leaves and bits of stick fallen from the trees on the banks, the excrement of the insect and other inhabitants, together with fragments left from their repasts, empty shells of all sorts of water-snails, cast skins of larvæ, the dead bodies of the multitudinous aquatic population (and the mortality in a thickly populated pond must be considerable) together with those of worms and other terrestrial creatures that have had the misfortune to fall in and be drowned—these are some of the materials that, besides the mere earthy matter, help to form the ever-increasing mud at the bottom. There are, however, multitudes of minute creatures constantly at work on this refuse matter, dividing it up and transforming the dead and effete materials into the living tissues of their own bodies, and thereby reducing the ultimate waste substance to a much smaller bulk, and rendering it innocuous to a degree that might at first seem impossible. Half buried in this mud, or slowly crawling over its surface, are the lurking monsters of entomological pond life, the majority of which belong to two orders we have hitherto scarcely noticed, the Neuroptera and Trichoptera, the former containing the dragon flies, and the latter the caddis flies. We will, however, first consider certain bugs which haunt these parts.

They are known as water scorpions, and two species inhabit this country, one commonly found in almost every pond, the other of much less frequent oecurrence. The have, of course, no connection with the true scorpions, which are not insects at all, but eight-legged creatures belonging to the class containing spiders and mites. The water scorpions, too, unlike their terrestrial namesakes, are not venomous. The first, and much the less common, is a long, narrow insect, called *Ranatra linearis* (Fig. 3). On account of its habit of frequently lurking in an inclined position amongst the water-weeds, often only a little below the surface, this creature belongs less to the fauna of the bottom than its common relative. Still, they are best treated of together. It is of a brownish colour, except the upper surface of the abdomen, which is scarlet, but this is concealed when the insect is in the water, being made apparent only when the wings are expanded, and then it is quite astonishing to see what a beautiful creature the apparently uninteresting object becomes. The head is small, but the eyes exceedingly prominent, as is often the case with aquatic insects, and the beak short and sharp, not bent underneath, but projecting in front like an extremely acute nose. Both thorax and abdomen are elongated to an enormous extent; indeed, the insect, with a length of an inch and a-half from tip of snout to end of abdomen, has its greatest breadth no more than one-sixth of an inch. The upper pair of wings, while almost as long as the abdomen, are each only about half its width, but the hinder pair are considerably broader, and have to be carefully folded up before they can be stowed away under their narrow covers. These hind wings are beautifully delicate and transparent, similar, indeed, to those of the Corixidæ before referred to. But when we have reached the tip of the abdomen, we have by no means got to the end of the insect; from this point there extend two long bristle-like organs, about an inch in length, which project straight behind like a stiff tail; they are tubular, and communicate at their base with the tracheal system, and are, of course, respiratory in function. The legs are long and slender; the first pair are not used for progression, but for seizing prey, and it is these in front, and the respiratory filaments behind, that give the creature whatever resemblance it may have to a scorpion, although the similarity to that venemous animal is not nearly so exact as in the other species to be considered presently. The front legs are most remarkable objects, and will well repay a careful study. To understand clearly their peculiarities, we must first refer to the general plan of an insect's leg (Fig. 4).

There is first a joint, usually comparatively small, and more or less globular, called the *coxa*, by which the leg is articulated to the body, and which is usually invisible from above. Succeeding this is a small triangular joint, called the *trochanter*, squeezed in, as it were, between the coxa and the next joint, and looking as if added, as an afterthought, to fill up a gap. Then follows, attached to the side of the trochanter, the first long piece of thr leg, the thigh, or *femur*, then another long piece, the shank, or *tibia*, and lastly the *tarsus*, or foot, which is composed of from two to five joints, and usually terminated by a pair of claws.

Now let us take one of Ranatra's fore-legs and compare it with this plan. First we find a long joint, which extends far beyond the head, but still, from its being that which articulates the leg to the thorax, we know it must be the coxa, though it protrudes so far that we may easily at first mistake it for the thigh. Then there is the trochanter, a little larger and more than usual, and this is succeeded by a long piece lightly curved at the further end, and with a tooth a little beyond the middle; this, of course, is the femur. After this there is a short, sickle-shaped part, less than half the length of the femur, and looking like a great claw; it is able to be folded back upon the inner edge of the femur, along which a narrow groove, serrated at the edges, is excavated to receive it, and then the tip just reaches the above-named tooth. This sickle-shaped part consists of both tibia and tarsus, the latter of which is very small and has no claws. It will thus appear that the leg proper is, as it were, spliced on to the end of a long handle, the elongated coxa, an arrangement the effect of which is to give the limb much greater freedom of motion and a much wider sweep, and thus to enable it to levy tribute over a much more extended area. So peculiar is the plan of these limbs that it is no wonder that many persons have been puzzled to understand them.

We must leave the habits of Ranatra for consideration in the next paper.

*(To be continued.)*

## Engineering Notes.

A New Mechanical Puddling furnace is claimed as one of the late achievements of English invention. The English correspondent of the *American Manufacturer* speaks of it as an improvement of Cort's puddling furnace, and a device for making the puddler (or boiler) no longer the drudge who handles the rabble bit, but the gentleman who watches automatically working machinery do all the labor required to turn crude iron into malleable iron, or into steely iron. It is more pretentious than the Danks furnace, says the above correspondent, since it proposes to ball-up as well as to boil. But whether it is likely to be attended with more success than that device is questionable. If it could be run as the inventor ventures to hope, then it would be a considerable improvement upon the Danks, since it would not only do more of the manual work, but would do it with a continuance scarcely contemplated by Danks; without, however, one would think, the capability of the Danks to treat heavy charges; though a series of rapidly perfect balls ought to be really beaten by the shingling hammer into massive blooms. But the device has not yet gone beyond the stage of models and plans.

How to Determine Expansion.—Mr. C. E. Emery made a very complete series of experiments some years ago upon the engines of the United States revenue cutters, Rush, Dexter, Dallas, and Gallatin, from which he deduced the following simple rule (subject to certain limitation) for the best ratio of expansion in steam engine: Rule—Add 37 to the steam pressure as shown by the guage; divide the sum by 22; the quotient will be the proper ratio of expansion. Example: An engine is running with a pressure of 90 pounds per square inch; what would be the ratio of expansion? $90+47=127 \div 22 = 5.77$ = the best ratio of expansion.

New York's First Cable Road.—The Third Avenue Railroad Gompany is progressing rapidly with its cable road extending through 125th street fram the East River to the North River, and from 125th street to 187th street on Tenth avenue. Concerning this new road Mr. J. D. Miller, the chief engineer, says: "This railway will be somewhat different from any other in the world. It is an improvement on the Chicago cable road for several reasons. In the first place, it is planned on a duplicate system—that is: there are two cables working in the same way on each track; while one is in use the other is not; but in case of accident to the one in use, it would take only two minutes to transfer the brake to the other, and the delay would be hardly noticeable. In the second place, the pulley wheels, which move the cable, are placed in vaults just 35 feet apart and 22 inches square. Now, the tracks are so formed that, in case of rain, the water will be stopped by them instead of flowing toward the curbstone, and will sink into these vaults. To take away this water a sewer pipe 6 inches in diameter will run the whole length of the road, underground. The whole road will be composed of steel iron, and concrete, no wood being used, because wood rots. The cars will be running early in October."