



## Pebbles

One of the most aesthetically pleasing objects in the natural world is a perfectly-rounded pebble. Pebbles are not just beautiful objects but they sit comfortably in the hand and somehow connect us directly with the natural world. This is perhaps not so surprising as holding a pebble and being fascinated by its perfection must be one of our oldest emotions.

The life of a pebble begins as a rock fragment falls from a cliff onto a beach or is swept into a stream or river. These 'angular' fragments join other pebbles and rub against each other by the process of 'attrition' as they are transported downstream by a river or moved by tides and waves along a beach. As the pebble's corners are knocked off they slowly assume a 'sub-angular' shape and with further rolling it will assume a 'sub-rounded' shape. In a river most of the usual 'hard' rocks such as flint and volcanic or igneous rocks will be transported out to sea before they have reached this stage of roundness. Softer rocks, such as most sedimentary rocks, may not even get this far and will be destroyed before they can become rounded pebbles. Sedimentary rocks often contain fossils and it is therefore not unusual to find traces of fossils in broken pebbles.

### What defines a pebble?

A **pebble** is a fragment of rock, usually rounded, with a diameter of between 4 and 64 millimetres. This size restriction is based on the internationally recognised scale of particle size or grain size. If it is larger (between 64 and 256 millimetres in diameter) it is called a **cobble** and if it is larger than this it is a **boulder**. If the pebble is smaller (between 2 and 4 millimetres) it is known as a **granule** and if it is smaller than 2 millimetres the material is classed as **sand**. When the particles become smaller than 62.5 microns in diameter (1/16 of a millimetre) the material is classed as **silt** and if they are smaller than 3.9 microns (1/250 millimetre) it becomes **clay**.

Once a rock fragment has arrived on the coast, either via a river or by the destruction of sea cliffs by the waves, it will be subjected to relentless battering. The angular fragment is gradually transformed into the familiar rounded shape and eventually it will be reduced to the size of a sand grain. Pebbles are moved along a beach as the prevailing wind drives the waves along the shore. Waves will carry pebbles obliquely up the beach but the backwash drags them straight down the steepest slope, perpendicular to the shore. Pebbles therefore pursue a zig-zag course along the shore and can travel long distances.

The lifespan of a pebble depends on the hardness of the original rock, whether it splits easily, and the ferocity of river currents, waves and storms. The chalk cliffs of southern England are battered by waves and fragments of chalk are briefly turned into rounded pebbles on the beach before they are completely



*Flint pebbles from Norsey Wood, near Billericay, rounded and smoothed on an ancient beach around 50 million years ago. Photo: G. Lucy*

destroyed. The nodules of flint in the chalk are, however, extremely tough and broken fragments of flint are turned into the billions of rounded pebbles that make up the vast majority of the beaches of southern and eastern England.

The shape of a pebble depends on the shape of the original rock fragment. Completely spherical pebbles are rare, most are described as ovoid, discoid or cylindrical. In other words they are shaped like an oval, a disc or a cylinder. The to and fro motion on most beaches produces the common ovoid shape in homogeneous rocks but laminated rocks will split into plates and therefore form pebbles of discoid shape, so useful for skimming on water. A beach of pebbles is called a shingle beach.

While the beaches of Essex consist mostly of rounded flint pebbles, the surface geology of Essex is also composed, in many places, largely of flint in the form of gravel laid down by glaciers or former courses of rivers such as the Thames. Gravel is a general term that refers to unsorted loose fragments of rock from 2 millimetres to 64 millimetres in size (i.e. the size range of granules and pebbles). Most of this gravel is sub-angular flint pebbles but there are occasional pebbles of exotic rocks and cobbles of extremely well-rounded flints and quartzite. The difference in roundness is often striking and indicates that the well-rounded constituents of the gravel have had a long history. Such durable pebbles are usually derived from an ancient beach that has long since disappeared, been deposited as a layer of gravel, uplifted and exhumed again be transported once more - a cycle that may have been repeated several times over hundreds of millions of years. Their beach origin is also revealed by the presence of small, crescent-shaped scars called chatter marks, which are percussion fractures produced when pebbles are violently thrown together. Some of these well-rounded pebbles can be found at high elevations such as the summit of Langdon Hills, near Basildon and High Beach in Epping Forest, indicating the great age of the gravels in which they are found.



*The crescent-shaped 'chatter marks' on the surface of this flint pebble are evidence that it was battered on a wave-swept beach in the past. Photo: G. Lucy*

## Further reading

CHATFIELD, J. 2003. **Pebbles**. BBC Wildlife Magazine. Pocket Guides. Number 8.

ELLIS, C. 1954. **The Pebbles on the Beach**. Faber and Faber.

NATURAL HISTORY MUSEUM. 1975. **Pebbles**. Mineralogy Leaflet. Number 3.

OSTERGAARD, T. and WHITTOW, J. 1980. **Rocks and Pebbles of Britain and Northern Europe**. Penguin Nature Guides. Penguin Books.



*Far left*

*A broken flint pebble from the beach at Burnham-on-Crouch revealing a fossil bivalve from the Chalk. Photo: G. Lucy.*

*Left*

*A pebble made from pebbles! Puddingstone is a remarkable rock consisting of flint pebbles cemented in a quartz matrix. Here, a fragment has been fashioned into a rounded pebble by battering on an ancient beach and then transporting by river - a beautiful example of Nature's recycling. From the Thames gravels at Bradwell, near Braintree. (see separate GeoEssex Factsheet on puddingstone). Photo: G. Lucy.*