NOTES ON THE SPEETON AMMONITES.

BY C. G. DANFORD.

Anyone who knows a little about the Speeton sections can soon pick up a fairly representative series of their Belemnites, but not of their Ammonites; that demands much time and luck. Such at least has been my experience, for notwithstanding the exceptional opportunities for constant search afforded by several years' residence almost on the spot, I have not yet found some species, only poor examples of others, and—proof of the exhaustive character of Prof. Pavlow's and Mr. Lamplugh's museum and field researches—hardly any that cannot be identified from the descriptions and figures in their "Argiles de Speeton,"* to which work I am further indebted for the nomenclature and the classification of the series† used in the following slight sketch.

The Ammonites at Speeton are not only in much worse condition than the Belemnites, but also far fewer, except in the Kimeridge, where their crushed remains are legion, while in a considerable part of the upper deposits there are apparently none.

Of the 43 species described or figured in the "Argiles de Speeton,"‡ all but four, representing as many genera, are included in *Hoplites* and *Olcostephanus*, the latter being divided

* "Argiles de Speeton et Leurs Équivalents," par A. Pavlow, et G.W. Lamplugh, Moscou, 1892.

† The main divisions are indicated by letters, their sub-divisions by numerals.

‡ In the "Table of the Cephalopoda of the Speeton Series," ("Further Notes on the Speeton Section," &c., Q. J. G. S., vol. lii., 1896, p. 181), Mr. Lamplugh adds to these, *Hoplites Mortelleti*, Pict. and Lor., C8-11?, *H. interruptus*? Brug. A., *Olcost. (Simbirskites) versicolor*? Trautsch., *Olcost.* (—) cf. *Carteroni*, d'Orb, C1 to upper part of C6?, *Oxy-noticeras* cf. *catenulatum*, Fisch. D4-8. He also notes the probable presence in D4 of *Olcost. plicomphalus* Sow.

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by Prof. Pavlow into six groups, or sub-genera, *Virgitates*, *Craspedites*, *Polyptichites*, *Holcodiscus*, *Astieria*, *Simbirskites*.

The *Hoplites* occupy the lower part of the upper Kimeridge, the extreme top of "the *Lateralis* zone" D, the lower part of "the *Jaculum* zone" C, the top of "the *Brunsvicensis* zone" B, and "the *Minimus* zone" A; the *Olcostephani*, occur in the upper Kimeridge, the Coprolite Bed E, the entire *Jaculum* zone, and the extreme base of the *Brunsvicensis* zone. The species not included in these two genera occur in the Kimeridge, the middle of the *Jaculum*, and the top of the *Brunsvicensis* zones.

ZONE F (KIMERIDGE CLAY).

The greater part of the Kimeridge is *terra incognita*, for there is no record of its base and middle having been seen even by the earlier collectors, though they appear to have been vouchsafed better exposures of these shales than their successors.

The beds with *Amm. biplex* (= *Perisphinctes lacertosus*) *Amm. evalidus* (= *Hoplites eudoxus*), together with other fossils described by Leckenby, and those from which Mr. Herries subsequently collected the same species are the lowest that have been observed. Among their Ammonites preserved in various museums, Prof. Pavlow recognises *H. pseudomutabilis* Lorient and *H. subundoræ* Pavl.

During the early part of the present year there were several slight and fugitive exposures of these deposits 200 to 300 yards north of Reighton Gap, i.e., about half a mile from Speeton Middle Cliff Ridge, at the base of which the Kimeridge and the Coprolite seam above it are always more or less visible. A striking feature of the most northerly was a band of septarian nodular matter about a foot thick, which rested on greenish-black shale. This band at first showed as an almost unbroken reef, but was soon breached by the heavy seas, so that if seen again at the same spot it will not present its original continuous appearance. The beds below it were alternately greenish-black

Photographed by Godfrey Bingley, Headingley, Leeds.

Figs. 1, 1a. *Olcostephanus (Polyptychites) bidichotomus* Leym. D2 base. 17821.
 „ 2, 2a. ——— (———) *polyptychus* Keys. D2 base. 17822.
 „ 3, 3a. ——— (———) cf. *Keyserlingi* Neum. & Uhl. D2 base. 17823.
 Scale $\frac{1}{2}$.†

*The numbers refer to the numbers of these specimens in the Catalogue of the Geological Museum, Jernyn Street.
 †Owing to a slight reduction in the making of the blocks in this and the following plates the figures representing the size of the specimens should be somewhat reduced.

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and bluish, rather hard and splintery. They contained good-sized oysters, numbers of small bivalves, and other shells; also many Ammonites, all crushed excepting those in the calcareous pyritous nodules, which were better preserved and large, often more than a foot across. These Ammonites belong to a form of *Hoplites* apparently distinct from those above-mentioned.

The lower half of a Belemnite, found a little below the band of nodular material, afforded the only indication of the existence of that fossil at this horizon. The fragment, together with the impression left by the vanished part of the guard, showed that this Belemnite was of the *Porrectus* type, but proportionately shorter, and not the *Bel. troslayanus* found by Mr. Herries.

Another exposure at a presumably higher level seemed nearly devoid of all fossils except Ammonites of the *Perisphinctes* type—*P. lacertosus*, Dum. et Font. These, like the *Hoplites*, were much crushed, often large, and fairly well preserved only in the nodules. It is hard to say what position the beds of these isolated exposures occupy in relation to those described by Leckenby, but if this *Perisphinctes* corresponds to *Ammibplex* they probably form part of his lowest series No. 1.

In most of the much higher beds crushed Ammonites abound, and in some near the top they occur as soft and brittle yellowish casts, indistinctly appearing to belong to round-backed forms. I have also seen detached nodules crowded with a species much resembling the figure of *Olc. (Perisphinctes)* cf. *miatchkoviensis* in the "Argiles de Speeton," Pl. I., fig. 6.

ZONE E (COPROLITE BED).

In the medley of materials that form this seam there are many Ammonite fragments, among which Prof. Pavlow recognised *Olc. (Virgitates)* cf. *scythicus* Michal., *Olc. (—)* cf. *Tchernischowi* Michal., *Olc. (—)* cf. *Panderi* d'Orb, and *Olc. (—)* cf. *dorso-planus* Michal.

ZONE D ("BEL. LATERALIS BEDS").

In no part of this zone below the *Astarte* bed D4 have I found Ammonites, although they occur there, for Mr. Lamplugh says, "De très petits Ammonites ne sont pas rares dans la partie inférieure de la zone (D4, D5, D6, D7), mais elles sont difficiles à déterminer." These Prof. Pavlow considers resemble the inner whorls of Ammonites of the *Olc. subditus* and *okensis* types, while one form from D4 he definitely determines as *Olc. (Craspedites) fragilis* Traut.

Small Ammonites, often very well preserved, are certainly common in D4, and most of them agree with the figures and description of *Olc. (Crasp.) fragilis* in the "Argiles de Speeton,"* while others, Mr. Lamplugh thinks "are identical with *O. plicomphalus* of the Spilsby sandstone." In this bed may also be seen the remains of much larger forms, but not in a state admitting of their identification.

The next bed, D3, contains large and small Ammonites of various types. The former are generally mere crumbled masses, but some have been partially preserved by incrustations of pyrites, and their innermost whorls are occasionally intact. They appear to belong to the very globose forms of the *Polyptychites*, such as *gravesiformis*, *Keyserlingi*, &c., or to the less inflated, as *Beani*, *ramulicosta*, and perhaps to *Lamplughii*, a species here discovered by Mr. Lamplugh.

Though distributed through the whole bed, these Ammonites appear to be commonest above, and a little below the two indurated ferruginous bands that traverse it. My best specimens came from the top, and belong to *Beani* and *ramulicosta*. The deeper whorled species seem to lie generally, but not always, lower.

Among the smaller forms *Olc. (C.) fragilis* certainly occurs, and there is one in which that variation in the arrangement of the ribs where the anterior branch of the umbilical rib, after passing over the back, joins the succeeding instead of the opposite

* "Argiles de Speeton," p. 15.

Photographed by Godfrey Bingley, Headingley, Leeds.

- Figs. 1, 1a. *Olcostephanus (Craspedites) fragilis* Traut. D2-4. 17940.*
 „ 2, 2a. ———— (*Polyptychites*) aff. *Beani*. D3. 17862.
 „ 3, 3a. ———— (————) *ramulicosta* Pavl. D3. 17863.
 „ 4, 4a. ———— (————) aff. *Beani*. D4. 17865.
 „ 5, 5a. ———— (————) *Beani* Pavl. D2 base. 17864.
 „ 6, 6a. ———— (*Astieria*) ? *Spitiensis* Blanf. CS-10. 17929.
 „ 7, 7a. ———— (————) *Astieri* Sharpe CS-10. 17927.
 „ 8, 8a. ———— (————) *sulcosus* Pavl. CS-10. 17928

Scale, Figs. 1-8, 1a-5a, $\frac{1}{4}$; 6a-8a, $\frac{1}{2}$.

*The numbers refer to the numbers of these specimens in the Catalogue of the Geological Museum, Jernyn Street.

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rib, seems to be rather the rule than the exception. In other respects this form seems to be of the *Beani* type.

It has been thought that it was from this, and the preceding beds, that the earlier collectors obtained their fine examples of the "coronated" Ammonites; but the phosphatic condition of most of their specimens, and especially of the splendid series in the Leckenby collection at Cambridge, points to these fossils having come from the base of the succeeding bed, D2, and not from D3 and D4, where, as far as my experience extends, the *Polyptychites* are, when at all well preserved, always in the pyritous state.

This bed, D2, which averages only about $2\frac{1}{2}$ feet in thickness, is perhaps the most interesting of the entire series. It is formed of dark gritty clays, easily distinguishable from the yellowish-brown deposits of D3. In its upper three-fourths there are not many fossils, but the half-dozen inches of its very compact base is crowded with them, as well as with phosphatic stones, "potato nodules," and larger concretions. Most of the phosphatic lumps are partly rounded and pitted, partly flat or angular, as if the masses to which they originally belonged had after long exposure broken up, and their fragments had soon been covered by sediments. Indications are not wanting that some, if not most of them, are derived from Ammonite casts. The nodules, soft and brown outside, hard and dark within, do not enclose fossils, though Belemnites, and very rarely Ammonites, are found adhering to their softer exteriors. The concretions consist of these lumps, nodules, and a variety of fossils, often in widely different states of preservation, cemented together by pyritous materials. Ammonites both square and round-backed are here numerous, the former represented by *H. regalis*, *H. hystrix*, &c., the latter by a larger number both of species and individuals. Some of the small forms are well preserved in the ordinary condition; others, small and large, round and square-backed, are more or less crushed, mere soft clay casts, or much impregnated and encrusted with pyrites, while many are in a phosphatic state, hard, dark, and brittle.

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These last are chiefly of the round-backed kind, and generally very fragmentary. Most of them seem to belong to *O. (Polyptychites) bidichotomus* and *O. (—) polyptychus*, but *O. (—) Beani* also occurs, and a very globose form, suggestive of *O. (—) Keyserlingi*, but with ribs finer and more numerous than in that species.

Among the fragments found there are also indications of the existence of other allied forms, some of which must have been of considerable size, as part of a whorl of the *bidichotomus* type measured nearly six inches across.

At this horizon *Lateralis*-Belemnites swarm, most of them showing signs of much exposure. There is also a slight sprinkling of *Bel. jaculum*. Other fossils, such as *Pleurotomaria*, *Pleuromya*, *Pecten*, *Exogyra*, &c., are common. Saurian remains are not rare,* and there is a good deal of fossilised wood. It is, in fact, a heterogeneous collection of materials, somewhat resembling that of the Coprolite seam. Though the rest of this bed is comparatively poor in fossils, it has yielded interesting forms, one an *Hoplites*, which quite agrees with Sayn's description and figures of *H. Arnoldi*, from the beds with *Bel. latus* at Blegiers, Basses Alpes,† which Pavlow says is not the *Arnoldi* of Pictet, and renames *heteroptychus*. This specimen is in the phosphatic state, well preserved, measures 48 mm., and has the deep constrictions (4) bordered by more strongly developed ribs that are mentioned by Sayn, but not by Pavlow in his description or apparent in his figures of *H. heteroptychus* from an unknown horizon at Speeton.‡ In the outer whorls the sculpture is irregular, as in these figures, but in the inner the umbilical ribs give rise to three, or more frequently four, branches which spring from sharply pointed and prominent tubercles,

* Saurian remains also occur at the top of the Kimeridge and the base of the *Brunsvicensis* zone.

† "Notes sur quelques Ammonites nouvelles ou peu Connues du Néocomien Inférieur," Bull. Soc. Geog. France, Series 3, vol. 17, p. 682, Pl. XVII., figs. 6, 7.

‡ "Argiles de Speeton," p. 109, Pl. XI., fig. 22.

Photographed by Godfrey Bingley, Headingley, Leeds.

- Figs. 1, 1a. *Oleostephanus (Simbirskites) Payeri* Toul. C6-S. 17919.*
 „ 2, 2a. ——— (———) *concinus* Phill. C6-S. 17924.
 „ 3, 3a. ——— (———) ? sp. C7-S. 17930.
 „ 4, 4a. ——— (———) *subinversus* M. Pavl. C7-S. 17931.
 „ 5, 5a. ——— (———) *progreiens* Lahus. C6. 17923.
 „ 6, 6a. ——— (———) *unbonatus* Lahus. C upper. 17921.
 „ 7, 7a. ——— (———) *Decheni* Roem. C upper. 17920.
 „ 8, 8a. ——— (———) *discofalcatus* Lahus. B base to C upper. 17922.

Scale $\frac{3}{8}$.

* The numbers refer to the numbers of these specimens in the Catalogue of the Geological Museum, Jermyn Street.

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situated about the middle of the flanks. These secondary ribs are very like those of *Olc. (Simbirskites) umbonatus*.*

Of two other forms I have also found but single examples. Both are *Hoplites*, one being somewhat of the *H. oxygonius* type, but with ribs that bifurcate with complete regularity unusually near the back. The branch, however, is often so much detached from the main rib that it presents an intermediate appearance. The other form is more compressed, with much finer ribs, which are regularly trifurcate about the middle of the flanks, the anterior being also generally detached. These forms have not yet been determined.

The top of the zone, D1, is well marked by the line of large nodules called by Mr. Lamplugh "the compound nodular band." They have mostly been formed round big Ammonites of the *Hoplites* type, and apparently sometimes *Crioceras*, of which a large species is present in D2, but the fossils and the concretions are so worn that it is very difficult to distinguish species.

These masses consist of bluish calcareous material, in which are embedded "potato" and darker nodules, which must have been formed earlier, but not much earlier, for the main and the subsidiary concretions contain the same fossils, among which are smaller and much better preserved examples of *Hoplites regalis*, *Roubaudi* and *hystrix*, *Lateralis* and *Jaculum*. Belemnites, Bivalves, and Crustaceans as *Myeria ornata*, but never, I think, any of the *Olcostephani*, unless some of the blacker lumps are fragments of their phosphatic casts.

As the question at what horizon these latter Ammonites ceased to exist is of some interest, I have in the cliff carefully dissected a stretch of Beds D1—D2, about 40 yards long by 2 feet wide, and in this fairly large sample have not found a trace of the round-backed Ammonites above the basal six

* Another specimen from the Comp. Nod. Band may be *heteroptychus*, but seems nearer *H. neocomiensis* d'Orb. It is, however, too fragmentary to be easily determined.

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inches of D2. The square-backed *Hoplites*, on the contrary, pervaded both beds, as did *Lateralis*- and *Jaculum*-Belemnites, the former showing a great decrease in numbers above the six inch limit, the latter an increase, slight at first, but very marked in D1.

Shore exposures confirmed these observations, for though fragments of the round-backed forms sometimes occurred at the "compound nodular band," they were not in place, but had been washed in from the closely adjacent base of D2, and lodged among the large nodules.

The development of the Belemnite and Ammonite immigrants has here evidently been quite dissimilar, for the *Jaculum*-Belemnites, though found as low as D4, and even D5, do not attain their full strength until nearly the middle of the next zone C, whereas the *Hoplites*, which have not been met with below D2, are nowhere in greater force both as regards size and numbers than at the compound nodular band.

Certainly the *Jaculum*-Belemnites on their arrival in the north must have found a vigorous, and perhaps hostile, crowd of their kinsfolk in possession. At all events they did not multiply much until the *Lateralis* tribe had vanished, but when the square-backed Ammonites came in from the south many of the round-backed species were probably extinct, and the rest may have been on the verge of extinction. Perhaps, however, it was all a matter of changed climatic conditions, which suited the one group better than the other.

ZONE C ("JACULUM BEDS").

The most abundant Ammonite of this zone from Bed 7 to its lowest bed 11 is *Hoplites regalis*,* but whether it ranges

* Prof. Pavlow points out that Neumayer and Uhlig have shown that the name *Noricus*, so generally applied to this Ammonite, is a misnomer, as the species is not found near Noris (Nürnberg), and that the name was originally given by Schlotheim to an example of the genus *Cosmoceras*.

Photographed by Godfrey Bingley, Headingley, Leeds.

- Figs. 1, 1a. *Hoplites Roubaudi* d'Orb. C11-D2. 17936.*
 „ 2, 2a. ——— *regalis* (Bean) Pavl. C7-11. 17932.
 „ 3, 3a. ——— *oxygonius* Neum. & Uhl. C7-11. 17933.
 „ 4, 4a. ——— *amblygonius* Neum. & Uhl. C lower. 17926.
 „ 5, 5a. ——— ? sp. D2 upper. 17937.
 „ 6, 6a. ——— ? sp. D2 upper. 17938.
 „ 7, 7a. ——— *hystrix* Phill. C11-D2. 17935.
 „ 8, 8a. ——— *Euthymi* Pict. C base. 17934.

Scale, 1-8, 2a, 3a, 4a, 8a, $\frac{1}{2}$; 1a, 5a, 6a, 7a, $\frac{1}{4}$.

The numbers refer to the numbers of these specimens in the Catalogue of the Geological Museum, Jermyn Street.

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any higher seems doubtful. In C7, at the foot of Black Cliff Ridge, it is common, but at that point the sequence of the beds along the shore is interrupted by a great landslip, and the condition of the ridge itself makes investigation there difficult.

Its near ally, *H. oxygonius*, with fewer and coarser ribs, appears to have an equally extended range. *H. amblygonius*, in which the ribs, also fewer, and coarser, form at the back an obtuse instead of an acute or right angle, as in the two preceding species, chiefly occurs in the lower beds. *H. Euthymi* easily distinguished by its three rows of prominent tubercles on each side, occupies a still lower position ; while *H. hystrix*, with similar tubercles, and coarse undulating ribs, which occasionally form loops between the tubercles, and *H. Roubaudi*, with its regular arrangement of alternate simple and bifurcate ribs, appear to be confined to the immediate vicinity of the compound nodular band.

Well-preserved specimens of this group are always of very moderate size, but remains, apparently of *regalis* and its nearest allies in and near the compound nodular band, show that these Ammonites attained large dimensions, for many there measured were from one to two feet across.

The *Hoplites* are not the only Ammonites of this zone, for it is also tenanted by members of the *Holcodiscus* and *Astieria* sections of the *Olcostephani*. The former, represented by *Olc. (Holcodiscus) rotula*, is mainly met with in the lowest beds, and has been found by Mr. Lamplugh even in the compound nodular band. This species is not rare, and is sometimes rather large. The forms of the latter group, *Olc. (Astieria) Astieri*, *Atherstoni*, *spitiensis*, and *sulcosus*, occupy a rather higher position ; such at least as I have found have not been near the base of the zone, certainly never in the *Lateralis* clays, where they have been said to occur, but usually near C9, the bed where the small nodules so often contain shrimps and other crustaceans, and which, owing to two distinct yellowish bands that run through it, forms a useful landmark in this often much

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obscured section. None of these species is at all common, but I think the least rare is a form with four constrictions, which is probably *sulcosus*.

The higher deposits of this zone are occupied by the *Simbirskites* section of the *Olcostephani*. These Ammonites first appear in C8, and are therefore overlapped by the *Hoplites*. The group here comprises 9 or 10 species, some well defined, others harder to distinguish. They are often spoken of collectively under the convenient name of *Speetonensis*, which is therefore said to be common. My own experience, however, is that true *Speetonensis* is rather uncommon, as are all the others except *inversus*, *sub-inversus*, and perhaps *concinus*. The two first which are superficially very much alike, but differ in the pattern of their sutures, present many varieties, with ribs coarse, fine, or arranged in the zig-zag fashion already alluded to, but always simply and regularly bifurcate, while in *concinus* some of the umbilical ribs, especially those of the inner whorls, are trifurcate.

These species occur at almost the lowest horizons occupied by this group, but are, according to Mr. Lamplugh's "Table of the Speeton Cephalopoda," preceded by *Payeri* and *versicolor*, and succeeded by *progreiens*, *speetonensis*, *discofalcatus*, *umbonatus*, and *Decheni*. The two last I have found in the topmost beds of this zone, *discofalcatus* still higher, at the base of the next zone.

In a recent memoir on the *Simbirskites* group,* Prof. Pavlow shows that the specimen with 30 umbilical ribs, described and figured in the "Argiles de Speeton" (p. 147, Pl. XI., fig. 22) as *Olc. (Simbirskites) discofalcatus*, Lahus. is not that species, which has only 19-21 umbilical ribs, but is *Simbirskites Phillipsi*, which has 24-30.

A specimen that is apparently of the true *discofalcatus* type, with only 19 ribs, was lately found by Prof. P. F. Kendall

* "Le Crétacé Inférieur de la Russie et sa faune," Moscou, 1901, p. 78., Pl. VI., figs. 1, a, b, c, d; Pl. VII., figs. 2, a, b, c; 3, a, b, c.

Photographed by Godfrey Bingley, Haddingley, Leeds.

- Figs. 1. *Hoplites* . . . sp. Base of Upper Kimeridge. 18150.*
 „ 2, 2a. ——— ? *heteroptychus* Pavl. D2 upper. 17939.
 „ 3, 3a. ——— *Deshayesi* Leym. B upper. 17915.
 „ 4. *Perisphinctes lacertosus* Dum. & Font. Base of Upper Kimeridge. 18151.
 „ 5, 5a. *Acanthoceras* ? *peltoceroideus* Pavl. C9. 17925.
 „ 6, 6a. ? *Desmoceras* cf. *cassidoides* Uhl. C6-9. 17917.
 „ 7, 7a. *Oppelia nissoides* Sarasin. B upper. 17916.
 Scale, 1, 4, $\frac{3}{4}$; 2, 3, 5, 6, 7, $\frac{1}{2}$.

*The numbers refer to the numbers of these specimens in the Catalogue of the Geological Museum, Jernyn Street.
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high up on Speeton Black Cliff Ridge. It therefore appears that as in the Russian deposits both forms are here represented.

The upper part of the Jaculum-clays has, however, of late years been but poorly exposed, which partly accounts for my having found only very few of its Ammonites, and my inability to give any additional information regarding their distribution.

The remaining Ammonite genera of this zone are each represented by only a single species, *Acantoceras* (?) *peltoceroide*s Pavl., and *Desmoceras* cf. *cassidoides* Uhl. Both seem to be rare, for of the former I have come across but one imperfect example near C9, and of the latter two fair specimens, one about the same horizon, the other much higher.

ZONE B ("BRUNSVICENSIS BEDS").

The soft brown nodules at the base of this zone sometimes contain specimens of *Olc.* (*Simbirskites*) *discofalcatus* or *Phillipsi* (?), but they are generally very ill preserved. Otherwise it seems to be quite devoid of Ammonites except in its uppermost beds. There *Hoplites Deshayesi* is common, but in a condition so decayed that even a fair example is a rarity. At the same horizon the small flat forms of *Oppelia nisoides* Sarasin are not rare, together with fragments of a distinct but apparently kindred species; and occasional glimpses of beds only a little lower have shown that they contain considerably larger Ammonites, very rotten, but which seem to be of the *Deshayesi* type.

ZONE A ("MINIMUS BEDS").

In the beds with *Bel. Ewaldi*, which succeed those with *H. Deshayesi*, and which it is thought may (possibly with others still unseen) constitute a separate zone intermediate between the B and A zones, no Ammonites have yet been detected, but in the *Minimus* marls Mr. Lamplugh has found *H. interruptus* Brug. If, however, more could be seen of the upper parts of the series than the patches now and again visible

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along the base of the cliff south of Speeton Beck, or their very partial and rare exposures on the shore, other species might doubtless be added to the meagre list that they have hitherto furnished.

NOTE ON CRIOCERAS.

The Criocerata of the Speeton clays do not seem to have been so thoroughly exploited as the other cephalopods, presumably because their forms being less compact, have been so badly preserved that even moderately good examples of most of them are rarely obtained.

Their range as at present known is from Bed 2 of "the *Lateralis* zone" to nearly the top of "the *Brunsvicensis* zone," and probably extends at least to the base of the *minus* marls.

The form of Crioceras in D2 resembles one of large size common in the lower part of "the *Jaculum* zone," which I think has been determined as *C. Duvali*. In that zone these fossils are most abundant in the middle beds, where they sometimes lie in almost continuous bands. None is more numerous than *C. semicinctum*, and the above-mentioned large species, while among others *C. puzosianum* and *Hamites intermedius* are sufficiently common. In this zone *C. Matheroni* is also found, but apparently only in the upper beds.

In the "*Brunsvicensis* zone," though Ammonites are so rare, there are many Crioceras. A small species like *C. Matheroni* occurs at its base, and in its lower beds *C. Strombecki* is common. The somewhat higher beds, and their bands of large nodules, contain many Crioceras, but they are either very rotten or very hard to extract. The *Deshayesi* beds have also large and small forms, which do not appear to occur elsewhere. Among these are *Toxoceras Royeri* d'Orb. and two species of *Ancyloceras*, considered by Dr. A. von Koenen to be undescribed.

The only fossil of this group which I have come across at an horizon which may be above the level of "the *Brunsvicensis* zone" was in a large nodule high up on Black Cliff. This

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specimen seems to agree with figures of *C. fissicostatum*. Examples of *Bel. Ewaldi* found near the same spot increase the probability of this determination being correct, and of the existence of the separate zone suggested by the presence of that belemnite.

As there is so little to add either as regards species or their distribution to Mr. Lamplugh's "Table of the Speeton Cephalopoda" (op. cit), it seems unnecessary to give another list of the Speeton Ammonites, but the few identified species of *Crioceras* may be enumerated. Some of my specimens have been examined and determined by Dr. A. von Koenen, others compared with the figures and descriptions of his great work on the Ammonitidæ of the North German Neocomian.* There can, however, be little doubt that many additions to this list might be made by anyone well acquainted with the forms of the group.

I have in conclusion to thank Dr. A. von Koenen, Mr. G. W. Lamplugh, Mr. G. Crick, and Dr. Kitchen for their kind assistance in the determination of specimens, and Mr. W. Crofts, Mr. J. W. Stather, and Mr. T. Sheppard for their help in field and other work.

TABLE OF THE SPEETON CRIOCERATA.

* <i>Crioceras</i>	Duvali d'Orb	..	..	..	C. mid-lower, to D2 ?
*	„	semicinctum Roem	..	..	„
*	„	Puzosianum ? d'Orb	..	..	C. mid.
	„	rareicinctum v. Koen.	..	..	C.
*	„	Matheroni	..	..	C upper.
	„	Strombecki v. Koen	..	..	B. lower.
	„	? fissicostatum Roem.	..	..	Zone with Bel. Ewaldi ?

* "Die Ammonitiden des Nord-deutschen Neocom (Valangine Hauterivien, Barremien und Aptien)" von Dr. A. von Koenen (Abhandlungen der Königlich Preussischen Geologischen Landesanstalt und Bergakademie) Neue Folge Heft 24, Berlin, 1902.

*Hamites intermedius Phill.	..	..	C mid.
*Ancyloceras sp.	..	..	B top.
* „ sp.	..	..	„
*Toxoceras Royeri d'Orb	..	..	„
*? Scaphites constrictus d'Orb	..	..	„

Species marked (*) have been determined by Dr. A. von Koenen.