

Chapter Nine

Limestone

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INTRODUCTION

Limestone is a spectacularly beautiful stone, both in its natural environment, and when used for architecture and sculpture. It exhibits a range of colours and textures that enhance and adorn countless grand and vernacular buildings. It has been used throughout the centuries for building the coarsest rubble walls to the finest ashlar walling, for bold architectural mouldings to the finest intricacy of screens and monuments, for the immense grotesques on church towers to the delicately modelled features and drapery of the most exquisite figure sculpture (Figure 9.1). Limestone is one of our great natural treasures, and once fashioned into myriad architectural shapes and sculptural forms, it becomes truly a precious stone.

In a limestone area of Britain, one can enter the local church and walk on smooth limestone flagstones, be surrounded by tooled limestone walls and be covered by a painted limestone vault, which is itself protected by a limestone roof. Light streams in through limewashed limestone tracery openings to illuminate polished limestone monuments and finely chiselled limestone corbels, capitals and columns.

This wonderful range of colour, texture, form and scale also presents a wide array of weathering and decay characteristics that challenge the conservation architect and stone conservator at every turn. In this chapter, attention is focussed on the ways in which powdering, crumbling, blistering, cracking, delaminating and eroding limestone surfaces are conserved and repaired.



Figure 9.1 The exquisite beauty of a thirteenth-century head carved in Doultling limestone on the West Front of Wells Cathedral.

CHARACTERISTICS OF LIMESTONE

The great variety of limestones used for architecture and sculpture in Britain range from very dense and hard polishable limestones like Purbeck 'marble' from Dorset to soft chalk limestones such as Beer from Devon. There is an enormous diversity of colour and texture in limestones, from black through to white including brown, orange, buff, yellow, green, grey, pink and cream. There are the coarse, shelly open textures of Ham Hill (Somerset) and Quarr (the Isle of Wight) to the very fine textures of Portland (Dorset) and Beer (Devon), and from highly porous Tufa and Chalk to low porosity polishable limestones like Devonshire 'marble'.

The decay characteristics of each type of limestone may be quite different and dependent on different causes and conditions. A strongly bedded stone like Ham Hill Stone (Somerset) has a tendency to delaminate, and this is exacerbated by the swelling of clay minerals present in this lias limestone. Blue Lias (Dorset, Somerset and at many other locations on the limestone belt) has a high clay content and is susceptible to cuboidal fracturing. Chilmark and Chicksgrove sandy (arenaceous) limestones have some decay characteristics that resemble those of sandstones and can be successfully impregnated with sandstone consolidants. The qualities of mortars used for limestone repair need to reflect the colour, texture and porosity of the stone to be repaired, for reasons of aesthetics, function and durability. The way a given limestone is cleaned also depends on its characteristics – water washing may damage some limestones, abrasive cleaning may be unsuitable for others, and poultice cleaning or laser cleaning may be the correct method for a certain limestone in a particular condition (see the previous chapter for further details on cleaning).

MAIN TYPES OF LIMESTONE DECAY

The weathering and decay patterns of limestone can be broadly divided into surface decay and deep decay. Sulphation of the calcium carbonate of which limestone is composed leads to salt formation, powdering, blistering, exfoliation and cracking (Figure 9.2). These result in surface distortion and surface loss (Figure 9.3). This can all initially occur to a depth of a few millimetres. In time, these processes can lead to deep decay, where the limestone becomes friable to a depth of at least 50 mm. Deep cracking and delamination can result from chemical and physical change of clay or iron minerals, or simply from poorly selected or incorrectly bedded stone. Surface and deep erosion are often the result of limestone surfaces being inadequately protected from rainwater, perhaps due to being situated in exposed areas of a building. Decay can also be caused by hard, cementitious mortars, which act as moisture traps and often lead to the deterioration of adjacent stone (Figure 9.4).

It is important to study the causes and conditions of each particular limestone's weathering behaviour, as this will provide information to tailor the appropriate conservation and repair strategy in each case. The choice of cleaning, consolidation, repair and protection techniques and materials are, to some extent, dependent on the nature of the decay in each particular case, and the general condition of the surface and substrate of the limestone.



Figure 9.2 A fine twelfth-century west doorway carved in Caen limestone from Normandy, at Ruckinge Church, Kent. The stone exhibits signs of sulphation decay, and soot crusts are collecting in sheltered areas.



Figure 9.3 A delicately carved eighteenth-century Chilmark limestone mask head, from the façade of Longford Castle, Wiltshire. Facial features have become distorted due to the formation and exfoliation of gypsum skins.



Figure 9.4 Beer limestone statue of Edward the Confessor, early nineteenth century, Exeter Cathedral West Front. There is deep decay under the hard impervious cement repairs, which are cracking and falling away.