locality is in Lawrence's manual of the "Geological Formations of the Western States" (Boston, 1843), in which he speaks of it as exceedingly rich in encrinites. "Here," he says, "the finest specimens in the country are obtained, both on account of their size and beauty." I doubt if either of these gentlemen did more than make a flying visit to those crinoid banks, or saw anything better than the rings and stems referred to above.

Organic remains, such as those now described, both interested and puzzled scientific men long before their true nature was discovered. Three hundred years ago curiosity-hunters in Europe found pebbles impressed with star-shaped figures, and called them "trochites." At first, they were regarded with mysterious awe; and it was doubted whether they were crystals, petrefactions, or elfin charms. Certain flower-like impressions were afterward found on the rocks, which were called "encrinites," or stone lilies. The long stems and feathery corona of these mimic blossoms deceived even the great botanist, Linnæus, who did not detect their animal nature. In A. D. 1755, a "marine palm" was found near the island of Martinique, which was described as such in the tenth edition of "Systema Naturæ," under the name of the *Pentacrinus asterias*. This is now regarded as the typical crinoid.

Cuvier saw the truth that had escaped others, namely, that the Pentacrinus, instead of being a plant, was an animal, "a star fish with a stem;" and that the encrinite was its fossil representative, of which the trochites were only fragments. At a still later day the name "crinoidea" was given, by J. S. Miller, to include the entire order. In common parlance at the West the term encrinites has been given to the fragmentary stems, while that of crinoid has been reserved for the flower-like head growing at the upper end of the stem. For reasons that will appear more fully in the course of this article, we know that, where the former are most abundant the latter are rare, and indeed they are now sought in an entirely different stratum.

In the summer of 1842, a New York collector advertised for encrinites, offering to pay $5 a bushel for them on delivery. What a chance for a boy nine years old to earn pocket money! I forwarded a bushel of the stems at once, and told him he could have more at the same rate; but he sent word that the market was supplied! While filling this order I picked up a pebble wholly unlike anything previously found in the region, and prudently retained it for my juvenile cabinet. It was covered with warty protuberances, and hence was identified by the rustics as a "petrified toad," by the same process of guesswork that led them to describe the stems as petrified snakes, and the rings as Indian beads. But my specimen was really a weather-beaten *Actinocrinus*, and was probably the first true crinoid ever found in the Crawfordsville banks, whence thousands have since gone to adorn public and private cabinets in this country and in Europe. The locality where it was obtained is now called Corey's Bluff, and is about six miles above the spot mentioned by Owen. Other crinoid banks were also explored—at Remley's Ford, Island Ford, Indian Ford, and on Walnut Fork, Black Creek, and other tributaries of Sugar Creek. By diligent search, additional crinoids were found, and of greatly diversified peculiarities. They are referable to what is now known as the Keokuk group, forming part of the broad belt of sub-carboniferous rocks that sweeps entirely through the State from the Ohio River to Lake Michigan. To the early geologists, however, who cautiously felt their way along the path of science, it was simply known as "Formation No. 3," and its fossils likewise were for the most part merely numbered, except in cases where well ascertained distinctions warranted an attempt at classification by names. My father published several articles bringing the crinoid banks of Indiana to the notice of the scientific world; but he left the task of describing new genera and species to those whom he regarded as more experienced palæontologists.

As recently as 1848, the only books in existence devoted exclusively to the subject of crinoids were the monographs of Miller and Austin, treating wholly of those that had been found in Europe. Numerous papers on the subject had appeared, however, some of them dating back to the last century; but these were scattered through various scientific works with which Indiana libraries were at that time scantily supplied. New contributions to crinoidal literature have been made since then in profusion, especially in connection with the elegant volumes embodying the results of geological surveys in many of the Western States, until now it is



GONIASTEROIDOCRINUS TUBEROSUS—(Natural Size.)

said that three hundred and eighty naturalists have written on crinoids, and that their productions would fill a library by themselves!

Agassiz, in his "Methods of Study," skillfully and at considerable length, traces the homology of the echinodermata; showing that the star fish, sea urchin, serpent star, sea cucumber, and sea lily (crinoid) are but modifications of one persistent creative idea.

Haeckel exalts the Echinodermata from being, as in the Cuvierian system, a mere class of the Radiata—the lowest sub-kingdom—to an honorable rank as one of the seven chief tribes into which he divides the animal kingdom, and only the third below the Vertebrata. He also arranges the crinoidea in three families, namely, those having arms and stems (brachiata); those that are nut-like (blastoidea); those that resemble little sacs or pouches (cystidea). The Indiana crinoids are mostly brachiata, but the other two families are represented.

The anatomy of the crinoid presents certain remarkable features, to be described as follows:

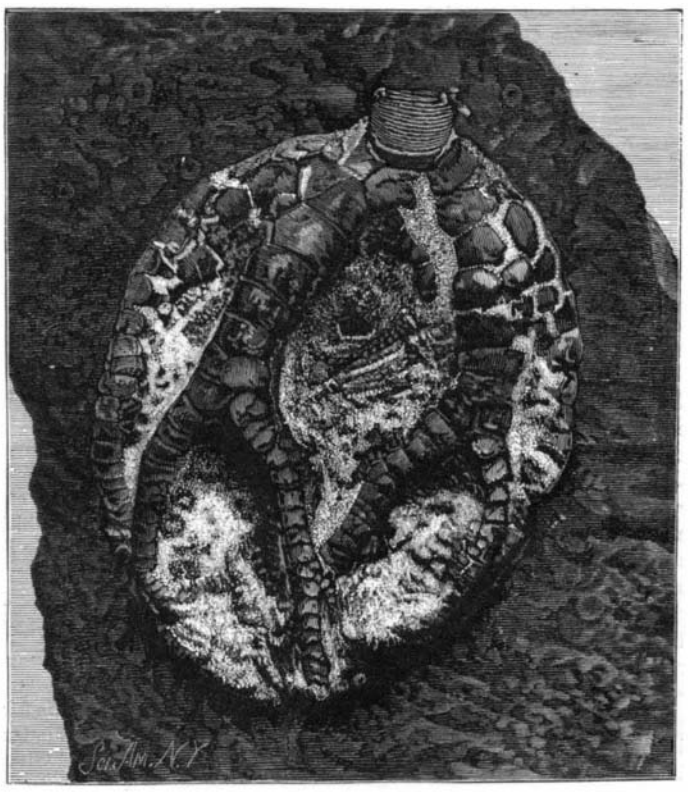


Fig. 2.—ONYCHOCRINUS EXCULPTUS—(Natural Size.)

1. *The Root.*—The comatula, and other free crinoids, have mere tufts of cirri, whereby to grasp sea weeds or any other support, or else to anchor themselves on muddy bottoms. They can free themselves at pleasure and either swim or float away elsewhere. But the fixed crinoids have stout, jointed, branching roots, some of which look like the stumps of diminutive oaks. These may grasp branches of coral, and the stems of other crinoids, or they may spread wide ramifications on the mud of the sea floor. Other roots are formed by a simple enlargement of the lowest ossicle of the stem, cementing it by concentric layers to a ledge of rock, whence the plant-like animal rises amid the waters. There are specimens in the Harvard Museum, in which this is reversed; the roots clinging to lignite, showing that these crinoids, which are from the Tertiary, originally hung down from floating blocks of wood.

2. *The Stem.*—This is a series of flat, calcareous rings, uniting to form a tubular column that rests on the root. The shape often varies, even in a single stem, making the identification of fragments difficult. The cyclindrical form prevails, but many are oval or pentagonal. The canal generally, but not always, conforms to the exterior. The rings are in some specimens extremely thin, while in others they are a quarter of an inch thick. They break with a crystalline fracture. The softer parts, not being capable of petrifaction, have disappeared; but it is supposed that in the living animal the joints were held together by fibers running lengthwise of the stem, and also by an integument. The canal was filled with gelatinous substance. The articulations of the disks usually radiate in fine lines from the canal outward. but in the curiously twisted stem of the *Platycrinus hemisphericus* a ridge coinciding with the long axis of the oval joint takes the place of these lines. This beautiful species has also two spiral rows of tendrils along a portion of its stalk, each joint furnishing a pair. In other varieties the tendrils protrude singly or in pairs, or in whorls of threes, or even fives. I have seen fifty successive rings without a tendril, and then one will shoot out of great relative size, spanning five or six rings at its base. Some stems are smooth, faintly marked cylinders; others are grooved, fluted, bead-like, moniliform, or decorated with spines and knobs. Usually they are broken up into pieces from one to five inches in length. But they often are much longer, and one was measured at Island Ford that was six feet long as it lay on the ledge. They vary in diameter from one thirty-second of an inch to an inch or more. Tablets of encrinital limestone are to be seen where they lie in coils and knots, cemented to the stone, with here and there a head in bass-relief.

3. *The Head.*—Every stem is fairly entitled to a head, but they are seldom found together. This is due partly to the existence of a peculiar split joint, called by Miller a "syzygy," not bound by muscles or fibers, hence easily snapped by a jerk, to free an entangled arm, that is afterward reproduced at leisure. Prof. Verrill states that living crinoids have to be taken with great care, and at once immersed in alcohol, or else they will literally fly all to pieces. This work of destruction is also aided by the natural decay of the membrane covering and holding together the whole body in life; whereupon the hundreds of calcareous plates fall apart. Hence good heads do not abound where the stems are best; but in beds of shale that was once mud, by which the animal was smothered and held while the stems, dismembered, sank down to a lower stratum. This is shown by a section of Corey's Bluff. On a floor of limestone rests a bed of blue shale, twenty-five feet thick, and almost completely made up of encrinite stems. Above this is a layer of gray sandstone, two feet thick, supporting a bed of softer shale than the first. Here the heads abound, being preserved as described. This is about five feet thick. Successive strata of sandstone, comparatively barren of fossils, rise for twenty-five feet, or to the soil. Thus deep and heavy excavations must be made in order to get at the fossiliferous horizon.

Inspection of a well cleaned calyx, or head, shows it to be built up of several series of plates. The lowest are the *basals*, being from two to six calcareous buttons resting on the terminal disk of the stem. Then come one or more circles of *radials* and *interradials*, uniting to form a visceral cup. The uppermost row is suitably beveled to receive the *brachials*, or arm plates. The primary branches are liable to repeated subdivision, until in some species there are from 80 to 100 rays, and the total number of plates exceeds 1,000, besides their fringe of graceful cilia. When the arms are expanded, or entirely removed, the close-fitting ventral plates are seen. The stomach is supported, as it seems from the researches of Meek and Worthen, by a convoluted cylinder, resembling the finest lace. The proboscis, or chimney, is really an excretory tube, rising from the ventral plates, in some cases, till it protrudes beyond the arms.

Austin, Murchison, and others regarded crinoids as predatory creatures, crushing and devouring shell-fish. But observation of living species proves this to be an error. The animal sucks in through channels in its arms, tiny streams holding food in suspension or solution. These are poured into the stomach, sifted perhaps by the net-like apparatus described above; then when all assimilable matter is extracted the exhausted liquid is spurted through the proboscis to such a distance as to prevent its immediate return. The currents thus made drew in young parasitic shells, which they also fed by animalcula. The most common of these in former ages were the *platyceras*, scores of which I have examined without finding any evidence that they either devoured or were devoured by the host that carried them; yet the shell sometimes grew to such a size as to be a troublesome if not a fatal guest. (See Fig. 1.)

The entire number of crinoids secured by us, including purchases, was about 3,000; varying in size from the *Onychocrinus exculptus* (Fig. 2) down to the merest buds and sprays. The best were cleaned for the cabinet; many were disposed of by exchange; the remainder are stored in boxes.

It is estimated that more that 5,000 crinoids in all have