

FUNNEL-HOLES ON LEBANON.

SIR,—The numerous funnel-holes upon the tops of the Lebanon and Anti-Lebanon Mountains afford striking examples of the power of solution and chemical disintegration unsupplemented by the action of torrents. My attention was directed to these holes last spring by Dr. Wm. T. Van Dyck, of Beirût, who also suggested a theory for their formation. A summer journey, which took me to the tops of nearly all the mountains of Lebanon and Anti-Lebanon as well as to Mount Hermon and the Anseireh Mountains, gave me an unusually good opportunity to observe these phenomena and enabled me to verify and somewhat amplify the idea suggested by Dr. Van Dyck.

The higher portions of the mountains visited were from 6000 to 10,500 feet above the sea-level. Below the level of 5000 feet their sides are worn by running water into very rough and precipitous gorges. Our attention was quite forcibly called to this feature by the great difficulty of climbing among the lower slopes. Above 6000 feet however the slopes become more rounded and the surface of the ground more smooth, until on the broad summits of some of the highest mountains carriages might safely be driven. This is markedly true of the summit plateau of the most lofty of all, the Duhr-il-Kađib, sometimes called the Fem-il-Mezâb. The lower slopes of the mountains in the winter and early spring abound with rushing torrents, but in the long summer these portions are perfectly dry, except in those rare and precious spots where there are springs. Here, consequently, the forces of disintegration are active during the winter and spring, and most of the *detritus* is washed away at once, leaving the rocks rugged and bare.

Different conditions are found in the upper regions. The thawing of the snow is gradual, so that probably the larger portion of the water, instead of running off, sinks into the ground, which on the heights is composed of a thick layer of more or less finely comminuted chips of stone over the solid rocks *in situ*. Even late in the summer we found on the eastern side of every favourably situated ridge or peak a large mass of snow sheltered from the prevailing warm west wind, and melting a little every day from about noon until sunset. At the foot of every such mass of snow was a funnel-shaped hole into which trickled every afternoon a tiny stream of water. We observed also many other such holes from which the snow had gone. The diameters of these across the top ranged from a few feet to one hundred yards, and the sides usually sloped at angles of from 15° to 40° straight to a point at the bottom, making inverted and irregular, but yet complete rather than truncated cones. The western side was usually the steeper. I may add that most of these holes occur in a compact limestone generally considered to belong to the Middle Cretaceous period, and further, that the *strata* can be traced as almost perfectly level for miles along the sides of these summits.

It follows then that the principal agency in the formation of each

of these funnel-holes must have been the chemical and solvent action of the water from its own snowdrift, aided to some extent by the mechanical work of the frost.

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ELEVATION AND SUBSIDENCE DURING THE GLACIAL PERIOD.

SIR,—In reply to the article by A. J. Jukes Browne (*GEOLOGICAL MAGAZINE*, December, 1890, p. 561), concerning high continental elevation of America with relation to the Glacial period, I may refer to my appendix in Prof. G. F. Wright's "Ice Age in North America," as containing a review of evidences of subsidence in the West Indies, cited in that article, probably contemporaneous with the elevation and glaciation of the northern part of North America. It was pointed out fifteen years ago by Dr. Ricketts (*GEOL. MAG.* Dec. II. Vol. II. 1875, pp. 573-580) that submergence of the Isthmus of Panama may have been an important element in the causes of the Glacial period; and at about the same time the collection by Dr. G. A. Maack of abundant Pleistocene fossils, "all living up to the present time," in the vicinity of the Panama railroad, and at many localities southward to the Atrato river, ranging in height up to at least 763 feet, while the lowest points of the interoceanic water-shed are less than 300 feet above the sea, gave proof that parts of this isthmus have been thus lately submerged (Reports of Explorations for a Ship Canal, Isthmus of Darien, United States Navy Department, Washington, 1874, pp. 155-176).

Nothing is more surely determined than the record of the Glacial period, as shown by glacial drift and striæ upon North America from the Atlantic to the Pacific, and from southern Illinois to the Arctic Sea, and upon north-western Europe from the British Isles to Germany and Central Russia, and northward across the Scandinavian peninsula. Some causes must have existed to produce the great climatic changes of this period. These causes seem to me to have been probably the great uplifts of the glaciated areas of which Professor Spencer has cited so much evidence, and the contemporaneous depression of the region of the West Indies and Isthmus of Panama, by which a part of the equatorial oceanic current that sweeps northward in the Gulf Stream would be permitted to pass into the Pacific Ocean, withdrawing a large portion of its heat from the North Atlantic area. Correlative northern elevation and southern subsidence, for both of which we have sufficient proof, would contribute almost equally to the climatic changes of the Ice age. This subject, and the probably contemporaneous uplift of a belt of land across the North Atlantic from France and Great Britain to the Færøe Islands, Iceland, and Greenland, as argued by Prof. James Geikie in his "Prehistoric Europe," I have discussed somewhat fully in the *American Geologist* for December, 1890, and the *American Journal of Science* for January, 1891, in the endeavour to ascertain the probable causes of the remarkable Quaternary changes of climate.

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