

are something between these two, say molten lava; then, in respect of movement also this will come intermediate between water and sand. Lava flowing down a mountain-side does so with a rolling motion, like that of the sand in a moving dune, and it would also exhibit the same kind of motion if the wind were powerful enough to move it upon level ground. The difference between the wave-movement of viscous fluid and the wave-movement of a mass of sand will therefore be less than the difference between the wave-movement of sand and the wave-movement of water. Driving snow accumulates in dune-like drifts, which in several respects differ from dunes: the higher the former are the more they become compressed by their own weight, until their lower layers grow so compact that all possibility of movement ceases. By this I mean that the same force, the wind, when acting upon different substances that in turn react upon it, ought to give rise to the same kind of wave-movement, although the manner in which this is produced may be more or less different in consequence of the different properties possessed by the several substances.

Cholnoky goes too far when he asserts, that sand-waves and oceanic waves are in no wise identical phenomena, and that the resemblances between them are entirely external and superficial. Has not Heim demonstrated that there exist an entire series of resemblances between a glacier and a river? * And the conclusion he comes to is this: »Soweit bis jetzt unsere Erkenntnis reicht, stimmen alle Gesetze der Gletscherbewegung mit denjenigen einer flüssigen Masse überein. Bei einer absoluten Flüssigkeit ist der innere Widerstand der Teilchen gegen Verschiebung unendlich klein im Vergleich zu der Schwere derselben . . . Das Gletschereis ist in seinem Fließen etwa 80 bis 100 Millionen mal träger als Wasser.»

Here the motive force is of course different, namely gravity, while the arresting force is principally friction. But notwithstanding that the two substances we are now considering, water and ice, possess such diverse properties of aggregation, we nevertheless have in both the same phenomena of movement, the reason being that both are set in motion by the same force and under the same circumstances. It should not therefore be too bold a thing to say, that waves and dunes are identical phenomena, especially as sand, despite the fact that each individual particle is a solid body, when taken in the mass becomes rather a fluid substance, — a property which we find put to practical use in the time-glass. Sand in the mass possesses no inherent cohesion; friction alone is present. With regard to wave-movement, water and sand are more closely akin than are water and ice. A cascade of sand would present greater resemblance to a waterfall than a cascade of ice, i. e. a glacier, would, the velocity of the last-named being infinitesimally slow as compared with the velocity of water and of sand. The greatest difference between the movement phenomena of a glacier and the movement phenomena of a river lies in the excessive slowness of the former. The same difference obtains between sand-waves and

herabzufallen, wonach durch Wirbel-bildung an der Leeseite einige Komplikationen kommen. — Durch dieser Unterschied in der Art der Fortbewegung von Wasser- und Sandwellen erklären sich auch die meisten anderen Unterschiede zwischen beiden, z. B. die von der Form der Wasserwelle verschiedene Form der Düne mit ihrem charakteristischen Unterschied zwischen Luv- und Leeseite, die Schichtung der Dünen und vieles andere.» (*Zeitsch. d. Ges. f. Erdk. zu Berlin.*, vol. XXXIV. p. 421).

* *Handbuch der Gletscherkunde*, pp. 185 ff.