APPENDIX II

ON THE AMMONITE HORIZONS OF THE GAULT AND CONTIGUOUS DEPOSITS

By L. F. SPATH, D.Sc.

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APPENDIX II

On the Ammonite Horizons of the Gault and Contiguous Deposits

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By permission of the Director of the Geological Survey the writer was enabled to incorporate in his account of an 'Excursion to Folkestone,'[1] some of the results of an examination of the well-known Gault locality of East Wear Bay, undertaken on behalf of the Survey. In addition to reporting on recent changes in the classical cliff-section, the writer collected numerous fossils, especially from the rather barren upper beds XI–XIII, Mr. S. W. Hester rendering valuable assistance. This allowed of a more detailed subdivision of the upper sixty feet, or more than half the total thickness, of Gault, misleadingly grouped by Price[2] as one 'Zone of *A. rostratus*,' whilst modern French authors[3] still include in this one 'Zone à *Mortoniceras inflatum*' the whole of the Upper Gault. Price had named nine out of his eleven 'zones' after ammonites, but six of these nine zonal ammonites were wrongly identified and Jukes-Browne's later account[4] was equally unsatisfactory. The records of such notorious species as *Hoplites* '*interruptus*,' *raulinianus*, *auritus* and *denarius* are generally useless on account of the confusion of externally similar forms belonging to different horizons in the Gault. A table prepared by the writer and included in the above Excursion Report gives a new subdivision of the Albian age and a correlation of its zones with the various beds found at Folkestone.

The occurrence of '*Anahoplites*' of the *catillus*-group in the lower part (where *Anisoceras* is particularly common) of bed XI, already recorded by Dr. Kitchin and Mr. Pringle in this Summary[5] was confirmed, also the absence of true *Turrilites*; and of special interest was the recognition of the succession in time of the various dipoloceratid genera, in view of recent criticisms by Stieler.[6] The writer's contention[7] that the genus proposed for the *rostratus*-group may require further subdivision was justified and Stieler's statement[8] that comprehensive interpretation of

[1] *Proc. Geol. Assoc.*, vol. xxxiv, 1923, pp. 70–76.

[2] 'The Gault,' 1879, table on p. 12.

[3] See Tomitch, 'Contrib. Connaiss. Étage Albien,' &c. (Notes Provençales du Dr. Guébhard, No. vi, St.-Vallier-de-Thiey). Le Mans, 1918.

[4] 'Cret. Rocks of Britain. I. The Gault and Upper Greensand' (*Mem. Geol. Surv.*), 1900.

[5] 'Summary of Progress for 1920' (*Mem. Geol. Surv.*), 1921, p. 62.

[6] 'Anomale Münd. b. Inflaticeraten,' *Neues Jahrb. f. Min.*, etc., Beil., Bd. xlvii, 1922, p. 339. 'Üb. Gault- u. Cenoman-Ammon. a. d. Cenoman d. Cap Blanc Nez,' *Neues Jahrb. für Min.*, etc., 1922, Band ii, Heft 2, p. 34.

[7] 'On Cretaceous Ammonoidea from Angola,' *Trans. Roy. Soc. Edinb.*, vol. liii, pt. 1, No. 6, 1922, p. 97.

[8] *Loc. cit.* (1922, 'Anomale Münd.'), p. 340.

species is particularly necessary in the case of the *Inflaticerata* can only be ascribed to limited knowledge of the richness and variety of the Gault fauna. It may be useful to state briefly the vertical distribution, as known at present, of the keeled ammonites of the Gault (*Dipoloceratidae*) and of the various Folkestone *Hoplites*, so abundantly represented in all collections.

Eight dipoloceratid genera are known to occur, but two others namely, *Oxytropidoceras* and *Falloticeras*, with the lyelliceratid genera *Brancoceras*, *Tegoceras*, and *Rauliniceras*, have not yet been found in this country. The earliest is *Mojsisovicsia* (bed IV) followed by *Dipoloceras* (beds V–VIII). The Upper Gault descendants of the latter appear to have the following ranges :—

Elobiceras	Beds IX & X
Hysteroceras	,, VIII to XI
Prohysteroceras	,, IX to XI
Inflaticeras	,, XI & XII
Neoharpoceras	,, XI & XII
Neokentroceras ?	Bed XIII

The hoplitid genera have been provisionally classed into seven groups, of which only four are at present named. The group of '*Hoplites*' *puzosianus* and '*H.*' *raulinianus* (d'Orbigny) is restricted[1] to bed Ia; *Hoplites* s.s. (*dentatus*-group) to beds I to III. The latter gives rise to two stocks that persist to bed XI, namely *Anahoplites*, Hyatt emend. Spath, comprising the groups of *A. splendens* and *A. tethydis*, connected by innumerable transitions, and the group of '*Hoplites*' *lautus* and '*H.*' *tuberculatus*. The *tethydis*-group leads to *Ammonites denarius* and *A. auritus*,[2] wrongly compared by Kilian and Sinzow to *Saynella* and confined to beds X and XI; the *denarius*-stock again leads to *Pleurohoplites* of bed XIII. The *lautus-tuberculatus*-type is continued in *Hyphoplites* of the *dispar*-zone and the Lower Cenomanian.

Other information not incorporated in the Excursion Report was obtained from some inland sections near Folkestone. In the Broadmead sand-pit at Cheriton the following sequence was shown :—

		Ft.	in.
	Soil	1	0
dentatus-zone	Clayey Greensand with *Hoplites dentatus*, &c.	2	0
	Line of 'Sulphur Nodules' without fossils	0	4
Non-sequence			
mammillatus-zone	Greensand	1	6
	Upper line of nodules with *Douvilleiceras monile* (J. Sow.), *D.* cf. *mammillatum* (Schloth.), *Beudanticeras ligatum* (Newt. and Jukes-Browne) and fossil wood	0	3
	Yellow sand	1	6
	Lower line of iron-stained nodules with *Douvilleiceras monile*, *Beudanticeras ligatum*, *Ostrea sp.*, *Pecten sp.*	0	3
Folkestone Sands	Silver-sand, without fossils	10–12 ft.	

[1] '*Hoplites*' in the Excursion Report, *loc. cit.*, p. 74.
[2] '*Anahoplites*,' *ib.*, p. 76.

The absence from the Folkestone area of the *regularis*-fauna has already been noticed by Dr. Kitchin in this Summary.[1]

In the shallow Broadmead clay-pit, belonging to the same works (Lord Radnor's), no fresh section was visible, and yellowish clays, yielding (loose) fossils like '*Hoplites*' aff. *proboscideus* (J. Sow.) '*H.*' *lautus* (J. Sow.), and *Anahoplites sp. nov.*, presumably from the top of the Lower Gault, were covered by chalky hill-wash.

Similarly the equally shallow Cheriton Pit, though mostly in lower (blue) Gault clay, did not offer a satisfactory, clean section, but both the yellowish Upper Gault (beds IX, X, and basal XI) and the blue Lower Gault (beds II or III to VIII) were exposed in a very clear 35–40 ft. section in the pit of the Brick and Tile Co. at Elenden Gardens, Cheriton. The beds are not uniform in colour or lithological character across the face of the pit, and at the western end, the top includes a greater portion of bed XI, below a foot or so of surface-soil, than at the eastern end, where the summit is low down in XI. Also, the hard bands in bed IX are very irregular, as seen on the face of the pit; but the 15–18 ft. of Upper Gault, to within a foot of the base of bed IX, is of a very distinctive yellow colour, sharply marked off from about twenty feet of more or less uniform, dark blue, Lower Gault, with irregular patches rather than bands weathering to a lighter blue. The light buff clay of bed III ('crab-bed') that forms a conspicuous, precipitous, seam in the cliff-section at Copt Point, was not distinct at the base of the pit; and the 'mottled bed' (VI) was not clearly recognizable. Conversely at 2, 6, and 10 feet up, nodular bands were seen, but could not be correlated exactly with those, for instance, of bed IV at Copt Point. According to the foreman, the base of the Gault clay was met with 12 ft. below the floor of the pit. Some new species of *Hoplites* and *Anahoplites*, peculiar to beds II and III on the coast, were discovered in the lowest five feet, associated with *Hamites attenuatus* J. Sowerby; but no detailed zonal collecting was done to ascertain the changes in the various beds and their apparent thickening in the short distance from the coast.

It may be useful to discuss the less local aspects of the Albian succession. Collecting in lower beds, and especially in the Gault of Wiltshire and other important areas, has not yet been done with the detail necessary to enable the writer to place, for example, the *Lyelliceras* fauna, absent from Folkestone, and almost certainly fairly low in the Lower Gault. The *benettianus* and *inaequinodus* faunas of Wiltshire and North Dorset are also at present only assumed to have existed during the time-interval that preceded the deposition, on the sandy substratum of the *mammillatus*-zone, of the lowest clay-beds at Folkestone.

The uppermost and lowest beds of the Albian, and the relations of their ammonite-faunas to those of the contiguous formations require special consideration.

[1] 'Summary of Progress for 1919' (*Mem. Geol. Surv.*), 1920, p. 45.

A fauna characterized by species of *Stoliczkaia* and by large, inflated forms of *Pleurohoplites* (*dispar*-zone) succeeds an earlier *Pleurohoplites*-fauna with small examples of *Pl. studeri* and the compressed forms of the type of *Pl. renauxianus* (d'Orbigny). The later (= *dispar*) fauna is found in North Dorset ('Upper Greensand') and is included in the phosphate-bed of Cambridge, in which deposit, however, the earlier *Pleurohoplites* and even the *aequatorialis* faunas (of the 'Chert' and 'Malm' Series of the Upper Greensand) are also represented.[1] It is uncertain to which of these three upper Albian zones must be referred the Mediterranean elements of the Cambridge Greensand, namely, *Phylloceras*, *Lytoceras* (*Gaudryceras*), *Tetragonites*, and *Desmoceras* ('*Latidorsella*'). It is also interesting to note that the lytoceratid genus *Kossmatella* has not yet been discovered in this country. It ranges through a number of horizons in Mediterranean deposits, but is referred by Jacob[2] to the '*dentatus*' or even '*tardefurcata*' zones, though other authors have recorded it from the Upper Albian. In the Drôme[3] some of its representatives are associated with *Phylloceras sp.*, *Tetragonites timotheanus* (Pictet), and *Desmoceras latidorsatum* (Michelin), three Cambridge Greensand types of little value for exact correlation; but this *Kossmatella*-bed is followed by shales with *Gaudryceras dozei* (Fallot) and undoubted Cenomanian *Turrilites*, probably corresponding to the *martimpreyi* beds of Aumale in Algeria.[4] At Ventnor, where *Pleurohoplites renauxianus* occurs, though *Stoliczkaia* has not yet been found, such supposed Lower Chalk species as *Gaudryceras leptonema* (Sharpe), *Phylloceras* '*velledae*' (Sharpe, *pars*, *non* Michelin,= *Ph. seresitense* Pervinquière) and *Puzosia octosulcata* (Sharpe) have been collected. There is little difference between the chalky matrix of these and that of the Albian *Pleurohoplites*. But Sharpe's *A. leptonema* is unlike any described species of Albian *Gaudryceras*, except possibly a Japanese *Lytoceras sp.* of uncertain horizon, figured by Yokoyama[5] and compared to *Gaudryceras sacya* (Forbes); and a doubtful example of *G. leptonema* from Devon recorded by Jukes-Browne[6] is associated with a true Cenomanian fauna.

[1] The forty feet or so of unfossiliferous clays below the phosphate-bed appear to correspond mainly to the *auritus*-zone of Folkestone, and the 'abundance of Lower Gault fossils in the Cambridge Greensand' ('Geology in the Field,' 1909, p. 151) has no real existence.

[2] 'Ammon. Crét. Moyen,' etc., *Mém. Soc. Géol. France*, *Pal.*, No. 38, 1907, pp. 21–3. W. Kilian ('Crét. Infér. France,' *Mém. Carte Géol. France*, 1920, p. 27) records *Kossmatella chabaudi* (Fallot) from the Lower Albian, as well as '*Gaudryceras sacya* (Stoliczka)' which is almost certainly due to misidentification.

[3] E. Fallot. 'Étude Géol. Étages Moyens & Supér. Terrain Crét. S.E. France,' *Bibl. École Hautes Études*, *Sect. Sci. Nat.*, xxx, 1, 1885, p. 153.

[4] L. Pervinquière. 'Ammon. Crét. Algér.,' *Mém. Soc. Géol. France*, *Pal.*, vol. xvii, 1910, Mém. No. 42, p. 77.

[5] 'Verst. Japan. Kreide,' *Palæontogr.*, vol. xxxvi, 1890, p. 180, pl. xix, figs. 3a, b.

[6] In Jukes-Browne and Hill. *Quart. Journ. Geol. Soc.*, vol. lii, 1896, p. 163.

Some work, then, remains to be done with regard to the exact horizon of several of these Mediterranean elements; but it may be mentioned that only one Cambridge Greensand ammonite, namely, *Puzosia sp. nov.* = *A. mayorianus* Seeley [*non* d'Orbigny], preserved indifferently in black or brown phosphate, has so far been found also in the Cenomanian (Chloritic Marl) of Warminster and Bonchurch. It will be readily admitted that a long-lived desmoceratid like *Puzosia* has no zonal value.

In the earliest British Cenomanian deposits *Schloenbachia*[1] is associated with *Mantelliceras couloni* (d'Orbigny) and *M. martimpreyi* (Coquand) and allied species and with two new genera, both represented by unnamed Warminster species, namely, *Submantelliceras* gen. nov. (type *Acanthoceras aumalense* [Coquand] Pervinquière 'Ammon. Crét. Algér.,' *Mém. Soc. Géol. France, Pal.*, (42), 1910, p. 42, pl. iv, fig. 11) and *Euhystrichoceras* gen. nov. (type : *Mortoniceras ? nicaisi* [Coquand] Pervinquière, *ibid.*, p. 65, pl. vi, figs. 18, 19). The zone of *Pecten asper* has, of course, long been found to be valueless, and Barrois's 'Zone of *A.* [*Sharpeiceras*] *laticlavius*,' according to Stieler,[2] at the type locality Cap Blanc Nez contains not only derived Lower and Upper Gault fossils, but *Mantelliceras* and *Calycoceras* from well above the base of the Cenomanian. How the occurrence in this supposed Cenomanian bed of, for instance, a derived *Douvilleiceras mammillatum* can be reconciled with Stieler's[3] statement that at Cap Blanc Nez, the Gault 'in its complete development' is overlain conformably by the Cenomanian, the writer is at a loss to understand. So far as observations go the Cenomanian seems to be divisible into the following ammonite-horizons :—

Upper Cenomanian	Metoicoceras pontieri
(Acanthoceratan)	Acanthoceras cenomanense
[*subglobosus*-zone of authors]	Calycoceras baylei
Lower Cenomanian	Euomphaloceras euomphalum[4]
(Schloenbachian)	Hyphoplites falcatus
[*varians*-zone of authors]	Mantelliceras martimpreyi

Better species may be found for these horizons when the necessary field-work has been done, and the lower three especially, forming the *varians*-zone of most authors, should yield distinctive species of the common genus *Schloenbachia*. The tuberculate

[1] Stieler's (*loc. cit.*, 1922, 'Blanc Nez,' p. 30) identification of *Schloenbachia intermedia* (Mantell) with *S. costata* (Sharpe) seems to show that some of the numerous British species of *Schloenbachia* are unknown on the Continent.

[2] *Ibid.*, pp. 25–26.

[3] *Ibid.*, p. 22.

[4] The new genus *Euomphaloceras* (type : *A. euomphalus*—Sharpe, 'Foss. Moll. Chalk,' pt. 2, 1854, p. 31, pl. xiii, fig. 4, *Palæontographical Society*; Brit. Mus., No. 50158) is here proposed for this stock, which has nothing to do with *Douvilleiceras*. Its suture-line resembles that of *Acanthoceras sussexense* and *A. cunningtoni*. (*See* Spath : 'Cret. Cephalop. from Zululand,' *Annals South African Mus.*, vol. xii, pt. vii, No. 16, 1921, p. 314.

early forms of *Calycoceras* of the *falcatus*-zone lead to two developments that flourished before the costate *Calycoceras* (*baylei*-group) and *Acanthoceras* s.s. became dominant. One (*Eucalycoceras* gen. nov.) includes '*Acanthoceras*' *newboldi* Kossmat and its var. *spinosa*, better renamed *Eucalycoceras spinosum*, '*Ac.*' *choffati* and '*Ac.*' *gothicum* Kossmat and others, and as type may be taken *Eucalycoceras pentagonum* Jukes-Browne (*Quart. Journ. Geol. Soc.*, vol. lii, 1896, pl. v, figs. 1, 1a). The other stock (*Protacanthoceras* gen. nov.) via *P. triserialis* (J. de C. Sow.) leads to *P. compressum* (Jukes-Browne) and *P. bunburianum* (Sharpe) (genotype, *loc. cit.*, 1854, p. 25, pl. ix, figs. 3a–c), and several unnamed forms. *P. hippocastanum* (J. de C. Sow.) is transitional from this to the typical, later, *Acanthoceras*, occurring chiefly in the *baylei*-zone, with flattened forms of the type of *Ac. vicinale* (Stoliczka) in the next higher zone. It may be added that *A. rhotomagense* (Defrance MS.)[1] is the genotype of *Acanthoceras* and Hyatt's *Metacanthoplites* must be rejected; whilst for *A. deverianus* d'Orbigny ('Pal. Franç., Terr. Crét.,' i, 1841, p. 356, pl. cx), generally erroneously included in *Acanthoceras*, the new genus *Romaniceras* is proposed; and for *A. peltoceroides* Pavlow ('Argiles de Speeton,' 1892, p. 152, pl. xviii, fig. 21), also wrongly referred to *Acanthoceras*, the new genus *Parastieria*.

Now the interesting problem arises whether faunas with ammonites such as *Hypengonoceras warthi* in India or *Knemiceras uhligi* in Portugal represent southern equivalents of our Upper Albian or Lower Cenomanian, or whether they existed during a time interval in which no deposits were laid down in north-western Europe. *Knemiceras uhligi*, of course, has been erroneously recorded from Lower Albian as well as Cenomanian strata; but in Portugal,[2] in the lower Bellasian zone I, it is associated with '*Schloenbachia inflata*, var. *lampasensis*' Choffat, which, though of somewhat unusual appearance, is probably related to some of the quadrituberculate species of *Inflaticeras* described by the writer from Angola.[3] In Tunis, *Knemiceras uhligi* occurs in beds classed by Pervinquière as Vraconnian, but including not only several horizons of the Upper Albian, but also undoubted Cenomanian fossils, *e.g.*, *Forbesiceras obtectum* (Sharpe) of the *falcatus*-zone.

In India, *Stoliczkaia* of the uppermost Albian and Lower Cenomanian is found, as well as *Mantelliceras*, *Sharpeiceras*, and *Forbesiceras*. It is thus fair to assume that dissimilar faunas here do not indicate deposits of different ages, even if detailed collecting in new areas may enable us to increase considerably

[1] In Brongniart: 'Descr. Géol. des Environs de Paris,' 1822, p. 83, pl. iv, fig. 2. Sowerby's *A. rhotomagensis* ('Mineral Conchol.', 1826, vol. vi, p. 25, pl. 515, fig. 1, B.M. No. 43983a) is specifically distinct and may be renamed *Acanthoceras subflexuosum* sp. nov. The original of fig. 2 agrees with Mantell's *A. sussexensis*.

[2] P. Choffat. 'Faune Crét. Portug.,' I, 1886, p. 47. *Comm. Trav. géol. Portugal.*

[3] *Loc. cit.* (Angola, 1922), pp. 115–18.

the number of hemeræ here recognised. It is possible that the *euomphalus* and *falcatus* zones, on further research, may be found to be divisible into such a sequence as the following :—

- Protacanthoceras compressum (*Jukes-Browne*)
- Schloenbachia costata (*Sharpe*)
- Forbesiceras sp. [aff. *complanatum* Mantell]
- Calycoceras naviculare (*Sharpe*) [*non* Mantell]
- Mantelliceras sp. [aff. *feraudianum* Sharpe, *non* d'Orb.]
- Mantelliceras mantelli (*J. Sow.*)

But in India other forms would represent the same succession and at Aumale in Algeria neither the English nor the Indian zonal species may be traceable though the same horizons are clearly developed. Local non-sequences may have no relation to the absence of whole faunas. That in southern deposits just those horizons or ages[1] are missing that were preserved in north-western Europe, and vice versâ, is as little probable as that ammonites had a uniform world-wide distribution. *Hypengonoceras*, like the earlier *Engonoceras* and other Pseudoceratites, or like the persistent radical stocks *Phylloceratidae* and *Lytoceratidae* in general, did not penetrate into the areas of temporary transgressions, where the rapidly modifying derivatives of these two 'stenothermal' families enormously increase. The genus *Oxytropidoceras* (*roissyanus*-group), referred to above, is common in North-, Central-, and South-America, in addition to Mediterranean countries, and in South Africa it is associated with Dipoloceratids of the upper part of the Lower Gault. But Hoplitids which in Western Europe far outnumber *e.g. Oxytropidoceras* or *Lyelliceras*, are absent in these American and African deposits. Mr. Buckman's[2] comparison, say, of the *transversarius*-fauna of Mediterranean countries with the *martelli*-fauna of England, without consideration of the ever-present *Sowerbyceras* and '*Haploceras*' on the one hand, and Cardioceratids on the other, that clearly demonstrate the limited horizontal distribution of certain ammonites, is undoubtedly open to criticism.

As regards the lower limit of the Albian, Ganz,[3] in 1912, placed the '*nodosocostatum*-zone' again in the Gargasian or Upper Aptian, but Kilian[4] in 1913, showed that Jacob and Stolley had been right in including the *nodosocostatum*-zone, or Clansayes horizon, in the Albian, and this classification is here adopted. Incidentally it may be remarked that Ganz also reviewed the history of the term Gault, as Jacob[5] had done in 1908, unfortunately equally unsuccessfully on account of incomplete knowledge of the English type-succession. It may suffice to point in this connexion to the curious mixture of Upper and Lower Gault

[1] S. S. Buckman, 'Type Ammonites,' pt. xxxiv, 1922, p. 7.

[2] 'Type Ammonites,' part xxxvii, 1922, p. 25.

[3] 'Stratigr. Mittl. Kreide, Ob. Helvet. Decken, N. Schweiz. Alp.,' *Neue Denkschr. Schweiz. Naturf. Gesellsch.*, vol. xlvii, 1912, p. 144.

[4] In Frech. 'Lethæa Geogn.,' vol. ii, Mesozoic., pt. iii, Kreide, i, Unterkreide, fasc. 3, 1913, p. 347.

[5] 'Études Pal. & Strat. sur la Partie Moy. d. Ter. Crét.,' *Trav. Lab. Géol. Univ. Grenoble*, vol. viii, 1908, p. 584.

forms that he records from his ' Lochwald Bed ' (p. 121) or to the supposed occurrence in the Cenomanian of *Hysteroceras varicosum* (p. 129).

Of the lowest six subzones of the Albian, namely :—

tardefurcata-zone	*regularis* subzone
	milletianus
	schrammeni ,,
nodosocostatum-zone	*jacobi*
	trautscholdi
	abichi

none has been identified in the Folkestone Sands. Mr. W. J. Atkinson, of Hythe, to whom the writer is indebted for much information regarding local beds of the Lower Greensand, sent a photograph of what appears to be a large *Parahoplites* of Upper Aptian age, said to come from the uppermost part of the Folkestone Sands at Sandling Junction. On the other hand, *Parahoplites* (*Acanthoplites*?) *simmsi* (Forbes) from Hythe, greatly resembling *Acanthoplites aschiltaensis* (Anthula), is preserved in an ironstone that cannot be higher than the base of the Folkestone Sands, where Topley noticed a brown ferruginous sandstone with nodules in which Price[1] found ' two ammonites.' Again, Meyer[2] regarded the Nutfield Beds [with Upper Aptian *Parahoplites* and *Ammonitoceras*] as being near the base of the Folkestone Sands and at about the same horizon as the Bargate Stone. The ammonite-fauna of the Bargate Stone, including true *Parahoplites* of the *nutfieldensis*-group, fully confirms Meyer's correlation, and the Folkestone Sands (beds I–III of Price) may thus correspond to the uppermost Aptian as correlated by Prof. Gregory,[3] or to the Lower Albian as indicated in the writer's table; or, what is more probable, with their nodule-beds above and below and possible non-sequences in between, the Folkestone Sands may represent the vestiges of a complicated succession of geological events that took place between the deposition of the *nutfieldensis*-beds from Kent to Wiltshire on the one hand and the existence of the *regularis*-fauna of Bedfordshire on the other. No ammonites seem to be known from the Sandgate Beds apart from the fragment recorded by Dr. Kitchin[4]; but in the Kentish Rag Beds of Hythe there are already Lower Aptian ammonites, including *Parahoplitoides*, *Dufrenoyia*,[5] *Cheloniceras* and ' *Ancycloceras*.'

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[1] ' Excursion to Hythe, Sandgate and Folkestone,' pt. ii, *Proc. Geol. Assoc.*, vol. xiii, 1893, p. 148.

[2] ' Notes on the Correlation of the Cretaceous Rocks of the S.E. and W. of England,' *Geol. Mag.*, 1866, p. 15.

[3] ' On a Collection of Fossils from the Lower Greensand of Great Chart, in Kent,' *Geol. Mag.*, 1895, p. 103.

[4] In Lamplugh and Kitchin, ' On the Mesozoic Rocks in some of the Coal Explor. in Kent ' (*Mem. Geol. Surv.*), 1911, p. 144.

[5] The genus *Dufrenoyia* Burckhardt, quoted by Kilian in 1915 (' La Faune de l'Aptien Infér. d. Environs de Montélimar,' Contr. à l'Étude d. Faunes Paléocrét. du S.E. de la France. I. *Mém. Carte Géol. France*, pp. 34, 35, 37; spelt ' *Dufrenoya* ' on pp. 178, 196, 198, 199, 203, 205, 207), has

[*Continued on page* 147.

A provisional table of the ammonite zones of the Aptian may here be inserted. It is based on the attempts at correlation published by the writer[1] on previous occasions; but the '*furcatus*-zone,' formerly adopted with considerable doubt from French authors, notably Kilian[2] and Jacob,[3] has been omitted since the identification of *A. furcatus* Sowerby with the Lower Gargasian *Dufrenoyia dufrenoyi* (d'Orbigny) is obviously wrong. Jukes-Browne's term 'Vectian,' like his 'Selbornian,' is unnecessary.

AMMONITE ZONES OF THE APTIAN.

	Zones.	Subzones.	
Upper Aptian (Gargasian)	*subnodosocostatum*-zone (Parahoplitan)	aschiltaensis	Folkestone Sands? / I. o. W. Sandrock Ser.
		nutfieldensis	Nutfield; Seend; Pulborough; Shanklin; Bargate Stone.
	martini-zone (Tropæuman)	tovilense	Maidstone
		bowerbanki	I.o.Wight, Ferrug. Sands
		hillsi	Hythe Rag; Upware
Lower Aptian (Bedoulian)	*deshayesi*-zone (Parahoplitoidan)	consobrinoides	I.o.Wight Crackers
		hambrovi	
		weissi	Atherfield Clay
		bodei	Perna Bed; Hunstanton Carstone; Speeton, B, top
	(Parancyloceratan)	bidentatus	Speeton, B., top
		rude	
		sparsicosta	

priority before *Stenhoplites* Spath ('On Cret. Ammonoidea from Angola,' *Trans. Roy. Soc. Edinb.*, vol. liii, pt. i, No. 6, 1922, p. 110); but according to kind information by Prof. Kilian, the name *Dufrenoyia* has not been published by Burckhardt. It may be advisable to retain the genus *Stenhoplites* for *A. furcatus* Sowerby, quite distinct from *D. dufrenoyi* (d'Orbigny) and of pre-*deshayesi* age. The genus *Hoplitides* v. Koenen, used by Franke ('Die Entfaltung d. Hopliten i. d. Unt. Kreide Norddeutschl.,' *Jahrb. k. preuss. geol. Landesanst.*, vol. xxxix, Teil I, Heft 3 (1918), 1920, pp. 491–3) for the group of '*Parahoplites*' *deshayesi* (Leymerie) has been restricted by Sayn ('Les Ammon. pyrit. d. Marnes Valangin. d. S.E. de la France,' *Mém. Soc. Géol. France, Pal.*, vol. xv, fasc. 2, No. 23, 1907, p. 64) to a division of *Leopoldia* occurring in the Valanginian Bed D2 at Speeton.

[1] *See* 'On Cret. Cephalopoda from Zululand,' *Ann. South Afr. Mus.*, vol. xii, pt. vii, No. 16, 1921, p. 311.

[2] 'La Faune de l'Aptien Infér. d. Environs de Montélimar,' Contr. à l'Étude d. Faunes Paléocrét. du S.E. de la France. I. *Mém. Carte Géol. France*, 1915, table to p. 114.

[3] 'Études Paléont. et Strat. sur la Partie Moy. des Terr. Crét.,' etc., *Trav. Lab. Géol. Univers. Grenoble*, vol. viii, 1908, p. 587.

It is inadvisable to use terms like ' Sandgate Beds ' or 'Atherfield Clay ' for wider correlations; for even in such closely neighbouring localities as Dover, Hythe, and Brabourne the sandy, glauconitic, or clayey beds respectively do not belong to the same palæontological horizons.

Much work, of course, remains to be done on the Lower Greensand faunas. Hitherto the tendency has been to rely too much on the relative position of beds to relegate them to some formation intermediate between the over- and under-lying strata, sometimes in contradiction to fossil-evidence and with the sole desire of making the sequence complete. The ' Punfield Beds,' for example, styled Neocomian by Price,[1] were promptly taken by Kayser[2] to cover the two enormously long periods of the Valanginian and Hauterivian, and in his table are followed by the ' Atherfield Beds,' according to this author of Barremian age, and said to contain *Simbirskites decheni*. In reality none of these formations are represented in the marine Lower Cretaceous of the South of England and even the lowest Aptian is missing. The only ammonite of the Ferruginous Sands in the Punfield Series is a *Parahoplitoides*, transitional to *Dufrenoyia*, and probably younger, not older, than the *Parahoplitoides* of the Atherfield Clay, itself well above the base of the Aptian.

Again, Bed B of the Speeton Clay, the so-called *brunsvicensis*-zone, has *Simbirskites* of the group of *S. discofalcatus* (Lahusen) and *S. carinatus* (v. Koenen) at the base, and Aptian *Parahoplitoides* of the *bodei*-subzone (horizon of the base of the Hunstanton Carstone) at the top. Not a single typical Barremian ammonite has been found in the intermediate beds, though Barremian *Acrioceras* of the group of *A. tabarellii* (Astier) and *A. silesiacum* (Uhlig), here recorded for the first time, occur in the Snettisham Clay. Even in Germany the ' *Crioceras* ' of the beds between the Hauterivian below and the Aptian above show merely resemblance to, but not identity with, the forms of the typical Barremian, and the less complete succession at Speeton probably includes only part of the Barremian formation. The gap between the Aptian and Albian beds, however, at Speeton is far greater than that between the Lower Albian *regularis*-horizon of Leighton Buzzard and the Upper Aptian *nutfieldensis*-subzone of Surrey, Sussex, Kent, Wiltshire, and the Isle of Wight.

The great confusion existing at the present day in correlations of the Albian has been due largely to the reference to the ' Gault ' of beds characterized by faunas of various ages; for instance, the *Parahoplites*-faunas of *nutfieldensis*-age in Mangyschlak and the Caucasus, the Upper Aptian beds of the Luitere Zug[3] with *Diadochoceras subnodosocostatum* (Sinzow), the Aptian faunas of North

[1] ' The Gault,' 1879, p. 8.

[2] ' Lehrb. d. Geol.,' 3. Aufl., II. Theil. Geol. Formationskunde, 1908, table on p. 483.

[3] Jacob & Tobler. ' Gault de la Vallée de la Engelberger Aa,' *Mém. Soc. Pal. Suisse*, vol. xxxiii, 1906, pp. 1–26, pls. i, ii.

Germany, or the Lower Horsetown Beds of California, etc. It is to be hoped that the forthcoming description by the writer of the ammonites of the English Gault may help to clear up any doubts remaining about the exact horizons represented in the type-succession; and may cause to disappear from our fossil lists of the Gault such species as the Cenomanian *Protacanthoceras triserialis* (J. de C. Sow.), the Aptian '*Ammonites*' *bicurvatus* Michelin and *Parahoplitoides deshayesi* (Leymerie), the Valanginian '*A.*' *carteroni* d'Orbigny, and the Lower Liassic *Polymorphites parvus* (J. de C. Sowerby).