

## Wind-Polished Pebbles from Northern Newton County, Indiana

M. M. FIDLAR

State Department of Conservation

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In the course of field investigations during 1938, the writer had opportunity to visit an interesting area in Lake Township, northern Newton County, near the center of the east line of section 33, T. 31 N., R. 9 W., approximately three miles south of Lake Village along U. S. Highway 41. In this vicinity in comparatively recent years, the stream which drains the northwestern portion of the old Beaver Lake swamp has entrenched itself deeply below the surface of the recent lake-bottom deposits. For thousands of years this area was covered by a vast glacial lake and swamp, but the urge for more farming land led some of the early settlers to dig a small drainage ditch to one end of the water area so as to be able to carry on further agricultural pursuits there. This ditch, owing to the fact that the original swamp area was perched several feet above the drainage lines to the north, was rapidly eroded downward to form the large open ditch in existence at present.

The entrenching of the drainage ditch allowed the wind to gain access to the thick deposit of lacustral white sand which was subjacent to the surface peat or muck of paludal origin. As a consequence of the resulting deflation, the sand was carried away to form small dunes



Fig. 1. White sand pedestal, capped by muck and vegetation, standing near the center of the Newton County blow-out. Pebbles on the floor near this feature are affected greatly by the action of moving sand.



Fig. 2. General view of blow-out. In background is drifting sand along entrenched stream. In foreground are pebbles and pieces of bog iron ore concentrated by the removal of the lacustrine sand by the wind.

to the northeast, following the destruction of the peat cover by undermining. An interesting pedestal of white sand, capped by muck and vegetation, stands near the center of the area of deflation (Fig. 1). During the existence of the swamp near the line of junction between the peat and the underlying white sand, nodules of bog iron ore were formed by the action of ground water heavily charged with iron minerals. At the site of the blow-out in discussion these nodules of limonite and sand, too heavy to be moved readily by the wind, are concentrated upon portions of the sand floor as the sand is blown away.

The white sand, forming a part of the lacustrine deposits, contains numerous pebbles and cobbles of varying size, which, like the bog iron nodules, are concentrated upon the floor of the blow-out, resembling the "hamada" or pebble pavements of desert regions (Fig. 2). The pebbles of varying composition have been attacked by the particles of moving sand rolled along the surface by the prevailing winds and have attained in some cases a beautiful "windpolish." In many cases partially-buried pebbles have taken on "desert varnish," a phenomenon due to the concentration of iron minerals on surfaces below the ground. Such pebbles, so far as the writer is aware, have never been described from Indiana although they are not uncommon in many arid regions where sand dunes are constantly moving.

The impact of moving sand in the Newton County blow-out does not have the same abrasive effect upon all pebbles. The sandstone fragments show no visible effect of the natural sand-blast although it is possible that such types of stone may be shaped to some degree by the rounding of corners and sharp edges. Shale pebbles seem to react in much the same way as those composed of sandstone. Compact limestone or slaty shale pebbles have assumed a certain amount of wind-polish, and sharp edges have been rounded and smoothed before polish-

ing. Laminated limestone pebbles have been grooved and faceted in a remarkable manner by sand-abrasion in the Newton County blow-out.

Igneous and metamorphic rocks have reacted most impressively to the attack of the driving sand. Granite and related igneous rock pebbles are etched as they lie upon the floor of the blow-out so that the harder mineral grains and crystals stand out in bas-relief. The white sand, composed in the main of quartz grains, readily attacks the mica and hornblende of the granite, whereas the feldspar crystals are only slightly reduced and the quartz grains undergo very little alteration with the exception of the frosting of the surface.

The most pronounced wind-polish has been attained by the pebbles composed of gabbro and basalt, fine-grained igneous rocks. Many pebbles of this composition exhibit rounded edges and wind-shaped facets on the windward side, and all surfaces with which the wind comes in contact are finely polished. On the leeward side, however, the pebbles have the frosted appearance characteristic of glacial pebbles, transported some distance from their parent outcrop, and show no effect of the abrasive action of the wind-driven sand.