

cold surface, and so no less certainly be deprived of a gaseous envelope and of oceans.

Accordingly it appears safe to say that really durable atmospheric conditions depend upon sufficient size of the planet, the presence of a sun, and rotation.<sup>1</sup> No doubt a host of other factors which exist in the case of the earth are only less important. In any event, all such phenomena, though varied by chance, are of automatic origin, and whatever may be the peculiarities of our solar system there is no reason to suppose that like conditions are not of frequent occurrence. Throughout space there must be thousands of planets which, like the earth and Mars, are enveloped in an atmosphere that endures through countless centuries, and that contains great quantities of water and carbon dioxide.

All such atmospheres must in greater or less degree manifest general meteorological phenomena. There must be winds and clouds, rain and snow and ice, the formation of oceans and ocean currents, streams and lakes, all interrelated by complex cyclic processes which endure. Tides, too, and magnetic and electrical phenomena cannot be absent, while

<sup>1</sup> A full discussion of all such problems will be found in the "Lehrbuch" of Arrhenius and in S. Günther's "Handbuch der Geophysik." Two volumes, Stuttgart, 1897-1898.