The historical taxonomy of the Lower Cretaceous theropods (Dinosauria) *Calamospondylus* and *Aristosuchus* from the Isle of Wight

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NAISH, D. 2002. The historical taxonomy of the Lower Cretaceous theropods (Dinosauria) *Calamospondylus* and *Aristosuchus* from the Isle of Wight. *Proceedings of the Geologists' Association*, **113**, 153–163. The historical taxonomy of the small theropod dinosaurs from the Wealden Group (Lower Cretaceous) of England is confused and complex. Of the twelve species names, several are synonymous and the remainder are mostly *nomina dubia*. Among the latter are the probable bird *Wyleyia valdensis*, the probable oviraptorosaur *Thecocoelurus daviesi* and the enigmatic forms *Ornithodesmus clunicultus* and *Calamosaurus foxii*. It has traditionally been thought that *Calamospondylus oweni*, the first British small theropod (or supposed theropod), was renamed and redescribed as *Poekilopleuron pusillus*, a taxon later given its own genus, *Aristosuchus*. Fox's correspondence with Owen, and discrepancies in the descriptions of these specimens, show that *C. oweni* and *A. pusillus* were based on different specimens. *A. pusillus* is based on a sacrum and partial pubes from a compsognathid coelurosaur. The whereabouts of the type specimen for *C. oweni* is presently unknown.

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1. INTRODUCTION

The Wealden Group strata (Berriasian–Aptian, Lower Cretaceous (Kerth & Hailwood, 1988; Allen & Wimbledon, 1991)) of mainland England and the Isle of Wight (Figs 1, 2) are famous for their diverse dinosaur fauna (Martill & Naish, 2001). Because isolated skeletal elements are common in the Wealden Group, and because some nineteenth century workers

used them to erect new taxa, the taxonomy of Wealden Group dinosaurs is complex.

The first supposed Wealden Group theropod material was first mentioned by Buckland (1824) and

Fig. 1. Sketch map of the Isle of Wight showing the distribution of dinosaur-bearing Lower Cretaceous strata on the island. *Calamospondylus* and *Aristosuchus* were both probably collected from the southwest side of the island.

Fig. 2. Simplified stratigraphic log for the Lower Cretaceous Wealden Group of the Isle of Wight. Both *Calamospondylus* and *Aristosuchus* were probably collected from the Wessex Formation, though from which horizon is unknown.

described by Mantell (1846). This consisted of fragmentary elements from Tilgate Forest, Sussex, and was regarded by Mantell as avian. It belongs to pterosaurs, however (Wellnhofer, 1991). Though material that belonged to a large Wealden Group theropod was mentioned as early as 1822 by Gideon Mantell (see Cadbury, 2000), recognition of the first Wealden Group large theropod is usually given to Richard Owen (1855, 1857). The first small Wealden Group theropod was not noted until 1866 when the Reverend William Fox briefly described the sacral region of a small dinosaur, assumed by all later writers to be from a theropod, from the Wessex Formation of Brook, Isle of Wight (Fox in Anon., 1866a). Following this report, numerous discoveries were made of small Wealden theropods. In order of publication these are: *Calamospondylus oweni* Fox in Anon., 1866a; *Poekilopleuron pusillus* Owen, 1876; *Thecospondylus horneri* Seeley, 1882; *Aristosuchus pusillus* (Owen, 1876); *Ornithodesmus cluniculus* Seeley, 1887a; *Thecospondylus daviesi* Seeley, 1888; *Coelurus daviesi* (Seeley, 1888); *Calamospondylus foxii* Lydekker, 1889; *Calamosaurus foxii* (Lydekker, 1889); *Thecocoelurus daviesi* (Seeley, 1888); *Wyleyia valdensis* Harrison & Walker, 1973; and *Aristosuchus oweni* (Fox in Anon., 1866a).

The taxonomy and identity of these taxa have formed part of a larger study on Wealden Group theropods (Naish, 1999a; Naish *et al.*, 2001). Although some of these names may pertain to a single taxon, comparisons of overlapping elements, including sacra, femora and tibiae do indicate that several small-bodied theropods were present in the Wealden Group (Naish, 1999a, b, 2000a). Although often of doubtful taxonomic validity, some of the taxa possess character-states that allow them to be allocated to specific clades. *Thecocoelurus daviesi* (Seeley, 1888), named for a partial cervical vertebra (BMNH R181), is probably an oviraptorosaur (Naish & Martill, 2002). *Wyleyia valdensis* Harrison & Walker, 1973, represented only by a small right humerus (BMNH A3658), was originally described as *Aves incertae sedis* (Harrison & Walker, 1973) but was regarded as a possible non-avian theropod by Feduccia (1980) and Norman (1990). Zhou *et al.* (1992) and Feduccia (1996) regarded *Wyleyia* as avian while Harrison (1991) regarded *Wyleyia* as an enantiornithine and Kurochkin (1995) suggested it was a palaeognath. BMNH A3658 possesses a number of characters including a proximal ligamental furrow and distal notch for the brachialis anticus which indicate that it is avian. The presence of the fossa for the brachialis anticus indicates that *Wyleyia* is not an enantiornithine. Howse & Milner (1993) showed that *Ornithodesmus cluniculus* Seeley, 1887a, long regarded as the type species for a pterodactyloid pterosaur genus, is a theropod. The affinities of *O. cluniculus* remain controversial and it has recently been compared both with basal theropods (Naish, 1999a, 2000a) and dromaeosaurids (Norell & Makovicky, 1997). The

new large, long-legged coelurosaur *Eotyrannus lengi* was regarded as a possible basal tyrannosauroid by Hutt *et al.* (2001). *E. lengi* is not demonstrably referable to any of the previously named Wealden Group forms (Hutt *et al.*, 2001).

The systematics of the smaller Wealden theropods have been reviewed by a number of authors including Swinton (1936), Ostrom (1970) and Norman (1990). All of these reviews have proposed various synonymies. Ostrom (1970), Norman (1990) and Blows (1998) advocated the referral of most small Wealden Group theropod taxa to the supposed earliest recognized and best known taxon, that represented by the sacrum and pubes BMNH R178, a specimen they believed to represent the type for *Calamospondylus oweni*. This parsimonious approach assumes a low diversity of small theropods in the Wealden Group. Norman (1985) stated that the names *Aristosuchus*, *Calamosaurus*, *Calamospondylus*, *Thecocoelurus* and *Thecospondylus* all pertain to the same taxon, for which he used the name *Aristosuchus* (but see Norman (1990)).

Because more than one small theropod taxon is clearly present in the Wealden Group (Naish, 1999a, b, 2000a), isolated elements cannot be confidently referred to any one taxon in particular and most or all suggested synonymies cannot be proven. It is therefore unsafe to refer non-overlapping material to *Calamospondylus oweni* or *Aristosuchus pusillus*.

Institutional abbreviations: BMNH, Natural History Museum, London; MTCO, Muzeul Tarii Crisurilor, Oradea, Romania; SMNK, Staatliches Museum für Naturkunde Karlsruhe, Germany.

2. THE CALAMOSPONDYLUS PROBLEM

Calamospondylus oweni, a small dinosaur based on 'the bones of the sacrum, consisting of five cemented vertebrae with the sacral ribs and portions of the other iliac bones' (Fox in Anon., 1866a), represents the earliest named small theropod from the Wealden Group. Its nomenclatural history is convoluted: it has been universally confused with *Aristosuchus pusillus* (Owen, 1876) and has also been considered congeneric with *Calamospondylus foxii* Lydekker, 1889. Validity of the name *C. oweni* has been problematic due to the place of publication and the inadequacy of the original description. These problems have been compounded by the assumption that the name *C. oweni* was created for the theropod specimen BMNH R178 (Fig. 3): however, this is not the case (see below).

C. oweni was discovered by the Reverend William Fox at Brook, Isle of Wight (Fox in Anon., 1866a; Blows, 1983). This is proven by one of Fox's letters to Owen (believed to date from 1866 (Blows, 1983)) in which Fox alluded to the creation of a generic name that would be the (roughly) translated version of 'reed-like vertebrae' (Fox in Blows, 1983). This name was first published in *The Athenaeum* of June 2, 1866

Fig. 3. BMNH R178 as figured in Owen's (1876) plate. This specimen was designated by him the type of *Poekilopleuron pusillus*. (A) left lateral view of the sacrum; (B) left lateral view of the pubis; (C) ventral view of the pubic boot.

(Fig. 4). Despite the informal place of publication, brevity of description and extreme difficulty that arises when one tries to determine which specimen Fox (in Anon., 1866a) was writing about, *Calamospondylus oweni* satisfies the requirements of Article 12 of the International Commission on Zoological Nomenclature (ICZN, 1999). Article 12 (names published before 1931) states that names must meet the requirements of Article 11 and must (if not accompanied by an indication, see Article 12.2) 'be accompanied by a description or a definition of the taxon that it denotes' (p. 16). *C. oweni* is therefore accepted here as a properly published name and is not regarded as a *nomen nudum* (as it is in Naish *et al.*, 2001). Fox's announcement on *C. oweni* was included within a larger section of text and there are several indications that none of this was written by Fox himself. Firstly, the article refers to Fox as its subject and does not read as if he wrote it. It is also not signed by Fox but

is included within a larger section of anonymously credited text. This text was probably written by an *Athenaeum* editor and is here cited as Fox in Anon. (1866a).

Fox's (in Anon., 1866a) *Athenaeum* article was reproduced in *The Geological Magazine*. That two identical articles appeared in 1866, both including the name *C. oweni*, has resulted in some difference of opinion with regard to which should be cited as the first publication of *C. oweni*. Lydekker (1891), Ostrom (1970) and Benton & Spencer (1995) all cited *The Geological Magazine* and did not cite *The Athenaeum* article. Norman (1990) and Insole & Hutt (1994) cited *The Athenaeum* reference. Swinton (1936) listed both articles in his bibliography, but only referred to *The Athenaeum*. *The Athenaeum* was a semi-popular magazine and seems an inappropriate place of publication for an article in which a formal taxonomic name was erected. This may explain why it was

have also been noticed. During his stay in Rome, Mr. Parker has superintended the execution of a very extensive series of photographs representing all these different styles, by an excellent artist, very well versed in Roman archaeology, of the name of Simeoli.

Early Christian archaeology has also made rapid strides at Rome. Not content with the great French work of Perrot on the Catacombs, which is generally considered to give far too highly finished a character to the various wall-paintings in them, M. de Rossi has published the first volume of a great work on the Christian inscriptions, and also a first volume on the Catacombs in general. He is also the editor of a periodical devoted to the early Christian archaeology of Rome. The Rev. P. Garavani has prepared a third edition of his remarkable work on the painted glass objects found in the tombs; whilst the Rev. Abbé Barbier de Montault has prepared a descriptive catalogue of all the Christian remains preserved in the Museum of the Vatican Library (where, by the by, we lately met Prof. Tischendorf, busily engaged upon some early indited MSS. of the Bible).

It may be useful to some of your readers to be informed that many of the objects which were in the Museum of the Vatican have been removed to St. John Lateran, which will in time become the great Christian Museum of Rome. Here, for instance, are placed all the great Christian iconography, as well as the Christian inscriptions (except these in the long gallery of the Vatican leading to the sculptures, in which the pagan inscriptions occupy the right and the Christian ones the left of the gallery). The collection of these inscriptions at St. John Lateran has been carefully arranged, according to their dates, by De Rossi. There is another great collection of things at St. Paul's Basilica (the restoration of which most noble church would of itself be sufficient to mark the reign of any sovereign pontiff); these are now fixed in the galleries leading to the library. A chrono-lithographic work on the 'Christian Mosics of Rome' is in progress, the first number of which will be ready for publication, by Spithöver, about the end of the present year.

The excavations at San Clemente are being continued under the direction of the excellent Prior, the Rev. P. Mullooly. Although the present basilica, which is one of the oldest in Rome, and well known for its interesting mosaics and its two marble ambones in their original position, is much below the adjoining street running from the Colosseum to St. John Lateran, an under-church of large size has been discovered, with numerous very early wall-paintings and fine marble columns. The excavation is at present being continued beneath the high altar of the upper church, which, it is feared, will have to be taken down and rebuilt. And, still deeper, a house has been discovered, which was doubtless the precursor of the lower basilica when the Christian inhabitants were but few in number.

The excavations undertaken by Mr. Parker, with the consent of the Abbess of St. Pudenziana, beneath the existing church (which, like San Clemente, is considerably below the level of the street), have been stopped by order of the superior authorities. Sufficient has, however, been found to show that a preceding basilica extended beneath the western half of the present church, a strong wall running from below the entrance to the spot below the high altar. The original pavement of the floor of the house of Pudens has been reached and partly cleared, and we had the pleasure to observe that it is formed of minute tesserae arranged mosaic-wise, just as in the original pavement of the western aisle of the church (which also is contemporary with the time of Pudens), and also as in the pavements of Pompeii. Thus we are brought into the residence of the famous senator Pudens, so deeply interesting, not only from his connexion with Caractacus and his family, but also from the fact to which Justin Martyr bore testimony, that the house of Pudens was the resort of early Christians visiting Rome, and that he himself had, on several occasions, been its inmate. The altar in this most interesting little church, on which St. Peter was

traditionally affirmed to have officiated, was removed by Cardinal Wiseman (as titular cardinal of St. Pudenziana); and so very early sepulchral inscriptions to members of the family of Pudens have also been moved, of order of the present Pope, to St. John Lateran, where they are lost in the crowd of similar stones; but a stone recording the burial of another female of the Pudenzian family has been found, and fixed in the west aisle, together with the grave-stone of an early bishop found on the spot, in remarkably fine and large Roman capitals.

The learned architect of the Vatican records, Dr. Finsterlin, has recently published a valuable series of documents connected with the mediæval history of England and Scotland from originals under his charge, as a supplement to two or three similar volumes illustrating the history of Germany and other countries of Europe.

J. O. W.

OUR WEEKLY GOSPEL.

THE Queen has corrected the popular idea that the second son of the British Sovereign must necessarily be a Duke of York, by creating Prince Alfred Duke of Edinburgh. This title has never before been conferred on the son of a reigning sovereign. It has been enjoyed by Frederick, son of George, Prince of Wales (afterwards George the Second), by Frederick's son, George (subsequently George the Third), by Prince William, George the Third's brother, as Duke of Gloucester and Edinburgh, and lastly, by Prince William's son, William Frederick, who died childless, in 1837. Duke of York is a far older and nobler title. From 1385 to 1438, it distinguished five Plantagenet princes, and from 1494 till the accession of James the Second, it was the title of the second sons of Henry the Seventh, James the First and Charles the First; all of whom became Kings of England. As Dukes of York and Albany, we have had, from 1716 to 1827, Ernest, the brother of George the First, Edward, brother of George the Third; and Frederick, second son of George the Third, who died in the last year named above.

The Professors of University College will hold their evening receptions on Friday, the 8th of June, in Gower Street. This year the learned body are trying the pleasant experiment of inviting ladies to their re-unions.

Cards have been issued for the Society of Arts Conversations for Wednesday, the 13th of June, at the South Kensington Museum.

Those of our readers who take an interest in our early history will no doubt be pained by the information that Mr. Thorpe is preparing an edition of the Topographical Charters of England, dating from the reign of King Ethelbert, A.D. 604, to the Norman Conquest. In this work the documents will be classed in counties, beginning with Kent, thus forming an appropriate companion to the Domesday Survey of that county. As in the 'Diplomatarium Anglorum' (of which this is the continuation), the charters in Anglo-Saxon and the Land-Boundaries will be accompanied by translations.

The fine collection of Oxford worthies, formed by the late Dr. Wellesley (which he commenced when an undergraduate and steadily increased throughout his life), arranged according to the different colleges, and consisting of many hundred engraved portraits, has recently been acquired by the Hope Curators and added to the Egean collection of portraits, now deposited in the Gallery of the Radcliffe Camera, at Oxford.

The bust of Capt. Speke has been erected at Taunton in the shire-hall, with an inscription from the pen of Sir Henry Rawlinson. Speke is recorded as "The discoverer of the sources of the Nile"—marked as a quotation. Does this form of testimonial mean that Sir Henry disputes the fact of discovery, like so many other geographers?

A correspondent says: "Your philologists are queer people, and love to 'fool as to the top of our bent.' The idea of the word, as employed by Shakespeare and Scott, meaning anything beyond will, humour, impetuous purpose; bent of inclination, in short, would seem wordiness, were there

not still a host of eager antiquaries of the Old-Blues species, who, when A. D. L. L. is shown to stand for 'Aikon Drum's Lang Laidie', turn their faces to the wall, and refuse to be comforted, having engendered themselves to get unconvinced meanings out of common things. As I have broken out into hourly suggestions, let me ask, whether it has occurred to any of those who have quarrelled with the word 'waterchurn', that it may have originated in 'Water's head misprinted'. The French have naturalised *Boatigrin* and *Bliffy* by a like process; and so, in former days, did our insensates by the signs of 'the Bull and Mouth' and 'the Goat and Compasses'."

Mr. Reinbourn has a volume of miscellaneous poems in the press.

While the Postmaster-General's recent report of his stewardship during the past year is interesting to the Chancellor of the Exchequer on the financial point of view, it is also interesting to the public generally, for the curious statistical information that it contains. The population of the United Kingdom in 1865, according to computation, 22,710,977, occupying 5,306,226 houses. There was an increase of 40,712 inhabited houses in England and Wales, of 2,229 in Scotland; but in Ireland there was a decrease of 5,123 inhabited houses, and 39,000 inhabitants, as compared with the previous year. The number of letters delivered in England and Wales in 1865, amounted to 697,377,616, being an average of 28 to each person, and an increase of 6.24 per cent. In Scotland, 67,948,872 letters were delivered, being 21 to each person, and an increase of 4.33 per cent.; and, in Ireland, 6,140,609, being 10 to each person, and an increase of 3.93 per cent. There were 43,563,965 free newspapers delivered in the year, and 53,682,511 book-packets, including chargeable newspapers. The total number of letters, papers, and packets was 815,669,550. Above 12,000 letters were posted without any address, and of these 228 consisted of such letters as, to the amount of 3,700. The newspapers amounted to 18,140,650. There were 611,836 depositors in the Savings Banks, holding 5,522,660.

The Rev. W. Fox, of the Isle of Wight, who last summer discovered his *Polacanthus Fori* has just brought to light another new Wealden reptile. The discovered parts of this animal are similar to the bones of the *acurum*, consisting of five cemented vertebrae with the sacral ribs and portions of the other iliac bones. The remains, therefore are quite sufficient to show that the reptile, to which they belonged was of the *Dinosaurian* order. It was small compared with the other monsters of the world of *effs*, the *acurum* being only six inches in length; yet apart from its size it had as much of novelty about it as some of the previously discovered dragons. The bones were more hollow, light, and compact in structure than the bones of birds, and quite as much so as those of the pterodactyls, with foramina for the admission of air into them, like the bones of the last-named reptiles. Such a formation was evidently given for the purpose of leaping from tree to tree, or for bounding from the grasp of other reptiles with an elasticity of spring equalling that of the grasshopper. With the approval of Prof. Owen, who has examined the bones, this new reptile has been dedicated to him by its discoverer, who has given it the descriptive name of "*Calamospondylus Oweni*" from the fact of its backbone being hollow, smooth, and compact like a reed.

We have received a copy of Mr. Collier's reprint of 'The Phoenix Nest', a dainty collection of plates published in 1893, and of singular interest for the illustration of our great literary period. Mr. Collier is doing an excellent service by the reprint of these rare plates.

How much longer is the public common sense to be outraged, and the health of Wodger, Lambeth and Pimlico to be imperilled, by the maintenance of the disgusting nuisance caused by the bone-bollers and manure-makers of Lambeth? A large portion of the London population from point up and down the river in the steamboats there no less than the inhabitants of the district are named, are exposed to the effects and offensiveness

Fig. 4. Reproduction of p. 740 from *The Athenæum*, 2014, p. 740 (2 June, 1866). Fox's article on *C. oweni* is in the bottom half of the third column.

ignored by some authors (e.g. Ostrom, 1970). Swinton (1936) considered Fox's *C. oweni* of 'no nomenclatural significance' because it was published 'in a "gossip note"', and 'without definition' (Swinton, 1936, p. 207). Swinton's (1936) view on *Calamospondylus* Fox had implications for his opinion on *Calamospondylus* Lydekker and its replacement name *Calamosaurus* Lydekker (Naish, 1999a). *The Geological*

Magazine article was published in part XXVI of volume III: this is dated on its cover as appearing in August 1866. It is therefore preceded in publication by *The Athenæum* article and the latter is regarded here as the formal source of the name *Calamospondylus oweni*.

Some items of historical interest regarding *Calamospondylus* are evident from Fox's letters to Owen (Blows, 1983). Fox suggested in an 1866 letter that

Calamospondylus might be awarded a specific name honouring Alfred Lord Tennyson, a friend and associate of Fox, and a man whom Owen also knew personally (Blows, 1983). Fox's eventual decision to name *Calamospondylus* in honour of Owen was apparently, however, to Owen's approval (Fox in Anon., 1866a). This strongly indicates that Owen's (1876) species *Poekilopleuron pusillus*, a name assigned without any doubt to the specimen BMNH R178, was not a renaming of *C. oweni*. Fox also appears to have been the first person to suggest that small theropods may have possessed scansorial abilities (Naish, 2000b).

The *Geological Magazine* article on *C. oweni* was published in the 'miscellaneous' section of the journal and was not signed off by the initials of an author. Instead, it was credited to '*Athenaeum*' – thus it shares its author with the writer of the latter article and is cited here as Anon. (1866b). Here ends Fox's contribution to the taxonomy of the smaller Wealden theropods, and from hereon the subject is complicated by the writings of other authors.

3. OWEN, SEELEY AND BMNH R178

Previous authors have assumed that whatever theropod material was described and named by Fox (in Anon., 1866a) was made better known by Owen's apparent redescription of it in 1876 (Owen, 1876). Owen (1876), as is apparent from his description and accompanying plate, described the theropod sacrum and pubes BMNH R178 (Fig. 3). He regarded this as crocodilian, referring it to *Poekilopleuron*, a genus erected for *P. bucklandii* from the Bathonian of France (Eudes-Deslongchamps, 1838). This species is a large, *Megalosaurus*-like theropod (Paul, 1988; Molnar, 1992). Owen did not approve of Eudes-Deslongchamps' spelling of *Poekilopleuron* and insisted on spelling it *Poikilopleuron*: Owen had instated this respelling in 1842 for *P. bucklandii* (Owen, 1842) and thus did not use it exclusively for *P. pusillus* (which demonstrates that it was not an attempt to erect a new genus). It is one of eight spelling variations of this name (Olshevsky, 1991) and, as it is incorrect, Owen's (1876) name for BMNH R178 should be written *Poekilopleuron pusillus*.

Owen's (1876) reason for referring BMNH R178 to *Poekilopleuron* rested entirely on one feature of the vertebral centra – the relatively large cavity within each centrum, referred to by Owen (1876) as the 'central chondrosal vacuity' (Owen, 1876, p. 2). This referral of BMNH R178 to *Poekilopleuron* was reviewed by Hulke (1879) who established the theropodan nature of *P. bucklandii*, predominantly on the morphology of the distal tibia. Hulke (1879) was confident that *P. bucklandii* was a junior synonym of *Megalosaurus bucklandii*, an opinion also promulgated by Paul (1988), but Hulke did not provide any taxonomic opinion on *P. pusillus*.

Owen (1876) noted that the material he named *P. pusillus* comprised eight vertebrae, an ungual phalanx

and a pair of fused distal pubes. He did not recognize the true nature of the latter and suggested that they might represent part of the series of abdominal ribs and a sternum (Owen, 1876, p. 2). This identification was not original, as Fox had previously suggested a similar identification in one of his letters. In Owen's (1876) plate, the pubic foot of BMNH R178 was labelled a haemal spine, and the shafts of the pubes were labelled as haemapophyses. BMNH R178 is not described in detail here as it has previously been described by Owen (1876) and Huene (1923, 1926a,b). The osteology, systematics and phylogenetic affinities of this specimen form part of a larger study in progress on Lower Cretaceous coelurosaurs and are not discussed here. As noted in Naish (1999c), BMNH R178 is probably a compsognathid and is very similar to *Compsognathus*.

Nowhere in Owen's (1876) text did he formally state that he had created a new taxon for the reception of this material, although it is evident from the name '*Poikilopleuron pusillus*, Ow.' heading the respective section that he did so.

Removing BMNH R178 from *Poekilopleuron*

Seeley (1887b, c) took issue with Owen's (1876) assignment of *P. pusillus* and, recognizing that BMNH R178 did not represent a crocodile but a dinosaur, drew attention to Marsh's (1884a, b) identification of BMNH R178 as a theropod (see below) (Seeley, 1887b). In fact, Seeley (1887b) noted (as did Lydekker, 1888) that Marsh (1884a, b) had even referred BMNH R178 to *Coelurus* (see below). Seeley (1887b, c) also argued that the presence of Owen's chondrosal vacuities (Seeley's medullary cavities) in the vertebrae of BMNH R178 did not provide a satisfactory morphological basis on which to assert a genus-level relationship, as per Owen (1876), for Seeley (1887b, c) was aware that such cavities were widely distributed in dinosaurs. This meant that there was no basis for Owen's (1876) referral of BMNH R178 to *Poekilopleuron*. Consequently, Seeley (1887b) gave the specimen the new generic name *Aristosuchus*.

Seeley (1887b) correctly identified the pubes of BMNH R178 and suggested that the ungual phalanx BMNH R179, regarded and illustrated by Owen (1876) as part of the *P. pusillus* material, did not belong together with it, but was in fact from a pterosaur. This does not appear to be correct, and the phalanx is here regarded as theropodan. Lydekker (1888) argued that, on the basis of its strong similarity to the third manual ungual of *Allosaurus*, BMNH R179 most probably belonged to the same animal as BMNH R178 (see Appendix).

The non-sacral vertebrae that have also been considered to belong to the same individual as BMNH R178 (the dorsal vertebra BMNH R178a and the two caudals both labelled BMNH R178b) cannot definitely be associated with it. Jurcsák (1982) and Jurcsák & Popa (1983) even referred material from the Lower

Fig. 5. BMNH R6426, a small (probable right) incomplete ischium that has been referred to *A. pusillus*, in (A) lateral, (B) medial and (C) dorsal view. Scale bar 20 mm.

Cretaceous of Cornet, Romania, to *Aristosuchus* as the undetermined taxon *Aristosuchus* sp. Benton *et al.* (1997) noted that, if correct, this referral would require that the Romanian theropod be somewhat larger than that represented by BMNH R178. Given that the supposed Romanian *Aristosuchus* material consists only of two isolated vertebrae (the cervical MTCO 16499 and the incomplete caudal MTCO 17245), Jürsák (1982) and Jürsák & Popa's (1983) referral must be considered extremely dubious.

In discussing the theropodan nature of *Aristosuchus*, Seeley (1887c, p. 223) wrote that Henry Woodward 'submitted to me the pubis, imperfect distally, of a type very similar to *Coelurus*, from Tilgate'. The undescribed partial ischium BMNH R6426 (Fig. 5) may also be referable to *Aristosuchus*. This could be correct but cannot be confirmed; the proximally located triangular obturator process shows that the specimen is from a coelurosaur (Holtz, 2000) and in general shape it resembles the ischia of

compsognathids. Unfortunately, it cannot be compared directly with the type specimen of *Aristosuchus*.

4. ARGUMENTS OVER SENIORITY: *CALAMOSPONDYLUS* OR *ARISTOSUCHUS*?

Because it has been widely assumed that the specimen named *C. oweni* by Fox (in Anon., 1866a) was the same as that later called *P. pusillus* by Owen (1876) and then *A. pusillus* by Seeley (1887b, c), it has been argued that both names should be regarded as junior synonyms of *C. oweni* (Norman, 1990; Weishampel, 1990; Insole & Hutt, 1994; Blows, 1998; Kirkland *et al.*, 1998). However, a number of other authors have regarded *A. pusillus* as the 'best' available name for BMNH R178 (Swinton, 1936; Steel, 1970; Galton, 1973; Madsen, 1974; Blows, 1983; Norman, 1985; Paul, 1988; Olshevsky, 1991). In these latter cases, the indication has always been that these authors regarded *C. oweni* as a *nomen nudum* created for BMNH R178, and not that they regarded it as pertaining to a different specimen.

Paul (1988) provided an exception to those that have accepted *Aristosuchus* as valid in that he acknowledged Fox's specific name by creating the new combination *Aristosuchus oweni*. This clearly assumes that both names refer to the same specimen but because Paul's (1988) use of the specific '*oweni*' indicates that he regarded Fox's name as valid (and not a *nomen nudum*), he should have used the generic name *Calamospondylus* in preference.

Was *Poekilopleuron pusillus* a renaming of *Calamospondylus oweni*?

That Fox (in Anon., 1866a) created the name *C. oweni* to honour Owen makes it seem unlikely that, shortly afterwards, Owen would simply disregard this name in favour of a new one created by himself. Furthermore, that Owen (1876) ignored the name *C. oweni*, making no mention of it in his 1876 description, nor making any mention of Fox's (in Anon., 1866a, b) articles, strongly suggests that he thought he was dealing with a different specimen. This supposition is supported by a number of facts that have been overlooked by previous authors who have regarded *P. pusillus* and *C. oweni* as synonymous.

Firstly, when Fox (in Anon., 1866a) wrote about the sacrum 'and portions of the iliac bones' named by him *C. oweni*, these remains were considered to be from a dinosaur (Fox in Anon., 1866a). This identification was confirmed by Owen (Fox in Blows, 1983). It seems strange then that, if the *C. oweni* material is the same as BMNH R178, Owen (1876) should later consider this to be crocodilian. The possibility exists that (supposing that *C. oweni* and *P. pusillus* do represent different names for the same specimen) Owen changed his mind with regards to the dinosaurian nature of the *Calamospondylus* material. This argument is, therefore, inconclusive.

Secondly, the respective sizes reported for *C. oweni* by Fox (in Anon., 1866a, b) and the size of BMNH R178 are significantly different. Fox (in Anon., 1866a) describes the *C. oweni* sacrum as six inches long (152.4 mm). Owen (1876) did not report measurements of BMNH R178. However, there is no doubt that this is the specimen he was describing and its total length is 125 mm. A difference of 27.4 mm therefore exists between Fox's (in Anon., 1866a) measurement of the *C. oweni* sacrum and the sacrum of BMNH R178. A 27.4 mm discrepancy is high for specimens only measuring around 125 mm in total length. This suggests that Fox (in Anon., 1866a) was not writing about BMNH R178.

What appears likely, and yet has been overlooked by all authors who have reviewed Wealden theropod taxonomy, is that Fox actually discovered two dinosaur specimens, both of which consisted predominantly of a sacrum, both of which were discovered around, or within, 1866, and both of which formed the basis of correspondence between Fox and Owen. In his biographical review of the Reverend Fox, Blows (1983) reproduces two 1866 letters sent by Fox to Owen, both discussing the discovery of small dinosaur material. In the first letter, stated by Blows (1983) to date to March 2, 1866, Fox wrote:

If you feel, as I do, that the light sacrum in your hands as well as the larger vertebrae, belong to reptiles as yet unrecognised and you think you have in the specimens sufficient data on which to establish new specific character, may I ask you as our great Palaeontological High Priest to give them names. What say you to the little one being named -spondylus [*sic*] from its *reed* [italics in original] like backbone. Add if you like your own name as a specific one. Call the other what you think proper; but do you think that your friend Tennyson, who without being deeply learned on these matters, can sing so beautifully of this saying 'A monstrous eft was of old etc' and who smoked like a true Philosopher over the grave of the old Eft while I was digging up some fragments of his bones, do you think I say that he would like to have his name linked with this dragon? If you deem the suggestion illjudged [*sic*] let it die in the flames with this paper . . . (Fox in Blows, 1983).

The problem with Fox's letter here is determining which theropod specimen(s) he was specifically referring to. While it is abundantly clear that Fox was writing about the specimen that he subsequently named *C. oweni*, was he writing, as Blows (1983) assumed, about BMNH R178? I do not believe he was, because in the second 1866 letter, reproduced below, Fox clearly writes about a second small dinosaur sacrum, and makes a number of references which strongly indicate that here he was referring to BMNH R178.

Fox wrote:

I found a few small bones the other day and they strike me as being rather interesting and I have a good opportunity of sending them to you by a friend, I have no doubt you will be happy to have the opportunity of inspecting them.

The whole were found in the compass of a dinner plate and in a bed where [sic] bones are not usually huddled together so that you may rely on their belonging to the same reptile. I suppose the two long bones are clavicles and if so, I judged it would be interesting to you to meet with them attached as they are to a breast bone. You will see in the small vertebrae which is in two pieces that it has been hollow. If you wish to examine the sacrum more narrowly than you can seeing [sic] I have cemented the pieces together, I daresay you would find the cement easily give way if you had a rag steeped in naphtha [sic] put round the fractures for a short time. The fracture near the breast bone will reveal the internal structure most clearly. But I think you will find no cavity except for the spinal cord which is very large indeed for such a small vertebra. The sacrum is I think quite different from the one in your possession of 'Calamospondylus Oweni' and yet perhaps not so far different but that the accompanying additional bones of the one may serve to assist in interpreting the other. I hardly like to express my crude thoughts lest I should say something unusually silly, yet I shall be rather anxious to hear whether you see any indication of a wing in the bones submitted to you (Fox in Blows, 1983).

Given that, in this letter, Fox refers to two long bones that he tentatively regarded as clavicles as well as a common element to which both were joined, it seems clear that the specimen he was describing was BMNH R178. Surely it cannot be coincidental that Owen (1876) regarded the distally fused pubes of BMNH R178 as representing abdominal ribs fused to a sternum. It is therefore particularly important that Fox explicitly states that BMNH R178 is 'quite different from the one in your possession . . . of "*Calamospondylus Oweni*"'. Whichever specimen the name *C. oweni* was based on, it was therefore not the same as BMNH R178. *C. oweni*, therefore, is not a senior objective synonym of *P. pusillus* and *A. pusillus*, and *A. pusillus* is, after all, the correct name for BMNH R178. Unfortunately, the fossil described by Fox (in Anon., 1866a, b), and named *C. oweni* by him, is lost.

The validity, or otherwise, of *Calamospondylus oweni*

While *C. oweni* satisfies Article 12 of the ICZN, it is regarded as a *nomen dubium* because none of the characters described by Fox (in Anon., 1866a, b) are unique to this species. The fact that the type specimen is lost is irrelevant with regard to this issue (ICZN,

1999). Fox (in Anon., 1866a) mentions four features that might have been used to distinguish *C. oweni* from other dinosaurs (see Fig. 4); the presence of five cemented vertebrae; its small size; bones which are more hollow in structure than those of birds; and the presence of foramina on at least some of the bones. None of the features is unique to *C. oweni*.

Among dinosaurs, the presence of five sacral vertebrae is widespread and ubiquitous among Theropoda (Holtz, 2000). Several non-avian theropods are now known whose conjoined sacral vertebrae measure less than 152 mm (e.g. Ostrom, 1978; Xu *et al.*, 1999, 2000; Burnham *et al.*, 2000), so small size is not unique to *C. oweni*. Indeed, comparison with other theropods suggests that a specimen with a sacrum 152 mm long may have been around 2.5 m in total length (Naish *et al.*, 2001) and thus not 'small' when compared with truly diminutive non-avian theropods (the eumaniraptoran *Microraptor*, for example, may have been less than 400 mm in total length (Xu *et al.*, 2000)). Extremely thin-walled, hollow bones are also not unique to *C. oweni*. In the coelurosaur SMNK 2349 PAL, for example, the wall of the femur is only about 1 mm thick (Martill *et al.*, 2000). Fox's fourth feature, the presence of foramina on some of the bones of *C. oweni*, is too vague to permit detailed assessment: was he referring to foramina on the sacral vertebrae or on the pelvic elements? However, neither would be unique to *C. oweni*. Foramina on the sacral vertebrae have been reported in dromaeosaurids and other theropod taxa (Norell & Makovicky, 1997), among which are the Isle of Wight theropods *Eotyrannus lengi* and *Ornithodesmus choniculus* (Hutt *et al.*, 2001). This raises the intriguing (but untestable) possibility that *C. oweni* is synonymous with either of these taxa. Foramina on pelvic elements are also seen elsewhere in the Theropoda (e.g. Foster & Chure, 2000) and thus would not be unique to *C. oweni*. Unfortunately therefore, Fox's description of *C. oweni* does not provide any features that might support recognition of this species as distinct.

5. CONCLUSIONS

The convoluted history of *C. oweni*, *P. pusillus* and *A. pusillus* can be summarized as follows:

1. In, or slightly before, 1866, Fox discovered a small dinosaurian sacrum, accompanied by some other remains from the pelvic region, at Brook, Isle of Wight. He informed Owen of this discovery and suggested that a new taxon might be created and that it might be; (1) given a generic name based on the root word 'spondylus'; (2) named in allusion to its thin-walled, hollow construction (which reminded him of a dried reed); and (3) given a specific name in honour of Owen himself. Without any doubt, this specimen is the same as that given the name *Calamospondylus oweni* by Fox in 1866.

2. Fox named this new taxon in *The Athenaeum* of June 2, 1866 (Fox in Anon., 1866a). This article was reproduced in *The Geological Magazine* of the same year (Fox in Anon., 1866b). This description fulfills the requirements of the ICZN (1999) and thus *Calamospondylus oweni* is regarded as a properly published name. However, the lack of any diagnostic features in the lost type specimen mean it must be considered a *nomen dubium*.
3. At about the same time, Fox discovered a second specimen on the Isle of Wight (the exact location is unknown) comprising a sacrum with two elongate elements joined to a single median element. This specimen is BMNH R178 and Fox made it clear in his correspondence to Owen that it was different from the holotype of *Calamospondylus oweni*. Owen (1876) described and named BMNH R178 as a new species of *Poekilopleuron*; *Poekilopleuron pusillus*.
4. Seeley (1887b, c) recognized that BMNH R178 was not referable to *Poekilopleuron* and created the new genus *Aristosuchus*. BMNH R178 thus became *Aristosuchus pusillus* (Owen, 1876).
5. Subsequently, several authors assumed that Fox's *Calamospondylus oweni* was a reference to the same specimen as BMNH R178 and therefore regarded *C. oweni* as the oldest name given to this specimen. As explained above, the name *C. oweni* was not created for BMNH R178 and *Aristosuchus pusillus* is the correct name for this specimen.

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APPENDIX

Discussion of the Wessex Formation theropod unguals BMNH R179 and R899

Referral of the ungual BMNH R179 to the animal represented by BMNH R178, and of the similar ungual BMNH R899, cannot be demonstrated. BMNH R179 is missing its dorsoproximal part, meaning that presence or absence of the dorsoproximal depression cannot be confirmed. In BMNH R899 the dorsoproximal region is preserved, showing that the specimen lacked the dorsoproximal depression seen in ornithomimosaur, tyrannosauroids, oviraptorosaurs, dromaeosaurids and troodontids (Rauhut & Werner, 1995). In BMNH R899 the flexor tubercle is weak and distally located. The manual unguals of *Compsognathus* also lack dorsoproximal depressions and have weak, distally located flexor tubercles (Ostrom, 1978; Rauhut & Werner, 1995), suggesting that BMNH R899 may be a compsognathid ungual. However, similar manual unguals are seen in the oviraptorosaur *Caudipteryx* (Zhou & Wang, 2000). In contrast to BMNH R899, BMNH R179 has a much more prominent, proximally located flexor tubercle so may belong to a different theropod taxon.

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