[For the Scientific American.]

THE SCORPION.

[By Edward C. H. Day, of the School of Mines, Columbia College.]

Every one has heard or read of the scorpion; there are no natural objects more familiar to us than insects; and yet, we venture to say, that there are but few readers of the SCIENTIFIC AMERICAN, excepting those who have been educated in the technicalities of natural history, that can place the scorpion in its proper position in the animal kingdom, or that can give anything like an accurate definition of the word insect.

The great sub kingdom or "branch," as some naturalists term it, of the animal kingdom, called the articulates, consists of those animals in which the entire being is divided into a series of joints, inclosed in rings forming, generally speaking, a hard external skeleton. In the lower forms, frequently, each segment possesses a more or less perfect individuality, and the total number of segments may be very great. Thus in the tapeworm they may be counted by hundreds, and most of the joints are capable of a temporary independent existence.

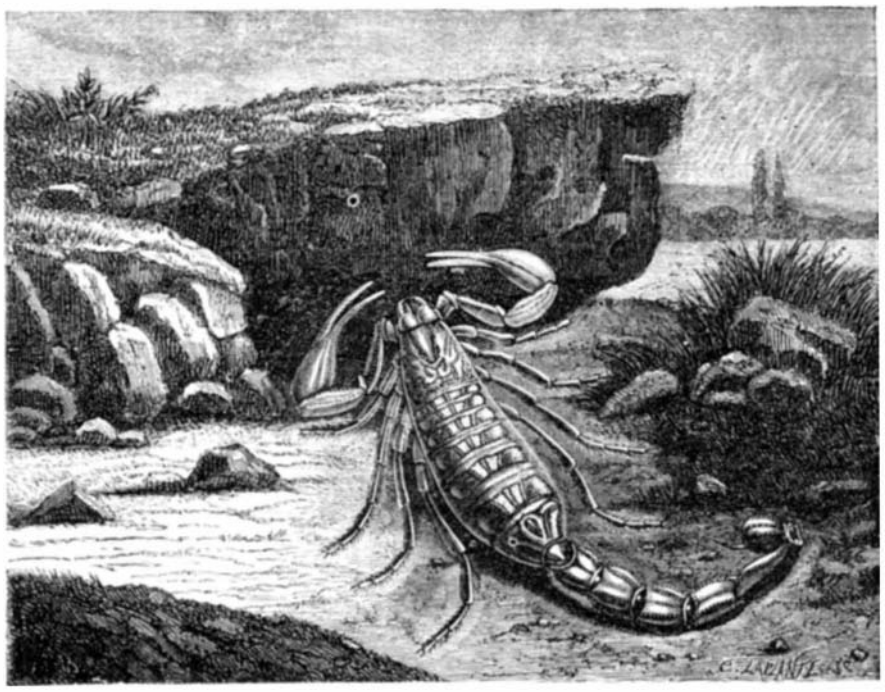
On the other hand, in the spider, the division into segments, although existing, is almost concealed, the animal being apparently divided into buttwo regions—the one composing the head and the limb-supporting portion of the body, the other constituting the hind-body or abdomen.

Among the creatures included in the articulate sub-kingdom, we thus recognize a primary broad distinction between those in which the ringed character is most apparent, and locomotive organs are altogether wanting, as in the common earthworm; and others, such as the lobster, the spider, and the various winged insects in which the repetition of joints is not necessarily so prominent a feature, and which are all furnished with distinct limbs. To the former group the great Linnæus gave the appropriate name of *Annelida*; the various members of the latter he massed together as *Insecta*. Later observers found, however, that the crustacea of which the lobster is the type, presented such great differences from the rest that these were separated as a class equal to the annelids. Thus the winged insects, the spiders, and the centipedes, were left together as the class of insects—and this classification obtains with many scientific men at the present; others, however, restrict the term insects to those articulates which, in the perfect state, have but six legs and are mostly winged, and class the spiders, scorpions, and mites, which have eight legs, as "arachnids," and the centipedes and galley worms, which have an indefinite number of feet, as "myriapods."

Thus the word insect is used at the present day by scientific men in two senses, and following the maxim that when doctors disagree opinions are free, the reader may consider himself at liberty to use the term indiscriminately. But if he is wise and wishes to avoid confusion and to cultivate accuracy of speech, he will recognize the importance of confining himself to using it in one or the other sense, and in that alone. Popular usage is, from ignorance, so loose on this point as on many others, that it indicates no choice; we would, therefore, recommend that the term "insect" be restricted to the first group, and that the words "arachnid" and "myriapod" be introduced into every-day language to indicate the others. There will be no difficulty in "naturalizing" such words as conversational terms, if taught to children with examples, just as they learn the words bird or fish. Let bees, butterflies, beetles, and bugs, be always spoken of as insects; a spider as an arachnid; a centipede as a myriapod. The two latter words are not harder to learn or less significant, while they will be far more frequently called into use than such words as hippopotamus or rhinoceros, about which many-syllabled compounds of Greek derivation neither old nor young ever make any great difficulty.

According to this system the scorpion is an arachnid, a member of the same group as the spider. The reader perhaps may fail to see much resemblance, and thinking of a lobster may ask: "Here are four pairs of legs and a pair of pinching 'claws,' and a long jointed hind-body, why don't you place this animal with the lobster among the crustacea instead of with the spiders, which have no such large pincers and a rounded unjointed abdomen?" These resemblances are only apparent; the differences are essential. The claws of the lobster are modified legs, those of the scorpion are greatly developed mouth organs—the latter belong to the head, the former to the creature's body. Again, if you examine the so-called tails, each segment of that of the lobster is provided underneath with a pair of little fins, while those of the scorpion are as free from such appendages as the abdomen of the spider. The respiration of the crustacean is by gills within its body—it breathes air from the water in which it lives, drawing in the water through its mouth, or even in some cases through its shell; whereas the scorpion breathes air directly by means of openings in its sides leading into (loosely speaking) lung-like sacs. Finally the lobster arrives at its adult state only after passing through a series of wonderful transformations, while the scorpion is viviparous, or rather ovo-viviparous—the eggs being fully developed and hatched within the body of the parent, and the young scorpion thus born begins life in its adult form, altering but little afterwards save in size. In this fact the reader will notice that there is a very essential difference from the development of the six-footed insects as described in a former paper. The difference between the spider and the scorpion is similar in its nature to that between the crab and the lobster. As the long, powerful, tail-like abdomen of the latter is represented by the almost unseen one of the former tucked away under the real body, so the rounded abdomen of the spider represents the long-jointed tail of the scorpion with all the parts concentrated and brought nearer the central governing head.

The spider, therefore, stands higher in the scale of existence than the scorpion—the formidable-looking though really harmless claws of the latter are represented by certain mouth organs called "palpi" in the spider. Instead of the sting at the end of the tail that gives the former its evil fame, the latter has hollow jaws, associated with venom glands, in its mouth. The scorpion's sting consists of a hollow claw, underneath which is the poison gland, and when the creature



THE RED SCORPION.

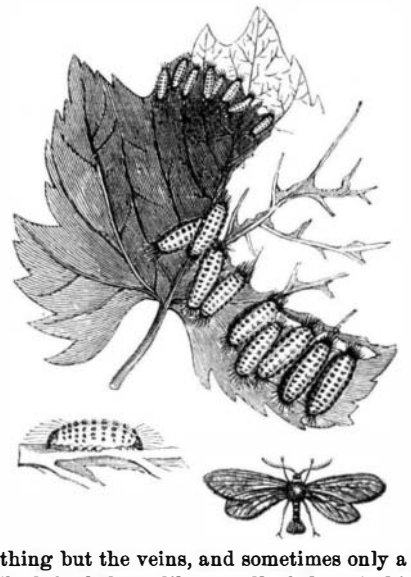
strikes its foe or its prey, the venom is injected into the puncture. The effects of this venom have been much exaggerated. In some cases of enfeebled or peculiarly susceptible constitution a bite may prove fatal, though such is seldom the case, the wound, however, generally producing very disagreeable effects. The most curious fact is, that the poison acts strongly on the creatures themselves. It is said that if several be confined together they will soon be all killed excepting perhaps a solitary survivor. So well was this susceptibility to its own poison recognized formerly, that the story was originated that when a scorpion becomes tired of life it commits suicide. Thus stated we fully assent to the statement, the little conditioned word "when" being, according to our idea, a sufficient guarantee against a very frequent occurrence of such scorpionic hari-kari.

[At least this is the opinion of M. E. Blanchard, as expressed in his beautiful work on insects and their metamorphoses, but Rev. Dr. Smith, President of Dartmouth College, who spent the past winter at the Island of Jamaica, informed us he had ocular proof that, under peculiar circumstances, the scorpion stung itself to death.—EDS.

Insects Injurious to Grape-Vines.

[From the Second Missouri Entomological Report].

During the months of July and August, the leaves of the grape-vine may often be found denuded of their softer parts,



with nothing but the veins, and sometimes only a few of the larger ribs left skeleton-like, to tell of the mischief that has been done. Very frequently, only portions of the leaf will be thus denuded, and in that event, if we examine such a leaf closely, we shall find the authors of the mischief drawn up in line upon the yet leafy tissue, with their heads all toward the margin, cutting away with their little jaws and retreating as they feed.

These little soldier-like files are formed by worms in black and yellow uniforms which produce a moth popularly known as the American Procris. The eggs from which they hatch are laid in small clusters on the underside of the leaves, and while the worms are small, they leave untouched the most delicate veins of the leaf, which then presents a fine network appearance, as shown at the left in the cut; but when they become older and stronger they devour all but the larger ribs as at the right of the figure.

When full grown these worms disperse over the vines or forsake them entirely, and each spins for itself a small, tough, whitish, flattened cocoon, within which, in about three days, it changes to a chrysalis 0·30 inch long, broad, flattened, and of a light shiny yellowish-brown color. In about ten days afterward the moths (shown in the figure) begin to issue. This little moth is the American representative of the European *Procris vitis;* it is wholly of a black color, except the collar, which is of a deep orange, and the body ends in a broad, fan-like, notched tuft, especially in the male. The wings are of a delicate texture, reminding one of crape, and when the insect is at rest they generally form a perfect cross with the body, the hind wings being completely hidden by the front ones, which are stretched out straight at right angles, as in the genus *Pterophorus*, to which belongs the Grape-vine Plume.

The full grown larva measures rather more than half an inch, and tapers a little towards each end. It is of a sulphur yellow color, with a transverse row of six velvety-black, prickly tufts on each of the principal segments, the lower tufts being less distinct than those on the back. The first segment is entirely black with a yellow edge, while the spots on segments 11 and 12 usually run into one another. Head small, brown, and retractile, being usually hidden in the first segment. Fine scattering hairs anteriorly, laterally, and posteriorly. The young worm is of a very pale yellow, covered with numerous fine white hairs, with a slight grayish-brown tint on the head, and with the fifth and seventh segments paler than the rest, and having the black spots scarcely visible.

This is the only North American grape-vine feeding caterpillar which has a gregarious habit, and as gregarious insects are always more easily subdued than those of a solitary nature, the American Procris need never become very destructive. Its natural food is undoubtedly the wild grape-vines of our forests, and the Virginia Creeper, and Mr. J. M. Jordan of St. Louis, has noticed that while it very commonly attacks the foliage of the Concord, yet it never touches the Clinton and Taylor in his vineyard—a taste which is remarkable and not easily accounted for, since the foliage of the latter kinds is more tender and generally more subject to insect depredations than that of the former.

There are two broods of this insect each year with us, some of the moths from the second brood of worms issuing in the fall, but the greater part not leaving their cocoons till the following summer.

Perpetual Motion.

We have received from John C. Gardner a copy of his neatly printed pamphlet of 52 pages, entitled "Perpetual Motion," of which he is an earnest advocate. He employs a variety of mathematical demonstrations in support of the doctrine, but gives us no clew to the particular form of machine which is to be a practical illustration of his theories. He however affirms that aerial navigation is a natural consequence of his discovery of perpetual motion, and we therefore expect before long to see him flying about from point to point, and showing his feathers. His concluding deductions that his perpetual motion theories must be correct because nobody has disproved them, remind us very forcibly of Mark Twain at the grave of Adam.

"It is a singular circumstance," says Mark, "that right under the roof of this same great church, and not far away from that illustrious column, Adam himself, the father of the human race, lies buried. There is no question that he is actually buried in the grave which is pointed out as his—there can be none—because it has never yet been proven that that grave is not the grave in which he is buried. I leaned upon a pillar and burst into tears. I deem it no shame to have wept over the grave of my poor dead relative."

Arsenic in the Soda of Commerce.

Dr. Fresenius calls attention to a fact, accidentally discovered by him, that the carbonate of soda (neutral), as met with in a crystallized state, and as manufactured at the alkali works, now often contains a very perceptible quantity of arseniate, or arsenite of soda, undoubtedly due to the use of sulphuric acid for converting the common salt into sulphate of soda, which acid contains arsenic, derived from the pyrites of which few are quite free from arsenic, and some of which contain that substance in considerable quantity. The tests applied for the detection of this arsenic were not the most delicate in use for this purpose; and the quantity found, though small, is sufficient to affect the purity of preparations for medicinal and chemical use.

PROF. CHANDLER, of the School Mines, Columbia College, recently gave a very delightful afternoon reception at his residence in 49th street to Dr. Vogel, of Prussia, who is now on a visit to this country as a delegate to the convention of photographers at Cleveland. President Barnard, of the College, Dr. Doremus, Prof. Silliman, and other distinguished gentlemen were present.

Improved Steam Excavator.

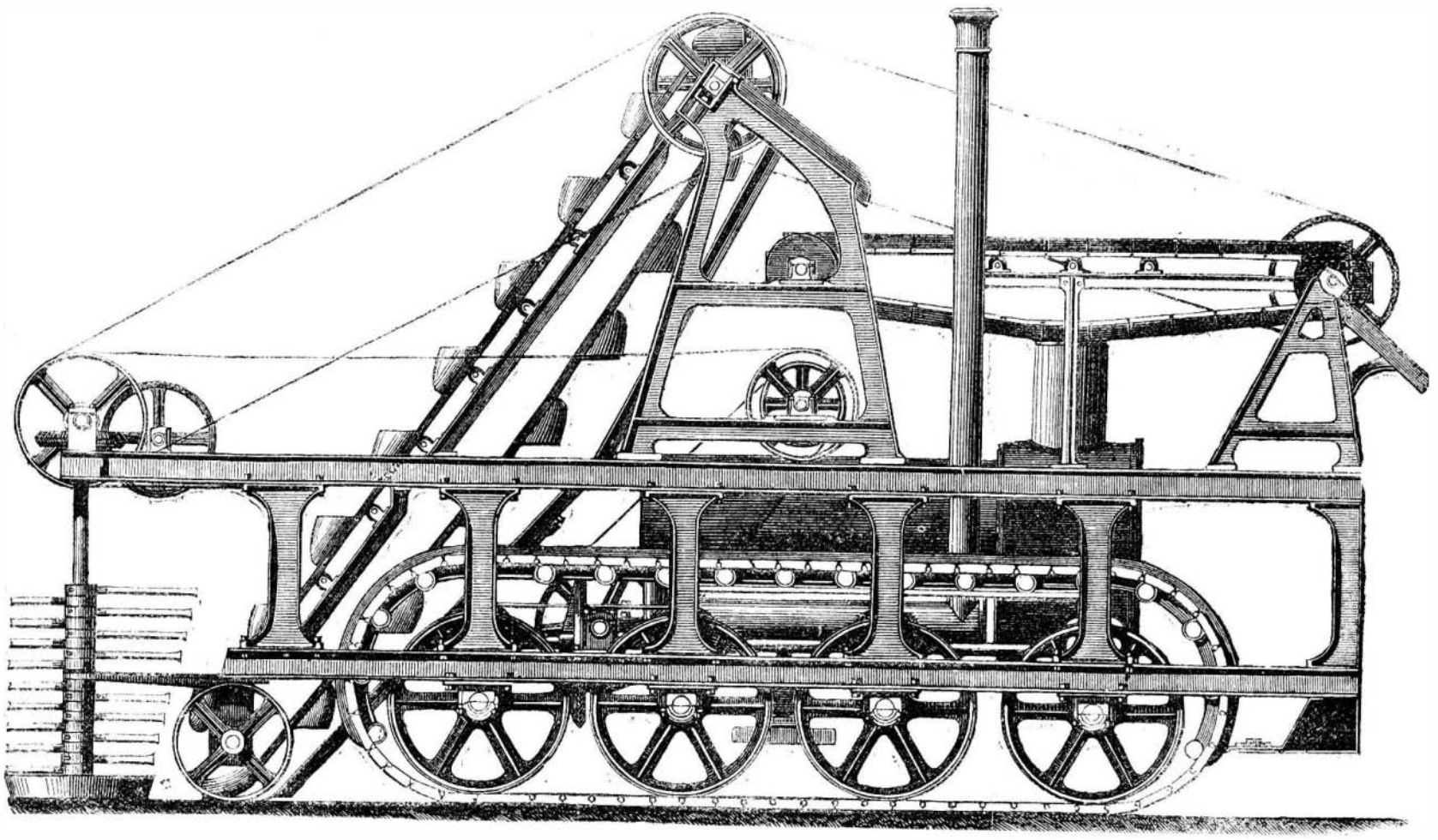
[From The Engineer, London.]

If the question were asked, is it possible to supersede every description of manual labor by the substitution of machinery, the correct answer would be to the effect that there is no doubt about the absolute possibility, but very considerable doubts regarding the expediency of the measure. No people have pushed this principle so far as the Americans—not so much from choice as from sheer necessity—and yet they find that there are some operations which must either continue to be performed by hand, as of old, or not performed at all. The price of labor is one of the most important circumstances bearing upon this subject, although it is equally affected by other considerations. One thing is certain, that, but for the higher cost or the absence of labor, a great number of present admirable inventions and plans in practice for employing machine *vice* hand labor would never have seen the day. It is not difficult to conceive the application of machinery to purposes of manufacture, and there is a certain amount of fitness in so employing it. But it requires a great stretch of the imaginative faculties to consider it as applied to land. Yet for large tracts of country it is now universally recognized as the only proper agent. Steam plows and steel cultivators are, after a hard fight, overcoming the prejudices and almost hatred entertained towards them by the agricultural population. Farming implements on a less pretentious scale, which have for their object the reduction of the laborers' toil, are now to be seen in and about the premises attached to every farm laying any claim to the epithet "large," and even small ones are provided with pulpers, bruisers, grinders, and other small machines, to an extent our grandfathers little imagined.

Engineers are continually being put in mind of the fact that the surface of the earth and its physical features require a good deal of alteration and modification before they can be rendered subservient to the wants and requirements of this age of progress. Excavating and embanking, or, in other words, the transport of some portion of the earth's surface to some other spot than where nature has placed it, is a perpetually recurring operation in all works of engineering and construction generally. The making up of embankments is simply a work of time; it is in the excavation that the navvy has to put forth his bone and muscle; it is by digging that the necessary material for the bank is obtained. We have the highest authority for knowing that in early times digging was, as it is now, the last resource for men who had no other means of gaining a livelihood but by manual labor; it cannot, therefore, be regarded as a very gentlemanly pursuit. Whether M. J. Vandenvinne has been actuated by these considerations we do not know, but he has recently invented and patented a machine for excavating earth which promises to be of great value and practical utility. The accompanying illustration represents it in elevation, and a brief description will render perfectly clear the manner in which it operates. In the first place there is no engine required. A glance at the cut will indicate that it is a steam engine as well as an excavating machine, and combines the motive power and the excavating agent all in one. The whole principle of the apparatus may be explained briefly by stating that the earth is excavated by a double series of horizontal picks rotating in opposite directions, which literally claw away the earth in front of them as the machine advances. It consists of a strong cast-iron frame-work, to the back of which is attached a steam engine for giving a forward or backward motion to the machine, and for driving its working parts. A pulley is keyed on the shaft of the steam engine which drives another pulley fixed on a horizontal shaft placed in the front of the machine; this shaft carries at each end a bevel pinion, which gears into two bevel wheels fixed on two vertical wrought-iron shafts, around each of which are fixed a certain number of picks or mattocks. These picks are arranged screw-wise, forming about a quarter of a revolution, and turning in opposite directions in such a manner that the picks of one of the shafts fit into the corresponding spaces left between the picks of the other shaft. These picks are in the form of a shovel, and as they dig out the earth horizontally it is thrown back and falls into buckets placed to receive it. Curved sheets of iron are arranged so as to prevent the loose earth from falling at the sides, and impeding the advance of the machine. The buckets are fixed on an endless chain passing over two drums, one at the bottom and the other at the top of the machine; the shaft of the top drum is driven by a band passing over a pulley fixed on the horizontal shaft before mentioned. The buckets are thus in incessant motion, and carry up the earth to the top of the machine, and turn it over on an endless chain which passes over two drums, on the shaft of one of which is fixed a pulley driven by a band from a pulley on the drum shaft of the trough chain. This endless chain carries the earth to the back of the machine, whence it may be carted away.

When required the apparatus can be so arranged as to deliver the earth at the side instead of at the back. Friction rollers are placed in suitable supports under the endless chain of the dredge, and also under the endless chain carrying the earth to the back of the machine. At each side of the latter chain, sheets of iron are fixed to prevent the earth from falling off, and two iron sheets, moved by a screw, are placed under the troughs on their descending side to prevent any earth falling into the machine. The forward movement of the machine is effected by means of a pulley fixed on the shaft of the steam engine, which drives a pulley fixed on a shaft in the lower part of the framework. The latter shaft drives by means of a wheel and pinion another shaft furnished with a bevel pinion gearing into and driving a bevel wheel fixed on a shaft carrying three endless screws. By these means motion is given to three gearing wheels fixed on the axles of the six wheels or cylinders on which the machine moves upon the endless floor. The machine has besides two other wheels placed towards the front part. A screw jack is adapted to the machine to raise it up when required to make it pivot on itself.

The necessity for enabling a machine of this description to work to any required gradient has been foreseen and provided for, as well as the case of curves, which, in the present day of railway making, approximate closely to what might be termed turning corners. In the engraving is represented a small machine weighing rather more than four tuns, and only about three-horse power. We witnessed its performance at the Ashburnham grounds at Chelsea some time ago, when it excavated the ground to a depth of 2½ feet. It broke the earth up small, and threw it into the buckets or hoppers, by which it was conveyed to the rear. One of the large-sized machines, weighing twelve tuns, is at work in Belgium, where it is performing in a most satisfactory manner. The speed of the advance can be regulated by the engine at pleasure. From the exceeding neat, clean cut made by this machine it appears to be admirably adapted for the cutting of trenches, for laying gas, water, and other pipes and drains, as there need never be any more earth excavated than what is actually required.



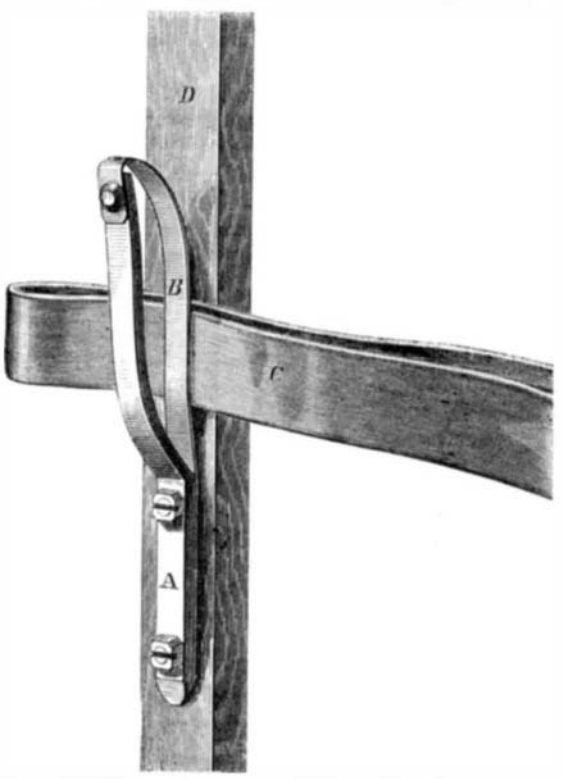
VANDENVINNE'S PATENT STEAM EXCAVATOR.

The Largest Pump Manufactory in the World.

The catalogue of Rumsey & Co., Seneca Falls, N.Y., embraces over 200 different styles and sizes of lift and force pumps. They are now turning out 1500 pumps per week, which range in price from $3 to $400, employing 130 hands in the business. John A. Rumsey has recently patented an improved galvanized non-corrosive cast iron pump which is safe from rust. An improved Hand Fire Engine, of great efficiency, is also on their list. The machinery in Rumsey & Co's factory is of the most efficient kind—much of it being of their own invention, and is driven by an unfailing water power. They are now building a new factory, 84 by 42 feet and 4 stories. When this is completed they will increase their working force to 250 hands. The business now carried on by this firm was established by Rumsey about 30 years ago.—*Boston Commercial Bulletin.*

ACHENBACH'S REIN HOLDER.

The fastening of the reins is one of the annoyances of horsemen. It is by no means conducive to good nature to return after leaving a horse hitched for a short space, to find the reins which you had endeavored to tie up securely, down under the horses' feet, foul with mud and filth. Yet in the usual way of fastening, unless special pains are taken, and the flies are less than usually annoying, such unpleasant consequences are almost sure to result. Besides, the knotting of the reins crumples and wrinkles them greatly, injuring their appearance.



Our engraving illustrates a neat little device, which completely removes all the disadvantages we have named.

A is a metallic bracket bolted to the bow, D, of the carriage top, dashboard, or other convenient part of the carriage. From the inside of this bracket rises a spring, B, the upper end of which is turned over and riveted to the upper end of