"The Singing Sands of Lake Michigan"

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The dune region of Lake Michigan extends along its eastern shore from Gary at the southern extremity to Mackinac at the northern with comparatively few breaks or interruptions. Throughout this region the sands near the water's edge, in dry weather, emit a peculiar but definite and unmistakable sound when the foot of the pedestrian pushes through them in an abrasive way. This unusual sound from an unusual origin is a source of great delight to children and an inciter of the curiosity of their elders, who, however, rarely pursue the subject far enough to arrive at an explanation for it. The sound is produced not only by the leather-shod foot, but is emitted also if the bare foot or hand is struck through the grains or if a stick is trailed boy-fashion, behind. The sound has been compared or the attempt has been made to relate it to that produced by the pedestrian walking through soft snow; to the crunching noise so frequently noticed when walking through snow after very cold weather or by the wheel of a vehicle on such snow; also to the sound emitted by hard, granular snow when one walks through it; but it is like none of these and has a distinctive character all its own. In a preliminary way several observations should be recorded as to the bearing of location and conditions of various sorts on the singing sands. The sound is produced only when the sand is dry, and apparently the dryer the sand is, the louder the sound produced. In wet weather or when the sand is moderately moist, the sound is not produced. In summer and indeed in the hottest weather the sound seems to be loudest, other conditions being the same, but it can be clearly heard at all seasons of the year, including winter, whenever the sand is dry. As one walks away from the water's edge he may be astonished to find out that the sound-producing sand ceases rather abruptly about fifty to one hundred feet from the shore line. These limits may vary at different locations but on the whole they are substantially correct. Back and away from the shore line, in blowouts and on the sides and tops of the dunes, the sound is never produced. There is no observable difference between the sand located near the shore and that located farther back or that forming the dunes, and indeed the sand which is washed up by the waves is that which, blown by the wind, goes to form the dunes. The upper beach limit of the singing sands is practically identical with the upper wave limit, that is, the boundary reached by the waves during storms. This limit is marked roughly by the line of driftwood and the lower limit of vegetation. The singing sands are therefore all subjected to periodical contact with the water of the lake and are moistened and washed by that water. These observations include, I think, all the obvious ones in connection with the singing sands. The most casual observer will remark with astonishment their very sharply defined upper limit. As one walks from the water's edge up the beach and crosses the upper wave limit, he notices a sudden cessation of sound as he passes the upper line of driftwood and the commencement of vegetation. Beyond this point he may proceed into a blowout of clear sand quite identical in appearance, macroscopic as well as microscopic, and of the same composition by ordinary methods of analysis and yet this sand fails entirely to produce the sound of the beach sand. His first conclusion would be that the proximity of the water and waves of the lake must have some relationship to the sound-producing grains. I wish to apologize in advance for offering a hypothesis of this sound production unsupported by convincing evidence.

What follows may, however, serve as a working basis for other investigators and may lead to a true explanation of the sound-production. My hypothesis briefly stated is this. The sand grains on the lower beach and as far as the upper limit of the storm beach are bathed periodically by the waters of the lake which contain various salts including calcium and magnesium bicarbonates. This water dries on the grains of sand, coating the surfaces with an extremely thin film of salts including ca1cium and magnesium carbonates. This film is of such a nature as to create considerable friction when rubbed and thus when the grains are brought into contact with various surfaces a sound is emitted. One may compare the action of the film of dried salts on the sand grains with the action of rosin on the violin bow. The beach sand is, of course, the same sand which later goes to form the dunes when transported by the wind but during this transportation, due to the abrasive action of grain against grain, much of the salt film is rubbed off and carried on by the wind in the same manner that clay dust is, to be deposited in quiet places as on the forest floor beyond. After deposition in blowouts or on dunes, the grains are subjected from time to time to the leaching action of rain water and this completes the removal of calcium and magnesium carbonates (in the form of bicarbonates and of the other salts) so that the original sand grain surface is restored or, to speak metaphorically, the sands lose their singing voice. Such is the hypothesis. A typical analysis of Lake Michigan water shows the following constituents:

Parts per 1,000,000	
Total residue	144.8
Loss on ignition	17.6
Chlorine	4.2
Sodium	8.3
Ammonium	05
Magnesium	10.9
Caloium	28.2
Silica	1.9
Nitrato	1.0
Chloride	4.2
Sulphate	l0.0

Some samples of Lake Michigan water show a higher content of solids than that given in the above analysis, the maximum being about 160 parts per million. When the singing sand from the beach is compared with dune sand or blowout sand under the microscope no difference is perceptible. When subjected to screen tests, the beach sands show themselves to be of the same physical composition and texture. By chemical analysis, according to the usual methods of conducting mineral analyses, both show the same composition. The amount, therefore, of salts in the hypothetical film above referred to must be therefore within the limits of analytical error. Experiments to prove or disprove the hypothesis readily suggest themselves. Some of the singing sands could be transported from the beach and placed in a perforated vessel, box or barrel, on dune or in blowout and left to be subjected to the action of rain for a considerable period of time, or some of the singing sands could be subjected to a tumbling action by rotating as in a laboratory rotating tumbler. After this some sand could be subjected to the leaching

action of distilled water saturated with CO_2. For a third experiment, some of the dune or blowout sand could be wetted several times with lake water and subjected to a drying action between the wettings. Suitable sound tests should, of course; be made at the proper times. These experiments should be performed by some one residing by the lake shore either permanently or during the summer so that advantage could be taken of changing weather conditions and rainstorms.
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Thoreau's " Journal" entry of September 22, 1858, in "Autumn.":
"One mile south-east of the village of Manchester struck the beach of musical sand. We found the same kind of sand on a similar but shorter beach on the east side of Eagle Head. We first perceived the sound when we scratched with an umbrella or the finger swiftly and forcibly through the sand; also still louder when we struck forcibly with our heels, 'scuffling ' along. The yet or damp sand yielded no peculiar sound, nor did that which lay loose and deep next the bank, but only the more compact and dry. The sound was not at all musical, nor was it loud. R---, who had not heard it, was about right when he said it was like that made by rubbing wet glass with your finger. I thought it s much like the sound made in waxing a table as anything. It was a squeaking sound, as of one article rubbing on another. I should say it was entirely the result of the friction of peculiarly formed and constituted particles. The surf was high and made a great noise, yet I could hear the sound made by my companion's heels two or three rods distant, and if it had been still, I probably could have heard it five or six rods."