

the contrary, have retained their transparency, neuration, and use. Scudder remarks, further, that a similar change took place after the Paleozoic, in the Orthopteroids generally, though to a less extreme degree; and it appears therefore that the Carbonic era was the time of culmination not only for the Cockroach family, but for the tribe as a whole. The change was a loss of locomotive function by the *anterior* pair of wings, and an example therefore of degeneration; and it was attended, as Scudder states, by a great loss in the size of the species, and especially of the wings; the mean length of the anterior wings in the Paleozoic species of Cockroaches being a little over an inch (26 mm.), and 40 per cent less in later kinds. Among *Hemipteroid* species, the Permian *Eugereon Böckingi*, of Germany, had the wings of both pairs similarly diaphanous, while in the *Phthanocoris* of the Permian of Missouri, described by Scudder, the anterior pair were much thickened; the result, probably, as in the Orthopteroids, of degeneration. It is probable that Carboniferous Beetles had a like method of origin from Insects having four diaphanous wings; but the line of descent remains unknown.

The Scorpions of the Upper Silurian are much like those of modern time. The type is the lowest among the tribes of Arachnids, notwithstanding their size. As in a Crustacean or Eurypterus, the body (Fig. 799) obviously consists of a cephalothorax and a long abdomen.

True Spiders have not yet been found in rocks earlier than the Carboniferous; and this is probably because Spiders are so little likely to be fossilized; for they are not only smaller animals than the Scorpion, but also they are unlike them in not having a durable exterior.

9. Derivation of Arachnids. — The line to the lower and earlier Arachnids — that is, to the Scorpions — leads up, according to Van Beneden, Packard, and others, from the early Pterygotus-like Limuloids. The early Scorpions, as well as the modern kinds, have the same number of body segments as a Eurypterus or Pterygotus: namely, seven thoracic and six abdominal (precisely the normal number in Crustaceans); the same *cephalic* relations of the legs; the same absence of abdominal appendages; a like absence of thoracic appendages from all the segments excepting the first two; and similar functions in the members pertaining to these two segments. Further, according to B. Peach, these early Limuloids sometimes have, like the Scorpions, pairs of "combs" or pectinated organs on the underside of some of the thoracic segments.

But in this change from an aquatic to a terrestrial species the upward progress in structure was great. The four posterior pairs of feet in the terrestrial Scorpion have no longer the low-grade feature of serving for jaws as well as feet, but are simply feet; they are the chief organs of locomotion, and only those of the anterior pair are appendages to the mouth. The antennæ are shortened to pincers (falces) that also serve the mouth. The four pairs of feet are thus *cephalic* organs, if comparison be made with the Limuloids and Crustaceans; though in Arachnology, they are called