

are always more or less doubtful, the above figures can be considered at the best as only approximations. To the great thickness estimated there is the additional source of doubt referred to on page 451, under the Archæan. For if 45,000', the temperature in the bottom beds would have been 1800° F., supposing the increase of temperature downward to have been 1° F. in 25 feet of descent, or only twice as great as now; and if 35,000', it would have been 1500° F., high enough for the complete metamorphism of the lower beds in the series. And yet there is no metamorphism.

The Animikie group, of slates, sandstones, quartzite, etc., on the north shore of Lake Superior, at the east end of Minnesota, about Grand Portage Bay and beyond, has intercalations of doleryte (diabase), gabbro, and other rocks, much like those of the Keweenaw formation. Supposed tracks or trails of marine animals, mentioned on page 446, are the only fossils yet found. The Cambrian age of the formation is considered probable by many geologists. The igneous intrusions are regarded as laccolithic by Lawson, and as related in time to those of the Keweenaw formation.

*Eastern Rocky Mountain slope.*—The Cambrian beds of the Black Hills are red sandstone and with fossiliferous limestone above, pertaining to the Upper Cambrian.

In central Texas, the beds of the Llano formation of Walcott are confined to Llano and Burnet counties; they rest on upturned beds referred to the Algonkian by Walcott (page 447).

*Rocky Mountain region and Pacific slope.*—Lower Cambrian beds occur in the Rocky Mountains of British America, on the Vermilion and Kicking Horse passes. At Cottonwood Cañon in Utah, the great section of the Wasatch has at bottom 3000' of quartzite, and above this 250' of hard shales, affording Lower Cambrian fossils, some of them identical with eastern species; then succeed Lower Silurian beds, the Upper Cambrian being absent. Above Ophir City, in Oquirrh Mountain, fossils occur in a limestone over sandstone, the whole 2300' thick. In Nevada, according to Walcott, in the Eureka district, a section of conformable high-dipping beds 7700' thick, contains below (1) 1500' of quartzite; (2) 3050' limestone, with Lower Cambrian fossils in the lower 500'; (3) 1600' shale, and above this 1200' of limestone, 350' of shale affording Upper Cambrian fossils at bottom. In the Highland Range, 125 miles south of the last, are 1450' of limestone and shales overlying 350' quartzite which are Lower Cambrian, and above these, 3000' of massive limestone which are Upper Cambrian.

Other sections occur east of Pioche; at Silver Peak; at the south end of the Timpahute Range. In Arizona, at the Grand Cañon of the Colorado, 3000' to 5000' deep, underneath horizontal Carboniferous and Subcarboniferous beds, the lower the "Red Wall Group" of Powell, lie horizontally 700' to 800' of shales and sandstones, the Tonto group of Gilbert, made Upper Cambrian; the highly tilted beds beneath are referred by Walcott to the Algonkian. In S. E. California, Inyo Co., Lower Cambrian (Walc., 1894).

For an extended review of the Cambrian of America see *Bull.* 81, *U. S. G. S.* (1892), by C. D. Walcott, to whom the science is indebted for the discovery of the larger part of the facts.

#### LIFE.

The life of the Cambrian, so far as known, was marine. The plants were Algæ (seaweed).

The animals thus far made out from the fossils are all *Invertebrates*. They include Sponges, Corals, Hydrozoans, Echinoderms, Worms, Brachiopods, Mollusks of the divisions of Lamellibranchs, Pteropods, Gastropods and Cephalopods; and also, among Arthropods, Trilobites and other Crustaceans. All these groups, excepting that of Cephalopods, were represented in the earliest of the three divisions of the era.