PRESENT

QUATERNARY 2.6 million years

TERTIARY

65 million years

CRETACEOUS

146 million years

JURASSIC

208 million years

TRIASSIC 245 million years

PERMIAN 290 million years

CARBON-IFEROUS 362 million years

DEVONIAN 408 million years

SILURIAN 439 million years

ORDOVICIAN 510 million years

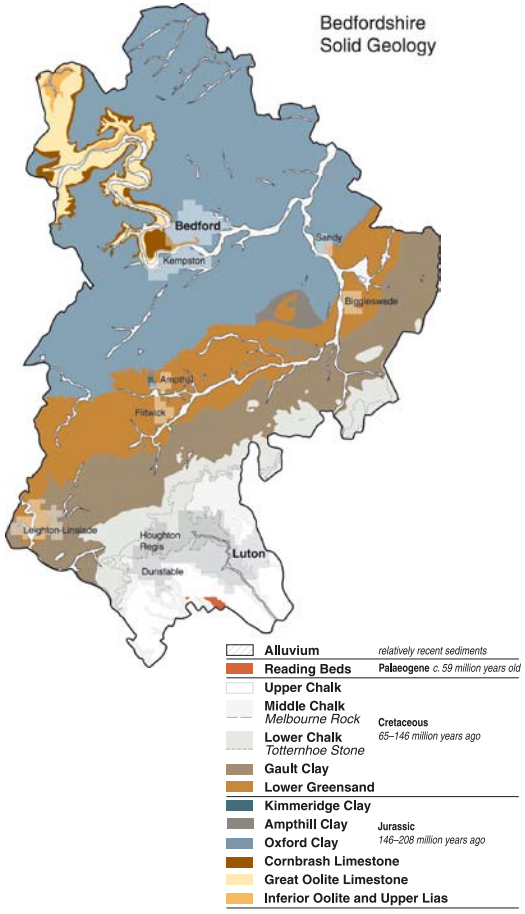
CAMBRIAN 570 million years

PRE-CAMBRIAN 4.6 billion years

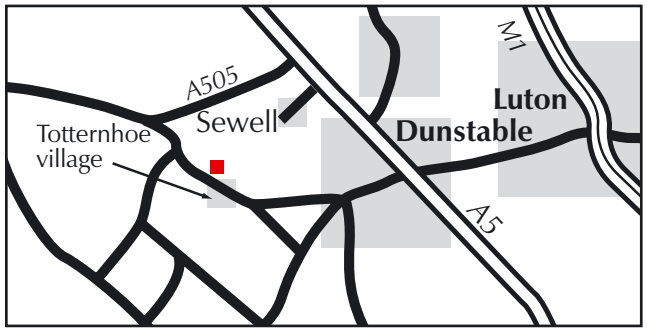
## Bedfordshire in the Bahamas

The rocks of Bedfordshire date from the early Jurassic to the Tertiary Period, about 190 to 40 million years ago. (The rocks laid down during the late Cretaceous and Tertiary are missing in our area, worn away by time and the glaciers of the Ice Age) All these rocks are made from many layers of sediments – limestones, clays and sands.

During the Jurassic and Cretaceous periods what is now Bedfordshire was at the latitude of the modern Bahamas. The Chalk that rises high in the south of the County was deposited on the floor of a warm tropical sea.






Totternhoe village and the Totternhoe Lime & Stone Co. quarry lie just east of Dunstable. Public rights of way in Totternhoe and adjacent parishes give access to an area that was extensively quarried in the past, with occasional views into working quarries. There are also public footpaths near the Puddlehill Quarry, between Houghton Regis and the A5, opposite the turn for Sewell. NOTE: quarries are dangerous places. To visit one, contact the quarry owner or join the BLGG!

**The Bedfordshire & Luton Geology Group** exists to encourage understanding of the geology and geomorphology of the county and to undertake site recording, interpretation, advice and education

**Regionally Important Geological and Geomorphological Sites (RIGS)** are places that reveal our geological past and are considered important enough to deserve conservation. They include sites where rocks can be seen (such as quarries and road cuttings) or where the geology or geological processes can be inferred from the shape of the landscape. Official RIGS are recognised by county councils and by Natural England.

For more information about the BLGG and our events as well as the geology and geomorphology of your area visit our website at

www.bedsrigs.org.uk

or contact B&LGG c/o Bedford Museum, Castle Lane, Bedford, Bedfordshire MK40 3XD.
Tel: 01234 353323; Fax: 01234 273401

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# Bedfordshire's geological industries

# Lime & Cement from the Chalk

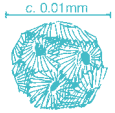
Bedfordshire & Luton Geology Group

bringing landscape to life

*Quarries such as Kensworth are impressive, but they're only the most recent 'holes in the ground' from which people have taken chalk for lime and cement.*

For thousands of years we've used mud from the bottom of a Cretaceous sea to fertilise our fields and build our homes and industries.

## The formation of the Chalk




As global temperature and sea level rose during the Cretaceous, microscopic algae known as *coccolithophores* began to thrive in the warm water. Their skeletons rained down on the seafloor, adding calcium carbonate – chalk – to clays washed from the retreating land. This chalky clay is now the Lower Chalk, a soft pale grey to cream layer at the base of the Chalk. The sea rose higher, reaching more than 300m above current levels; as the water deepened, the harder, purer limestones of the Middle and Upper Chalk were deposited. These layers are roughly 5% clay and 95% calcium carbonate, the fossil skeletons of algae so small that thousands would fit on the head of a pin – even more impressive when you know that the Chalk was well over 255m thick before icesheets and weathering reduced it to the height we see today.

*Fossils found within the Chalk tell us about the marine environment. Fish scales and teeth, fragments of marine reptiles, the skeletons of corals, casts of sea urchins and many shells show this sea was sometimes full of life.*

## Geology, landscape and industry

The Chalk influences southern Bedfordshire in many ways. It shaped the settlement and development of the county by storing water and encouraging people to travel certain routes. Building materials sourced from the Chalk add to the 'sense of place' created by the grassed Downs curving high against the sky. All this and the Chalk also provides raw materials for industry.

### *Lime burning*

Our word 'calcium' comes from the Latin *calx* meaning lime, a measure of its importance. 'Burning' good quality calcium carbonate – chalk or limestone – by heating it to 888–1000°C drives off carbon dioxide

*A 19th century lime kiln.*

and some oxygen to leave calcium oxide, known as *quicklime*. This is added to water[1] in the process known as *slaking*; *lime* is the product of the resulting violent reaction. Relatively little water yields powdery hydrated lime; more water creates lime putty (the basis for lime mortar) and eventually limewash. These lime products are *non-hydraulic,* which means they harden by drying, or by reacting very slowly with atmospheric $CO_2$.

People have burned lime for millennia: the earliest known kiln was used *c.* 2450BCE in Mesopotamia. Roman lime kilns are known from several sites in Bedfordshire, including one near Caddington Mill that would have used limestone. Kilns could have been built in ways that leave little archaeological evidence, so the lack of finds until the 12th century is not proof that the Anglo-Saxons did not use lime. In the Middle Ages lime mortar (lime putty plus sand and other materials) was used to lay brick- and stonework, lime plaster smoothed internal walls and render protected external surfaces, and limewash whitened walls inside and out. The practice of liming agricultural land to improve yields began in the 16th century and continues today.

There were several lime companies working quarries near Dunstable. Today only the Totternhoe Lime & Stone Co. still produces lime. Its works at Totternhoe opened in 1650 and once had 10 coal-fired kilns burning local chalk; today the company also brings in chalk from elsewhere. New quarries have opened at Sewell and Barton to supply chalk for lime, which has found new uses in neutralising acid flue gases from power stations and incinerators, in decontaminating liquids, and in the chemical industry.

1. Never add water to quicklime: the reaction becomes even more violent and dangerous.

### *Cement*

Burning calcium carbonate with a significant clay or silt content produces *hydraulic* lime, which sets and hardens after contact with water. The Romans were probably the first to mix other materials with the lime to create cement; they used several kinds including one containing *pozzolana* (a siliceous volcanic ash) that set underwater.

Modern Portland cements were developed from hydraulic limes in the 19th century. Precise amounts of calcium oxide, silicon oxide, aluminium oxide, ferric oxide, and magnesium oxide are blended, ground, then heated to *c.* 1450°C in a cement kiln. The resulting clinker is combined with calcium sulfate and ground to make Portland cement, or blended with other materials to change its properties.

Hat-making was once the main industry in Houghton Regis. In 1891 a lime works opened; in 1912 this was taken over by Blue Circle Portland Cement, who expanded the works and began producing cement in 1925. Puddlehill fed the kilns with Lower Chalk, the works grew larger, and the twin chimneys became a local landmark. In 1971 production ceased and the chimneys were demolished in the late 1970s.[2] In the 1960s eight Bedfordshire quarries[2] were extracting chalk for the cement industry; in 2007 only one is still working. Now owned by Rugby Cement, Kensworth opened in 1964 to work the Lower and Middle Chalk. Since 1965 the chalk from Kensworth has been mixed with final state sewage effluent from Houghton Regis, then pumped to Rugby in a 90km underground pipeline to reduce traffic near the quarry. Kensworth is now the largest chalk quarry in the UK, producing 8,000 tons of chalk per day.

### *Whiting*

Whiting is pure chalk, ground to powder or washed to sort the particles by size. Traditionally mixed with water to make whitewash, industries now add it to paint, toothpaste, plastics, indigestion tablets, and use it as an absorbent and cleaning agent. The whiting industry thrived in late 19th-century Dunstable, but had disappeared by the 1960s.

2. Chalk quarries also starred in another industry. Episodes of *Dr Who* were filmed in Totternhoe (1971) and Houghton Regis (1967).