

into the Devonian. But in the western part in Wales, — and in the Lake region to the north, — they lie *unconformably* beneath the Old Red Sandstone (Devonian), proving thereby that an epoch of local mountain-making in that region closed the period. Similar evidence of disturbance exists in Ireland.

#### BIOLOGICAL PROGRESS.

The records of the Upper Silurian era add to the terrestrial fauna the earliest of Arachnids, or Spiders, in the form of Scorpions, and additional species of Insects. The former are in the successional line of the Eurypterids, whose earliest species is Lower Silurian; the Insects are structurally in the line of the Myriapods, although no antecedent species of Myriapod is yet known. The Cockroaches are Orthopters, and species of imperfect metamorphosis, like the Hemipters. The relations of the above-mentioned groups are illustrated in the course of the General Observations on the Paleozoic, on pages 721, 722.

Among marine Invertebrates, the era is marked by a large diminution in the number of species and genera of Graptolites and Trilobites — Lower Silurian characteristics; by an abundance of Cystoids and Orthids — also Lower Silurian in aspect; by an increase in the number and size of the Brachiopods of the families of Spiriferids, Pentamerids, and Productids — Devonian characteristics; by an increase in the Pteropods of the Conularia type; by an increase in the number of Gastropods of the Platyceras (Capulus) type, and in the number of species and genera of Polyp-corals, Crinoids, and Asterioids — which also look toward the Devonian; by an increase in the number and variety of Eurypterids and Ceratiocarids — facts having the same bearing.

Still more marked is the advance from Entomostracans to Tetradeapod Crustaceans; and far beyond this is the appearance of Insects. It is remarkable that the first remains of Scorpions should have been found in Europe and America in rocks of very nearly the same age. But it may be that earlier specimens are yet to be found.

Fishes, the only Vertebrates of the Upper Silurian, were represented by Placoderms, the mail-clad type that first appeared in the Trenton Period of the Lower Silurian, and possibly also by Selachians. But no remains of other Ganoids have yet been found in the beds, although reported from the Trenton. Rarity in fossils of lime-secreting aquatic species is not common. Remains of Chimæroids, mostly cartilaginous species, also are absent.

#### CLIMATE.

There is no evidence that the climate of America was roughened by frigid winds, or that the ocean was much modified in temperature by polar currents. The species living in the waters between the parallels of 30° and 45° were in part the same with, or closely related to, those that flourished between the parallels of 65° and 80°. (See page 544.) From this life thermometer we learn only of warm or temperate seas.