

MANTELL, CUVIER, BUCKLAND AND THE IDENTIFICATION OF *IGUANODON* : A CONTRIBUTION BASED ON UNPUBLISHED ANNOTATIONS BY MANTELL

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Abstract : Previously unpublished annotations by Gideon Mantell on a publication sent to Alexandre Brongniart in 1824 document his vacillating conceptions about the fossil vertebrates from Tilgate Forest, just before he finally identified *Iguanodon* as a giant herbivorous reptile. The influences of Cuvier and Buckland on Mantell's conceptions are discussed. Cuvier at first misidentified *Iguanodon* remains as those of mammals, and it took him nearly a year to change his mind. His eventual conversion to Mantell's original idea of a large herbivorous reptile then played an important part in the final recognition of *Iguanodon*.

Key words : History of palaeontology, *Iguanodon*, Mantell, Cuvier, Buckland, Brongniart.

Mantell, Cuvier, Buckland et l'identification d'*Iguanodon* : une contribution fondée sur des annotations inédites de Mantell

Résumé : Des annotations inédites de Gideon Mantell sur une publication envoyée à Alexandre Brongniart en 1824 illustrent ses hésitations au sujet des vertébrés fossiles de la forêt de Tilgate, juste avant l'identification finale d'*Iguanodon* comme un reptile géant herbivore. Les influences de Cuvier et Buckland sur les conceptions de Mantell sont examinées. Cuvier identifia d'abord à tort des restes d'*Iguanodon* comme appartenant à des mammifères, et il lui fallut presque un an pour changer d'avis. Sa conversion à l'idée d'un grand reptile herbivore, proposée à l'origine par Mantell, joua ensuite un rôle important dans l'interprétation d'*Iguanodon*.

Mots clés : Histoire de la paléontologie, *Iguanodon*, Mantell, Cuvier, Buckland, Brongniart.

INTRODUCTION

The story of the discovery, identification and description of the dinosaur *Iguanodon* by Gideon Mantell (1790-1852) in the early 1820s has often been told. It is indeed one of the most famous episodes in the history of vertebrate palaeontology, and this has sometimes led to unfounded embellishments, the best known of which being the story of the discovery of the first *Iguanodon* tooth by Mrs Mantell while her husband was visiting a patient (e.g. Colbert, 1968 ; Swinton, 1970). Factual accounts recently published by Dean (1995, 1999) clearly distinguish fact from fiction in this respect.

It is well attested that the first teeth and bones of *Iguanodon* from the Wealden of Tilgate Forest, in Sussex, were a source of considerable puzzlement both to Mantell and to authorities on fossil vertebrates (including Buckland and Cuvier) to whom he

submitted his discoveries. *Iguanodon* teeth were tentatively referred to a rhinoceros by Cuvier, or to a fish by Buckland (see Buffetaut, 1987, Norman, 1993, Spalding, 1993, Dean, 1995, 1999, Sarjeant, 1997). As noted by Dean (1999, p.76-77), "confused by the prolonged opposition of his most respected colleagues and the unusual strata, Gideon became temporarily unclear regarding Tilgate fauna and the succession of life generally".

Following the discovery of hitherto unreported handwritten corrections and additions by Mantell on a copy of his "Outlines of the Natural History of the Environs of Lewes" (1824), I have tried to reconstruct in more detail the stages through which Mantell went in his interpretation of the strange fossils from Tilgate Forest, and the influence exerted on him by Cuvier, and to some extent by Buckland, from 1823 to 1825.

MANTELL, CUVIER AND THE FOSSILS FROM TILGATE FOREST

As the leading authority of the time on fossil vertebrates, Georges Cuvier (1769-1832) naturally exerted considerable influence on Mantell. The fact that his first identifications of the *Iguanodon* remains sent to him by Mantell were erroneous has often been pointed out, sometimes in a not very accurate manner. Taquet (1983, p. 475) tried to show that “ the errors of interpretation attributed to Cuvier with regard to the determination of *Iguanodon* are probably unfounded ”. As this point is of some consequence for the interpretation of Mantell’s own changing state of mind concerning *Iguanodon*, it deserves a brief reconsideration. A second important question is whether it was Cuvier or Mantell who first guessed that the strange teeth from Tilgate Forest were those of a herbivorous reptile. Cuvier is often credited with this important suggestion (Taquet, 1983), but Mantell hinted in several of his publications that he had independently come to this conclusion even before he sent specimens to Cuvier. In his original paper on *Iguanodon* (1825, p.180), he wrote that the remarkable teeth found in the summer of 1822 were “ evidently referable to some herbivorous reptile ”, which seems to imply that he had reached this conclusion very soon after the initial discoveries. In 1839, he wrote (p.389) : “ It is several years since the discovery of a mutilated fragment of a tooth led me to suspect the existence of a gigantic herbivorous animal in the strata of Tilgate Forest... ”. However, in 1851 (p.228) he gave a somewhat different and rather unclear account of the identification of *Iguanodon*. According to this account, he first thought that the strange tooth from Tilgate Forest “ entirely resembled in form the corresponding part of an incisor of a large pachyderm ground down by use ”, and was at a loss to account for its occurrence in the Wealden. Nevertheless, a crucial document in this respect seems to be a short letter “ on the Iron-Sand Formation of Sussex ” that he wrote to William Fitton, at that time the Secretary of the Geological Society, on June 1st, 1822. Although this letter was not published in the *Transactions* until 1826, it was read at a meeting of the Society in June, 1822. In the list of fossils from Tilgate Forest at the end of that letter, Mantell mentioned “ teeth of an unknown

herbivorous reptile, differing from any hitherto discovered either in a recent or fossil state ” (Mantell, 1826, p.134). This certainly seems to demonstrate that as early as June 1822, Mantell had already concluded that a large herbivorous reptile was present in the Tilgate Forest beds. At a meeting of the Geological Society, which, according to Dean (1999, p.73), was that of 21st June, 1822, he exhibited some of the mysterious teeth from Tilgate Forest, but, in his own words (Mantell, 1851, p.229) “ Dr Wollaston alone supported my opinion that I had discovered the teeth of an unknown herbivorous reptile, and encouraged me to continue my researches ”, whereas other eminent geologists (including Buckland, Conybeare and Clift) thought they were either fish teeth, or mammal teeth from a “ diluvial deposit ”.

Mantell first sent *Iguanodon* remains to Cuvier, after he wrote his letter on the Iron-Sand Formation, and after the above-mentioned meeting of the Geological Society (Mantell, 1851 ; Dean, 1999), in the early summer of 1823 (Dean, 1995, 1999), not during the first half of 1824 as suggested by Taquet (1983). They were brought to Paris by Charles Lyell, who showed them to Cuvier on June 28th. According to Mantell’s reminiscences published many years later (Mantell, 1851), Cuvier’s initial reaction was to identify metatarsals as belonging to a hippopotamus, and teeth as incisors of a rhinoceros. As mentioned by Dean (1999, p.74-75), an *Iguanodon* tooth preserved at the National Museum of New Zealand is clearly labelled by Mantell as “...the first tooth of the *Iguanodon*, sent to Baron Cuvier, who pronounced it to be incisor of Rhinoceros ”. An annotation by Lyell on the back of the label mentions that this identification was given at a dinner party and that on the next morning Cuvier thought it was something different (and unspecified in Lyell’s annotation).

Taquet (1983) has tried to show that Cuvier very quickly came to the conclusion that the remains from Tilgate Forest were those of a large herbivorous reptile, and that the oft-repeated story of his earlier misidentifications was largely a result of Mantell’s later inaccurate retelling of the events. In fact, it appears that Cuvier did misidentify the first specimens brought to him by Lyell as belonging to mammals. Taquet’s argument is largely based on his erroneous belief that the first *Iguanodon* remains were sent to him during the first half of 1824, in which case his

famous letter of June 20th, 1824 (quoted in full by Mantell, 1825, 1851, and Taquet, 1983), in which he suggested a herbivorous reptile, would have been written very soon after he first saw the specimens. In fact, this important letter was written almost a year after Cuvier first saw specimens from Tilgate Forest. The account of Cuvier's initial misidentifications written later by Mantell (1851) is corroborated by Cuvier's own words on Mantell's finds in the second edition of his *Recherches sur les Ossemens Fossiles* (1824), in which he admits that at first sight he had mistaken metapodial fragments for those of a large hippopotamus, and had thought that a worn tooth was clearly from a mammal and closely resembled a rhinoceros molar (not an incisor, as mentioned by Mantell).

When Mantell wrote to his friend Davies Gilbert on November 18th, 1823, after Lyell's return from Paris, he reported that Cuvier had identified "bones and teeth of the rhinoceros ; and the teeth of a quadruped [...] distinct from any now known either in a recent or fossil state..." (Dean, 1995, 1999). By that time, Cuvier apparently had dismissed the idea of a hippopotamus, but still considered that a rhinoceros was present in the Wealden of Tilgate Forest. In addition, he now thought that an unknown quadruped also occurred there, but he seems to have had no very definite idea about its affinities.

By the time he wrote the chapter about "fossil saurians" of the second edition of *Recherches sur les Ossemens Fossiles*, published at the end of 1824 (it was received by the Académie des Sciences on December 22nd, according to Smith, 1993), Cuvier had come to the conclusion that the peculiar teeth from Tilgate Forest were those of a reptile with a type of tooth wear similar to that of mammals. What brought him on the right track is clear from the passage about the "geological treasures" from Tilgate Forest in the second edition of *Recherches sur les Ossemens Fossiles*, in which he clearly stated (p.351) that he became convinced of his own error only after Mantell sent him a series of teeth showing various stages of wear ("ce n'est que depuis que M. Mantell m'en a envoyé une série d'entières et de plus ou moins usées, que je me suis entièrement convaincu de mon erreur"). Mantell (1851) also mentioned that he had sent more teeth to Cuvier before his famous visit to the Hunterian Museum, in August or September

1824 (Dean, 1995, 1999), where Samuel Stutchbury showed him the teeth of a recent iguana, which eventually led to the naming of *Iguanodon*. According to his own accounts, the resemblances between the fossil teeth and those of the iguana finally convinced him that he had been right to suppose that the problematic fossils from Tilgate Forest belonged to a giant reptile. This led to the description and naming of *Iguanodon* in 1825.

THE "OUTLINES OF THE NATURAL HISTORY OF THE ENVIRONS OF LEWES" AND MANTELL'S CORRECTIONS

Mantell's works published between 1822 (*The Fossils of the South Downs*) and 1825 (the paper on *Iguanodon* in the *Philosophical Transactions*) reflect his changing opinion about the bones and teeth from Tilgate Forest that were to be described as *Iguanodon*. In the *Fossils of the South Downs* (1822, p.54), he mentioned specimens that were later identified as *Iguanodon*, as "several teeth and bones, whose characters are too obscure and uncertain to admit of determination, without the aid of more illustrative specimens", and provided no illustrations of them. He nevertheless suggested they may have belonged to some giant reptile (Dean, 1995, 1999). Mantell had used Cuvier's published works for the preparation of his *Fossils of the South Downs*, but it was not until 1823 that he was able to send Cuvier *Iguanodon* specimens (brought to Paris by Charles Lyell). By then, he had already expressed his opinion about the existence of a large herbivorous reptile in his letter on the Iron-Sand Formation read at a meeting of the Geological Society in June 1822 (see above).

Cuvier's first (and erroneous) impressions about the specimens from Tilgate Forest were reflected in Mantell's "Outlines of the Natural History of the Environs of Lewes", originally published as part of Thomas W. Horsfield's *History and Antiquities of Lewes and its Vicinity* in 1824. In this work, a few copies of which were also published separately for private circulation, Mantell clearly shows the state of confusion brought about by Cuvier's (and Buckland's) comments. "Outlines of the Natural History of the Environs of Lewes" has not attracted

much attention, perhaps because it was only a part of Horsfield's book. It is nevertheless of considerable interest for several reasons. It includes what appears to be the first published drawing of an *Iguanodon* tooth (Dean, 1999), on figure 14 of plate XXIX. That tooth is mentioned in the text (p.14-15 of the separate printing, section 77) as belonging to "the teeth, and probably bones, of an herbivorous animal, which M. le Baron Cuvier, (who did me the honour to examine them), assures me are perfectly distinct from any previously known, either in a recent, or fossil state". Fig. 14 of plate XXIX unmistakably shows a well preserved *Iguanodon* tooth (Fig.1).

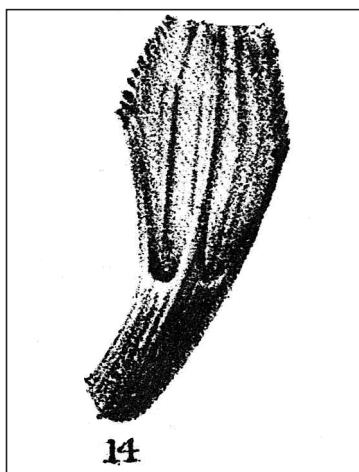


Fig.1 : The first published drawing of an *Iguanodon* tooth : figure 14 of plate XXIX of Mantell's "Outlines of the Natural History of the Environs of Lewes" (enlarged).

However, section 77 of Mantell's text, as noted by Dean (1995), also mentions "the teeth of the rhinoceros" and "bones of the elephant" among the fossils from Tilgate Forest, and this seems to reflect at least partly some of Cuvier's first misinterpretations. When "Outlines of the Natural History of the Environs of Lewes" was completed (on February 1st, 1824, according to Mantell's dedication and introduction), Mantell clearly still believed that fossil remains of both large mammals and a completely unknown "herbivorous animal" occurred in the strata of Tilgate Forest.

As mentioned by Dean (1995, 1999), Mantell quickly changed his mind during the following months. This change of mind was influenced by both Buckland's description of *Megalosaurus* from Stonesfield and Cuvier's new interpretation of the

Tilgate teeth as those of a herbivorous reptile. An interesting document illustrates a transitional stage in the evolution of Mantell's thought concerning the fossils from Tilgate Forest : the Central Library of the Muséum National d'Histoire Naturelle in Paris possesses a copy (n° 14.514) of Mantell's "Outlines of the Natural History of the Environs of Lewes" sent to A. Brongniart and bearing handwritten corrections and additions by Mantell himself. This thin volume is inscribed "to M. Brongniart with best regards of the Author" on the title page, and a handwritten note explains that "the following essay was published in the "History and Antiquities of Lewes"; a few copies only, have been printed separately for private distribution". Mantell's correspondent was Alexandre Brongniart (1770-1847), the geologist who collaborated with Cuvier on the description of the geology of the Paris Basin, not his son Adolphe Brongniart (1801-1876), one of the founders of palaeobotany, with whom Mantell also corresponded (see, for instance, several entries in Mantell's diary : Curwen, 1940). This is demonstrated by a letter from Alexandre Brongniart to Mantell kept in the Alexander Turnbull Library (Wellington, New Zealand) and dated 5th November 1824. In it, Brongniart apologises for his late answer to several letters from Mantell, and specifically mentions the above-mentioned separate :

"J'ai reçu dans le temps avec votre lettre du 1^{er} avril votre beau et recommandable travail intitulé modestement Outlines of natural history of the environs of Lewes".

It therefore appears that Mantell's notes and corrections about the fossils from Tilgate Forest were written on the copy sent to Brongniart sometime between February 1st and April 1st 1824. The dedication and introduction of "Outlines" were dated February 1st 1824, but the passages Mantell later corrected may of course have been written earlier. Be that as it may, very soon after his work appeared in print, Mantell thought it necessary to correct it before it was sent to colleagues abroad - which reflects the rapid changes in his conceptions about the Tilgate Forest fossils.

The main corrections concern section 77, on page 14, where several words have been crossed out and partly replaced. The sentence in question, which has already been mentioned above, originally read :

"Also the teeth of the Rhinoceros ; bones of the

Elephant, and some large unknown quadruped ; and the teeth, and probably bones, of an herbivorous animal, which M. le Baron Cuvier, (who did me the honour to examine them), assures me are perfectly distinct from any previously known, either in a recent or fossil state ”.

As corrected by Mantell, the sentence reads (Fig. 2):

“ Also the teeth of of the Rhinoceros ? bones of some large unknown animal ; and the teeth, and probably bones, of an animal, which M. le Baron Cuvier, (who did me the honour to examine them), assures me are perfectly distinct from any previously known, either in a recent or fossil state ”.

By the time he sent his book to Brongniart, Mantell’s opinion had therefore changed in several respects :

- he now had doubts about the presence of the rhinoceros (originally suggested by Cuvier) in the strata of Tilgate Forest ;

- he no longer thought the elephant was present in these beds ;

- he was in fact questioning the existence of any large land mammals in the Tilgate Forest strata. This is shown by the change from “ quadruped ” to “ animal ”. “ Quadruped ”, in the scientific usage of

the early 19th century, often (although not always) was used as a synonym of “ mammal ”. “ Animal ”, as used by Mantell in his corrections, could encompass reptiles as well (although Mantell occasionally used the term “ oviparous quadruped ” for reptiles, as for instance in his mention of mosasaur vertebrae in the Sussex Chalk in “ Outlines ”, section 40). Alternately, this change could also indicate that Mantell considered the possibility of a large *marine* animal, for which the term “ quadruped ” would have been inappropriate. His mention of whale remains in the handwritten additions mentioned below may support this interpretation.

- possibly in connection with his doubts concerning large mammals, Mantell also deleted the mention of an *herbivorous* animal. The idea of a giant herbivorous reptile was apparently more difficult to admit than that of a carnivorous one. Buckland’s description of *Megalosaurus*, presented at the Geological Society on February 20th, 1824, had shown that giant carnivorous “ lizards ” had indeed existed, and Mantell had identified *Megalosaurus* teeth and bones among the fossils from Tilgate Forest (as mentioned in his handwritten additions to the book he sent to Brongniart ; see below).

§ 77. The organic remains of these beds consist of the casts of univalves and bivalves ; of the stems of plants allied to the *Euphorbia* and *Cacti* ; the leaves of unknown species of ferns, and other vegetables, and of fruit or seed vessels : bones and plates of freshwater, land, and marine turtles ; teeth of sharks and other fishes ; and the bones, scales, and teeth of a gigantic crocodile, or alligator ; (a tooth of this kind is figured in Pl. xxix. 1.) Also the teeth of the Rhinoceros, ~~bones of the~~ ^{animal} some large unknown ~~animal~~ ; and the teeth, and probably bones, of an ~~herbivorous~~ animal, which M. le Baron Cuvier, (who did me the honour to examine them), assures me are

§ 77. I have collected the following remains from these strata: viz
 Ribs, vertebrae, teeth, femurs, metatarsal bones, of the Megalosaurus.
 Vertebrae, teeth, ribs, and other bones, of the Crocodile.
 Vertebrae and teeth of the Plesiosaurus.
 Humerus, rib, and vertebrae of a cetaceous animal, probably, Whale

Fig.2 : Mantell’s handwritten corrections and additions to the section on fossils from Tilgate Forest, on p.14 of the copy of “ Outlines of the Natural History of the Environs of Lewes ” which he presented to Alexandre Brongniart in 1824 (Bibliothèque Centrale, Muséum National d’Histoire Naturelle, Paris, n°14.514). See text for discussion.

Mantell's corrections are supplemented on Brongniart's copy of the *Outlines* by a few handwritten lines in the lower margin of page 14, which read (Fig.2) :

“ §77. I have collected the following remains from these strata, viz.
 Ribs, vertebrae, teeth, femurs, metatarsal bones of the Megalosaurus.
 Vertebrae, teeth, ribs, and other bones of the Crocodile.
 Vertebrae and teeth of the Plesiosaurus.
 Humerus, rib, and vertebra of a cetaceous animal, probably Whale. ”

The mentions of the fossil reptiles *Megalosaurus* and *Plesiosaurus* are of especial interest. Dean (1995, 1999) has rightly commented on the influence on Mantell's thought of Conybeare's paper on *Plesiosaurus* and Buckland's paper on *Megalosaurus*, both presented at a meeting of the Geological Society on February 20th, 1824. Mantell's mention of both *Megalosaurus* and *Plesiosaurus* in his notes on Brongniart's copy of the *Outlines* certainly reflects these influences (remains of theropod dinosaurs and plesiosaurs were indeed present in Mantell's material from Tilgate Forest, although some of the bones attributed to *Megalosaurus* at that stage probably belonged to *Iguanodon*). The mention of a whale may appear more puzzling. A letter from Mantell to Cuvier dated July 9th, 1824, quoted by Taquet (1983, p.483-484), shows that this idea originated with Buckland, who, on a visit to Mantell, had identified large bones in the latter's collection as belonging to cetaceans. Mantell had his doubts about Buckland's identification, since in the same letter he wrote about these bones that “ they appear to me to have belonged to a saurian animal probably a species of *Plesiosaurus* ”. In his paper on *Megalosaurus*, Buckland (1824) mentioned the occurrence of whale remains at both Stonesfield and Tilgate Forest. The supposed “ bones of large cetacean animals ” from the Oxford region came from Enslow Bridge, not Stonesfield, and they later turned out to be bones of the sauropod *Cetiosaurus* (Delair & Sargeant, 1975). The mention of whale remains from Tilgate Forest by both Buckland (in print) and Mantell (in his handwritten corrections) probably refers to early discoveries of sauropod bones at Cuckfield, later identified

by Mantell (1850) as belonging to *Pelorosaurus*. As mentioned by Mantell (1851, p.330-331), vertebrae belonging to this animal were at one stage referred by him to *Iguanodon*, “ for it was not supposed that the remains of several genera of gigantic reptiles were entombed in those previously unproductive deposits ”. Apparently, Mantell did not long entertain the idea of Wealden whales, and soon realised that the bones in fact belonged to large reptiles, although their exact affinities remained uncertain. There is no longer any mention of whales in the faunal list for the Tilgate sandstone given in his 1825 paper on *Iguanodon*. Interestingly, however, Cuvier endorsed the idea of cetaceans in the Tilgate Forest strata in the second edition of *Recherches sur les Ossements Fossiles* (1824). In fact, the brief list of fossil vertebrates from Tilgate Forest given there is very similar to that provided by Mantell in his corrections and by Buckland in his paper on *Megalosaurus* (1824), since it includes, in addition to cetaceans, *Plesiosaurus* and *Megalosaurus*. What distinguishes Cuvier's discussion of the Tilgate Forest fossils - published at the end of 1824 - from the earlier ones by Buckland (1824) and Mantell (1824) is the basically correct interpretation of the teeth of the large herbivorous reptile. However, the latter had already been clearly mentioned in Mantell's 1822 letter on the Iron-Sand Formation ; his much more diffident position in the “ *Outlines* ” (and, to some extent, in his handwritten corrections) was certainly a result of Cuvier's earlier misidentifications. As already concluded by Dean (1999, p.84-85), there seems to be no doubt that the idea of the large herbivorous reptile originated with Mantell, not Cuvier.

The corrections and additions in Mantell's hand on Brongniart's copy of the “ *Outlines* ” illustrate an interesting stage in the evolution of his thoughts about the Tilgate Forest fossils, when he was apparently more influenced by Buckland (and Conybeare) than by Cuvier, and began to entertain serious doubts about the existence of large mammals in the Wealden. Still, there remained the mysterious animal, “ distinct from any previously known ”, that Cuvier himself had not been able to identify. Two factors apparently played an important part in convincing Mantell that he had been right from the beginning : Cuvier's letter of 20th June, 1824, in which, after seeing a better series of teeth from Tilgate Forest, he confirmed that

they may have belonged to a large herbivorous reptile, and Mantell's comparison of the Tilgate teeth with Stutchbury's iguana at the Hunterian Museum.

By the end of November 1824, not only had Mantell convinced himself again of the existence of a hitherto unknown giant reptile in the strata of Tilgate Forest, but a name - *Iguanodon* - had been coined for it, at the suggestion of W. Conybeare, as noted by Mantell himself in his 1825 paper (Mantell had earlier thought of naming the new reptile *Iguanosaurus*, as mentioned in a letter to Cuvier of 13th November, 1824 - see Taquet, 1983). The entry for November 28th in his diary (Curwen, 1940, p.52) reads :

“During the last week, have had numerous applications from different persons respecting the new animal whose teeth I have discovered in the sandstone of Tilgate Forest, and which I have named the *Iguanodon*”.

The final stage in the recognition (if not in the full understanding !) of *Iguanodon* as a large herbivorous reptile was of course Mantell's *Notice on the Iguanodon, a newly discovered fossil reptile, from the sandstone of Tilgate forest, in Sussex*, communicated to the Royal Society by Davies Gilbert, on February 10th, 1825.

CONCLUSION

MANTELL'S, CUVIER'S AND BUCKLAND'S PARTS IN THE IDENTIFICATION OF *IGUANODON*

Although it is one of the most famous episodes in the early history of vertebrate palaeontology, the details of Gideon Mantell's discovery of *Iguanodon* are somewhat unclear, both because Mantell's own accounts in his various books and papers are not always consistent with each other, and because later authors have added fictitious embellishments to the story. What is undisputable is that identifying the bones and teeth from Tilgate Forest as those of a large herbivorous reptile was by no means a simple or easy process. Between the first discoveries in 1822 and the formal description and naming of *Iguanodon* in 1825, Mantell went through several periods of indecision or even confusion, which are reflected both in his correspondence and in his main publication between the *Fossils of the South Downs*, of 1822, and the

Iguanodon paper of 1825, i.e. the “Outlines of the Natural History of the Environs of Lewes”. The handwritten corrections and additions to the copy of the latter work he sent to Brongniart provide hitherto unpublished evidence about an interesting stage in the development of his conceptions, when he had realised that there was little solid evidence for the presence of large mammals in the Tilgate sandstone and that large reptiles such as *Megalosaurus* and *Plesiosaurus* occurred there, but before he became fully convinced again of the former existence of giant herbivorous reptiles.

On the basis of the available evidence, the sequence of events may be reconstructed as follows. After the first discoveries of *Iguanodon* teeth in the sandstones of Tilgate Forest (some of which were found by Mrs Mantell), Mantell suspected that they belonged to a large herbivorous reptile ; this was clearly expressed in his 1822 letter on the Iron-Sand Formation, and he repeatedly mentioned this early supposition in several of his later books and papers. This idea was met with scepticism when Mantell displayed some of his finds at a meeting of the Geological Society in London in June, 1822, only Wollaston being sympathetic to it, while Buckland, among others, thought that the teeth belonged either to a fish or to a “diluvial” mammal. Thereafter, Mantell used the opportunity of Lyell's visit to Paris in June, 1823, to submit some of his finds to Cuvier. There can be no doubt that Cuvier was mistaken in his first identifications, and that he mistook bones and teeth of *Iguanodon* for those of large mammals. This is obvious both from Mantell's published accounts and correspondence, and from Cuvier's own frank admission in the second edition of *Recherches sur les Ossements Fossiles*. For a time, during the second half of 1823 and part of 1824, Cuvier apparently considered that both a rhinoceros and a large unknown “quadruped” of very uncertain affinities were present in the Tilgate sandstone. This is basically what is reflected in Mantell's “Outlines”, published early in 1824 (with the unexplained addition of elephant bones).

As he clearly admitted in the 1824 edition of *Recherches sur les Ossements Fossiles*, Cuvier did not reach a better understanding of *Iguanodon* until Mantell sent him a good series of worn and unworn teeth, in all likelihood sometime in the spring of

1824. He then wrote his celebrated letter of 20th June 1824, in which he suggested the existence of a large herbivorous reptile, which must have come as a welcome vindication to Mantell, who apparently had suspected from the beginning that the mysterious teeth from Tilgate Forest belonged to such an animal. Be that as it may, it is clear that it took Cuvier nearly a year to reach this conclusion, after his initial misidentifications.

Mantell's gradual change of opinion is documented by the corrections and additions he made to his description of the Tilgate Forest fauna in the copy of his "Outlines" he sent to Brongniart on April 1st, 1824. Interestingly, they seem to reflect mainly the influence of Buckland's and Conybeare's descriptions of large extinct reptiles, which had been presented at the Geological Society early in 1824. Buckland, in particular, doubtless exerted some influence on Mantell's opinion. The idea that whale remains were present in the Tilgate sandstone, as expressed in Mantell's handwritten additions, certainly originated with Buckland. In his paper on *Megalosaurus* (1824), he drew a striking parallel between the fauna from Stonesfield and that from Tilgate Forest, *Megalosaurus* itself being only one out of many fossil forms supposedly found at both localities (as realised by Mantell at an early stage : see Dean, 1999). This certainly encouraged Mantell to think in terms of giant reptiles rather than large mammals. However, there is no evidence that Buckland agreed with the idea of a giant herbivorous reptile before Mantell and Cuvier finally both became convinced sometime during 1824.

By the time (no later than April 1st, 1824) he corrected the copy of the *Outlines* he wanted to send to Brongniart, Mantell had not yet reached a definitive conclusion concerning the mysterious large animal from Tilgate Forest (apparently, he was no longer sure it was a quadruped, or a herbivore). Sometime during 1824, he finally became convinced that he had indeed found the remains of a large herbivorous reptile. Whether the crucial factor was Cuvier's letter or the comparison with the teeth of the iguana at the Hunterian Museum, or simply the discovery of more *Iguanodon* teeth showing various degrees of wear, is uncertain ; all may have played a part.

One of the conclusions of this re-examination of the process through which Mantell came to identify

Iguanodon as a large herbivorous reptile is that Cuvier's influence was ambiguous. By failing to support, in 1823, Mantell's original intuition that the strange fossils from Tilgate Forest were those of a herbivorous reptile, and by suggesting that at least some of them belonged to large mammals, he first led his British correspondent on the wrong track, and this may have delayed the recognition of the true nature of *Iguanodon* for a few months. Later, in 1824, after the examination of more material had led him to the conclusion that the unusual teeth were indeed those of a large herbivorous reptile, his unchallenged scientific authority lent weight to Mantell's final identification, which was largely based on comparison with the iguana. Interestingly, Cuvier did not think it necessary to modify the passage about the peculiar teeth from Tilgate Forest in the third edition of *Recherches sur les Ossements Fossiles*, published in 1825, which is basically a reprint of the second edition, the only changes being in the *Discours sur les révolutions du globe* (the same applies to the posthumous fourth edition : see Smith, 1993, for details about the various editions). As a result, the name *Iguanodon* never appeared in Cuvier's major palaeontological work.

Far from detracting from his reputation as a scientist, the fact that Cuvier frankly acknowledged his former misidentifications of fossils from Tilgate Forest testifies to his scientific integrity. Mantell, who apparently never lost his admiration for Cuvier (see Dean's description of their only meeting, in London in 1830 : Dean, 1999, p.103-104), clearly felt that way, and repeatedly expressed it in print.

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REFERENCES

- BUCKLAND, W. 1824. Notice of the Megalosaurus or great fossil lizard of Stonesfield. *Transactions of the Geological Society*, **1** : 390-396.
- BUFFETAUT, E. 1987. *A Short History of Vertebrate Palaeontology*. Croom Helm, London.
- COLBERT, E.H. 1968. *Men and Dinosaurs*. Dutton, New York.
- CURWEN, E.C. 1940. *The Journal of Gideon Mantell*. Oxford University Press, Oxford.
- CUVIER, G. 1824. *Recherches sur les Ossemens Fossiles*, 2nd edition, vol.5, part 2. Dufour & D'Ocagne, Paris.
- 1825. *Recherches sur les Ossemens Fossiles*, 3rd edition, vol.5, part 2. Dufour & D'Ocagne, Paris.
- DEAN, D.R. 1995. Gideon Mantell and the discovery of *Iguanodon* ; pp. 207-217. In SARJEANT, W.A.S. (ed.) *Vertebrate Fossils and the Evolution of Scientific Concepts*, Gordon & Breach, Amsterdam.
- DEAN, D.R. 1999. *Gideon Mantell and the Discovery of Dinosaurs*. Cambridge University Press, Cambridge.
- DELAIR, J.B. & SARJEANT, W.A.S. 1975. The earliest discoveries of dinosaurs. *Isis*, **66** : 5-25.
- MANTELL, G.A. 1822. *The Fossils of the South Downs*. Lupton Relfe, London.
- 1824. Outlines of the Natural History of the Environs of Lewes. Pp.iii-xxiv. In HORSFIELD, T.W., *History and Antiquities of Lewes and its Vicinity*. Baxter, Lewes [also published separately at the same place and date].
- 1825. Notice on the Iguanodon, a newly discovered fossil reptile, from the sandstone of Tilgate Forest, in Sussex. *Philosophical Transactions of the Royal Society of London*, **115** : 179-186.
- 1826. On the Iron-Sand Formation of Sussex. *Transactions of the Geological Society*, 2nd ser., 2, 1 : 131-134.
- 1839. *The Wonders of Geology*. 3rd edition. Relfe & Fletcher, London.
- 1850. On the *Pelorosaurus*, an undescribed gigantic terrestrial reptile, whose remains are associated with those of the *Iguanodon* and other saurians in the strata of Tilgate Forest, in Sussex. *Philosophical Transactions of the Royal Society of London*, **140** : 379-390.
- 1851. *Petrifactions and their Teachings*. Bohn, London.
- NORMAN, D.B. 1993. Gideon Mantell's 'Mantel-Piece' : the earliest well-preserved ornithischian dinosaur ; pp. 223-243. In SARJEANT, W.A.S. (ed.) *Vertebrate Fossils and the Evolution of Scientific Concepts*, Gordon & Breach, Amsterdam.
- SARJEANT, W.A.S. 1997. The earliest discoveries ; pp. 3-11. In FARLOW, J.O. & BRETT-SURMAN, M.K. (eds), *The Complete Dinosaur*, Indiana University Press, Bloomington and Indianapolis.
- SMITH, J.C. 1993. *Georges Cuvier. An Annotated Bibliography of his Published Works*. Smithsonian Institution Press, Washington and London.
- SPALDING, D.A.E. 1993. *Dinosaur Hunters*. Key Porter, Toronto.
- SWINTON, W.E. 1970. *The Dinosaurs*. George Allen & Unwin, London.
- TAQUET, P. 1983. Cuvier - Buckland - Mantell et les dinosaures ; pp. 475-494. In BUFFETAUT, E. ; MAZIN, J.M. & SALMON, E. (eds) *Actes du Symposium Paléontologique Georges Cuvier*, Ville de Montbéliard, Montbéliard.

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