Stage nomenclature in the uppermost Jurassic rocks of Britain

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Following the ratification of the Tithonian Stage as the Primary Standard Stage for the terminal Jurassic, the Kimmeridgian Stage can only be used in its shorter sense. For those areas of north-western Europe including Britain, where ammonite provinciality precludes use of the Tithonian Stage, the Secondary Standard Stages Bolonian and Portlandian will need to be used for precise intra-provincial correlation pending any future firm correlation with the Primary Standard. The Volgian will continue to be used, but only as an informal unit in Russia and adjacent areas, but cannot be legitimately used outside of Russia, for not only are its ammonites absent from the Jurassic of other parts of Europe, but it belongs to both Jurassic and Cretaceous systems and is thus unacceptable as a formal stage in chronostratigraphy. The Bolonian genus *Pectinatites* is far more widespread than generally recognised and the base of the lowest Bolonian Elegans Zone appears to correlate closely with the base of the Tithonian Stage.

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Introduction

Stratigraphical refinement progressed rapidly during the 19th Century with the introduction of the concept of the stage (d'Orbigny, 1842-51) and the zone (Oppel, 1856-58). Much of this work was pioneered in the Jurassic System in which, over north-western Europe, a succession of ammonite faunas showed that increasing stratigraphical resolution was possible. When Oppel produced his table of zones for the Jurassic Period (1856-58) he recognised 33 zones of which 22 had an ammonite species as their index fossil. Since then progressive refinement has increased the number of zones so that by 1933 Arkell listed 57 zones (all of them with an ammonite as zonal index) and Cope (2006) recorded the then total as 76, most of which are divided into subzones.

In the uppermost Jurassic, however, there are still major problems of correlation, because of faunal provincialism; ammonites became restricted geographically and faunas in one area are totally different from those of another. In a few instances, however, ammonites occur that enable different faunal provinces to be correlated at discrete points.

Development of nomenclature

When d'Orbigny drew up his table of Stages (1840-51) he named the Kimmeridgian and Portlandian Stages after British localities but relied upon the detailed descriptions of Fitton (1836) for knowledge of the British sections. D'Orbigny also, however, defined his stages, in addition to lithological units at different localities, by their fossil content; thus for the Portlandian Stage (named after Portland Isle) he said it was equivalent to the Portland Sand and Portland Stone of Fitton (1836) but also listed the species *Ammonites gigas, A. gravesiana* and *A. irius* as characteristic. These species all occur in the Upper Jurassic of the Boulonnais region of northern France, so that it was natural that the French called these rocks Portlandian, but these species were then unknown in Britain. More than 60 years later, Salfeld (1913) found these ammonite species (which he included in his new genus *Gravesia*) in the middle of the English Kimmeridge Clay at Kimmeridge, and recognised that their occurrence meant that these rocks were already Portlandian to French eyes. British geologists, however, reading that d'Orbigny's Kimmeridgian Stage included the whole of the Kimmeridge Clay of Fitton (1836) continued to regard these rocks as Kimmeridgian; they also restricted their interpretation of the Portlandian Stage to the Portland Sand and Portland Stone of Fitton following the first of d'Orbigny's criteria. In retrospect it seems clear that although d'Orbigny named these stages after British localities his ambiguous definitions arose because he had never seen the British sections, and was totally unaware of the position of *Gravesia* in the middle of the British Kimmeridge Clay.

What was overlooked for many years, however, was that Blake (1880, 1881) had already appreciated this problem. Thus Blake (1880, p.196) wrote: "*The fact is that in England we possess the* ***normal*** *formation, to which the name Kimmeridge was originally applied* [by Webster (1816)]; *while at Boulogne we find an* ***episode*** *having no relation to the Portlandian above, but to which the name of "Boulognian" may well be given… The upper part of their* [the French] *"Middle Portlandian" is our Portland Sand…The lower part of their "Middle Portlandian"…* [is]*… not at all unlike the top of the Kimmeridge at Chapman's Pool. ... Referring to my section on the Kimmeridge coast (1875) … the comparative thicknesses of the deposits are 252 feet* [76.8 m] *in England and in France 44 feet* [13.4 m]. *We are thus forced to look for the normal representatives of the Boulognian episode in the beds from No. 10* [Freshwater Steps Stone Band] *downwards of my succession… The existence of this*