

species that abound on steppes and grassy plains. Fresh-water shells are usually rare, and marine forms do not occur. Loess is found at all elevations, up to 5000 feet among the Carpathians, 8000 feet in Shansi, China, and probably to still higher altitudes further west. In hilly regions it fills up the valleys, shading off on either side up the slopes into the angular débris of the adjoining rock. Elsewhere, it spreads over the surface so as completely to conceal the original inequalities of the ground. In Northern China, Richthofen found it to have a thickness of 1500 or possibly over 2000 feet, and to be cut into deep valleys and precipitous ravines, with cliffs 500 feet high, which are excavated into tiers of chambers and passages by a teeming population.²⁰ In the arid tracts of North America the loess or "adobe" is estimated to be sometimes 2000 or 3000 feet thick.²¹

Various theories have been proposed in explanation of this singular deposit. By some it has been referred to the operation of the sea; by others to the work of lakes or of rivers. But its wide extent, its independence of the altitude or contours of the ground, its uniform and unstratified character, the unworn condition of its component particles, and the nature of its organic remains, show that it cannot be assigned to the action of large bodies of water. Richthofen propounded in 1870 the opinion that the loess is mainly due to the long-continued drifting and deposit of fine dust by wind over areas more or less covered with grassy vegetation, aided by the washing influence of rain, and this view has been widely accepted. Where rain is

²⁰ See Richthofen's description, *Geol. Mag.* 1882, p. 293, and his "China," above cited.

²¹ Russell, *Geol. Mag.* 1889, p. 292.