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Folia



series, near its base, contains coarse conglomerates of well-rounded white and pink quartz-pebbles; but they differ markedly in this, that on the Logan water no unconformability was observed between the bottom of the Old Red Sandstone and the Silurians containing the *Eurypteri*, &c., which are referred by Sir R. Murchison, on palaeontological grounds, to the Ludlow period. I have compared the Portencross Silurians with those of the south of Ayrshire; but this conclusion, resting solely on mineral characters, cannot rise higher than a mere probability.

In the elaborate memoir* on the geology of the Isle of Arran, by Sedgwick and Murchison, it is shown that the axis of elevation of the Old Red Sandstone, the coal-measures, and the red sandstones which are superior to the coal, passes through North Sannox on the coast, and that these formations dip very regularly N.N.W. and S.S.E. respectively on the two sides of this axis. The strike of the beds, therefore, is E.N.E.; and if the axis be prolonged on the map from North Sannox to the coast of Ayrshire, it will strike the coast close to Portencross, where the above-described protrusion of Silurian rocks occurs. The coincidence is too striking to be accidental: it is clear that the exertion of force which has elevated the Devonian beds and the coal-measures in Ayrshire is the same as that which has produced the same effect in Arran, distant about 10 miles. But it is to be observed also, that this axis runs E.N.E., that is to say, exactly parallel to the strike of all the lower Silurian rocks in the south of Scotland. Now it is certain, from many sections described by many different observers, that the Silurian rocks had undergone upheavals and convolutions, and had had their present strike impressed upon them, previously to the deposition of the Old Red Conglomerates,—while the facts I have mentioned above prove that an exertion of force very different, indeed, in energy, but exactly corresponding in direction, reoccurred after the close of the Permian period.

2. *On the KELLOWAY ROCK of the YORKSHIRE COAST.* By JOHN LECKENBY, Esq. (Communicated by JOHN MORRIS, F.G.S.)

[PLATES I. II. III.]

AMONG the more interesting features in the geology of the east coast of Yorkshire is the Kelloway Rock, whether compared, in its extraordinary development, or in the great variety of its fossils, with its Wiltshire prototype.

The Kelloway Rock is first seen in the cliff a short distance to the south of Gristhorp Bay, and here, but for its position below the Oxford Clay, and the presence of some characteristic fossils, there is little about the thin band of calcareous pisolite in which these fossils occur to identify it with the ochreous and arenaceous

deposits as it usually appears. This band, which immediately underlies the Oxford Clay, never exceeds 5 inches in thickness, and after a course of 50 yards, thins out into a bed containing much decomposed lignite, and which at this point forms a passage into the Oxford Clay above. The great mass below, presenting a thickness of nearly 30 feet, is entirely unfossiliferous. The thin deposit at the top, and the passage into beds of lignite, seem to indicate the gradual filling up of some shallow sea of that period.

From the southern extremity of Gristhorp Bay, the Kelloway Rock is seen on the cliff, from the base to a height of fifteen to twenty feet, presenting, by its laminated markings and longitudinal fissures, an appearance of artificial masonry. It gradually ascends northward (the fossiliferous band having disappeared), until, about midway in the bay, it passes inland.

The underlying Cornbrash is well developed about halfway up the cliff, and has been occasionally quarried and sent to Hull for conversion into cement.

The projecting point of Red Cliff presents the next important section, and here the Kelloway Rock assumes its more general lithological character. Here also occur in abundance two species of *Ammonites* which characterize the rock in Wiltshire (*Am. Koenigi* and *Am. sublevis*), so exactly similar, that if mixed in a cabinet, it would be next to impossible to separate the northern from the southern examples. Here two distinct zones of fossils, and the following section, in a descending order, may be observed.

- | | |
|---|-------|
| A. Moderately compact iron sandstone, 1½ foot thick, traversed by darkened veins of the same metallic character, across which <i>Ammonites</i> are often placed, and which divide the fossil into separate portions when an attempt is made to extract it. This bed is characterized by the presence of <i>Am. Koenigi</i> , <i>Am. flexicostatus</i> , and <i>Belemnites tornatilis</i> . <i>Am. flexicostatus</i> is here special to the bed. | feet. |
| B. Loose friable sand and sandstones, without fossils | 4 |
| C. Bed similar to A, but much richer in organic remains, containing, besides <i>Am. Koenigi</i> and <i>Belemnites tornatilis</i> , <i>Am. sublevis</i> , <i>A. Gowerianus</i> , <i>A. Chamuseti</i> , <i>Pholadomya acuticosta</i> , <i>Modiola pulchra</i> , <i>Terebratulæ</i> , <i>Gryphæa dilatata</i> , and other shells. It is more nodular and cherty than the upper zone, and its fossils are better preserved | 1½ |
| D. Compact sandstone, entirely unfossiliferous, with the rare exception of a stray Belemnite or Ammonite in the centre of one of its huge blocks | 20 |

The same divisions obtain at the Castle Hill, Scarborough, which point next claims our attention. A fine section near the pier may be advantageously examined, and it is here that a flooring of the rock has yielded an abundance of its finest and most characteristic fossils. The upper zone, as at Red Cliff, contains *Ammonites*

Koenigi, *Am. flexicostatus*, *Belemnites tornatilis*, all which, however, occur in greater abundance and perfection in the lower zone, which is the chert-deposit. Amongst the Cephalopods are

Ammonites gemmatus.....	Common.	Ammonites lenticularis.	Very rare.
— Duncani	Common.	— Arduennensis? ...	Very rare.
— Gowerianus.....	Not rare.	— perarmatus	Scarce.
— athleta	Not rare.	— Gulielmi.....	Common.
— lunula	Scarce.	— bipartitus	Rare.
— Chauvinianus	Rare.		

Here it is that the great bulk of the Mollusca and Gasteropoda afterwards enumerated have been obtained.

At this point *Am. Gulielmi* is found in tolerable abundance; but, although *Am. Calloviensis* is recorded by W. Smith and by Prof. Phillips as having been found here, and, in fact, is mentioned by these authors as one of the fossils which first led to the identification of the rock with the Wiltshire beds, I have nowhere seen a specimen of true *Am. Calloviensis* from Yorkshire. Prof. Phillips's figure does not agree either with typical Wiltshire specimens, or with the figures of Sowerby or D'Orbigny.

On the north side of Scarborough Castle, numerous blocks of this rock, derived from section D, but having portions of C attached, formerly strewed the base, the accumulated debris of centuries from the undermining and falling over of the cliffs adjacent.

A few years ago the surfaces of these blocks were found to consist of cherty calcareous nodules, filled with fossils, and so diligently have these been explored, that now hardly a block is to be found to reward the industrious collector.

The Kelloway Rock finally disappears from the cliffs about 200 yards north of the Castle. Its upper beds were removed about two years ago in preparing the ground for the erection of a row of houses, and many characteristic fossils were then brought to light, including examples of *Am. Gulielmi* and *Am. gemmatus*, of unusual dimensions.

At all the points enumerated, in conformity with a pretty general law, the great deposit of fossils is at or near the top of the bed; while all below, for a thickness often of 20 feet, is solid, compact sandstone, as at Hackness, where quarries of this rock have yielded the material for the erection of some of our public buildings.

The Kelloway Rock ranges inland from Gristhorp to Oliver's Mount, where it keeps the lower part of that curious ridge*; the middle being composed of Oxford Clay: the whole is surmounted by calcareous grit. The eye of the practical agricultural geologist will detect the argillaceous belt of Oxford Clay as he passes on the railway along the valley, as well as on the hills on the opposite side. In the parallel valley westward, the Kelloway Rock may be examined in a quarry used for extracting material for repairing roads. Between this point and Hackness I have not observed it; but the peculiar

* One or two springs of water mark its junction with the clays of the Cornbrash beneath.

ridges and escarpments formed by the resistance of the calcareous grit, and the denudation of the Oxford Clay, characterize all the hills around Scarborough, the Kelloway Rock occupying the valleys. At Newton Dale the upper beds thin out, and there is a paucity of organic remains, compared with Hackness and Scarborough, but *Gryphæa dilatata*, *Trigonia*, and *Am. Gulielmi* may be obtained.

Organic Remains.

The following is a catalogue of the fossils of the Kelloway Rock of Yorkshire, with descriptions of some new or imperfectly understood species:—

Cephalopoda.

Ammonites, sublaevis, Sowerby.	Ammonites putealis, Bean, MS.
— ordinarius, Bean, MS.	— turgidus, Bean, MS.
— rugosus, Leckenby.	— gregarius? Bean, MS.
— Gowerianus, Sowerby.	— Lunula, Zieten.
— reversus, Simpson, MS.	— Chamuseti, D'Orbigny (=
— Vertumnus, Bean, MS.	<i>A. lenticularia</i> , Phillips).
— Poculum, Bean, MS.	— funiferus, Phillips.
— Chauvinianus, D'Orbigny.	— hyperbolicus, Simpson, MS.
— alligatus, Bean, MS.	— glabellus, Bean, MS.
— Arduennensis, D'Orbigny.	— conterminus, Bean, MS.
— binatus, Bean, MS.	— bipartitus, Zieten.
— Koenigi, Sowerby.	— Baugieri, D'Orbigny.
— Athleta, Phillips.	a Belemnites tornatilis, Phillips (=
— gemmatus, Phillips.	<i>B. Puzosianus</i> , D'Orbigny).
— Gulielmi, Sowerby.	a — hastatus, Blainville.
— Murrayanus, Simpson, MS.	a — gracilis, Phillips.
— Placenta, Bean, MS.	c Nautilus hexagonus, Sow.
— Lamberti, Sowerby.	

NOTE.—Of the foregoing list of *Ammonites*, one species *Am. alligatus* ascends to the Calcareous Grit above. All the others (except *Am. binatus*, of which a dwarfed variety is found in the Oxford Clay) are peculiar to the Kelloway rock.

Gasteropoda.

a Alaria bispinosa, Phillips.	b Turbo elaboratus, Lycett & Morris.
Natica (a cast).	Pleurotomaria guttata, Phillips.
b Chemnitzia vittata (?), Phillips	— arenosa, Bean, MS.
(imperfect casts).	b — granulata, Sowerby.
Cerithium abbreviatum (n. s.).	a — depressa, Phil.
— Culleni (n. s.).	— striata, Bean, MS.
b Littorina punctura, Bean, MS.	Patella? graphica, Bean, MS.
b — ornata, Sowerby.	a Actæon retusus, Phillips.
Turbo sulcostoma, Phillips.	c Dentalium annulatum, Bean, MS.

Brachiopoda.

b Terebratula ornithocephala, Sow.	Discina (Orbicula) centralis, MS.
c Rhynchonella varians, Schlotheim.	Mr. Bean's Collection.
Lingula levis, MS. Mr. Bean's	
Collection.	

Conchifera.

b Gryphæa bullata, Sowerby.	Ostrea undosa, Bean, MS.
c — dilatata, Sowerby.	— archetypa, Phillips.
c Anomia inæqualvis, Phillips.	c — Marshii, Sowerby.

- Ostrea canaliculata*, Bean, MS.
 — *procerula*, Bean, MS.
 — A peculiarly elongated smooth species approaching *Vulsella*.
 — *striata*, Bean, MS.
c *Pecten demissus*, Phillips.
b — *fibrosus*, Phillips.
c — *vagans*, Sowerby.
c — *abjectus*, Phillips.
c — *arcuatus*, Sowerby.
b *Lima duplicata*, Sowerby.
 — *Phillipsii*, D'Orbigny.
 — *notata*, Goldfuss.
c *Avicula inæquivalvis*, Sowerby.
a — *ovalis*, Phillips.
c — *Braamburiensis*, Phillips.
 — *clathrata*, Bean, MS.
b *Perna rugosa*, Goldfuss.
a *Pinna mitis*, Phillips.
c *Modiola dipartita*, Sowerby.
c — *cuneata*, Sowerby.
 — *pulchra*, Phillips.
a *Cucullæa æmula*, Phillips.
b — *elongata*, Sowerby.
b — *clathrata*, (n. s.).
 — *minima* (n. s.).
Solemya Woodwardiana (n. s.).
c *Nucula lacryma*, Sowerby.
c *Trigonia costata*, v. *pulla*, Sowerby.
c — *elongata*, Sowerby.
 — *flavellata*, Parkinson.

Crustacea, Annelida, &c.

- c* *Glyphæa rostrata*, Phillips.
c *Serpula intestinalis*, Phillips.
c Imperfect remains of *Cidaris* and
 Encrinal stems.

Remains of Vertebrata.

- c* Palatal bones and teeth of Fishes; and vertebræ, teeth, and bones of Saurians.

Vegetable Remains.

- c* Dicotyledonous wood and remains of *Cycadæa* (imperfect) are sometimes found in the Kelloway Rock of Scarborough.

NOTE.—In this list, the species marked *a* occur also in the bed above, or the Oxford Clay; the letter *b* indicates that the species are found in the bed below, or Cornbrash; *c*, that they are common to all the three deposits.

NOTES ON THE FOSSILS.

1. AMMONITES SUBLÆVIS, Sowerby.

Locality. Red Cliff only.

2. AMMONITES ORDINARIUS, Bean, MS.

This Ammonite approaches in general form *Am. Harveyi*, but the ribs bend more towards the aperture, and the increase of the volutions is somewhat greater. The angle formed by the ribs in passing over the back gives it a somewhat keeled appearance. Its claims for distinction as a species are weakened by the existence of many intermediate

- c* *Trigonia clavellata*; a variety, much less produced posteriorly, and with the tubercles crowded on the anterior margin.
b *Cardium cognatum*, Phillips.
b — *citrinoideum*, Phillips.
 — *subdissimile* (?), D'Orbigny.
a — *Crawfordii* (n. s.).
b *Lucina lirata*, Phillips.
 — *crassa*, Sowerby.
Corbis ovalis, Phillips.
 — *lævis*, Sowerby.
b *Astarte lurida*, Sowerby.
b — *minima*, Phillips.
b — *politula*, Bean, MS.
b *Unicardium depressum*, Phillips.
b — *sulcatum*, Bean, MS.
c *Isocardia tumida*, Phillips.
b — *minima* (?), Sowerby.
b — *triangularis*, Bean, MS.
 — ? *clarissima*, Bean, MS.
c *Anatina undulata*, Sowerby.
 — *versicostata*, Buwignier.
b *Pholadomya acuticosta*, Sowerby.
b — *ovalis*, Sowerby.
 — *carinata* (?), Goldfuss.
b *Myacites calciformis*, Phillips.
b — *decussatus*, Phillips.
b — *securiformis*, Phillips.
a — *recurvus*, Phillips.
c *Goniomya V-scripta*, Sowerby.
c *Gresslya peregrina*, Phillips.

gradations of form between it and *Am. sublævis*, all of which in the adult shell become smooth and hardly distinguishable from each other.

Localities. Near Gristhorpe Bay, and at Red Cliff.

3. AMMONITES RUGOSUS, Leckenby.

Gibbous, deeply umbilicated, ribs very thick and strong, separated by wider spaces. Aperture rounded, indented one-fourth by the succeeding whorl.

Locality. Near Gristhorpe Bay.

4. AMMONITES GOWERIANUS, Sowerby. Pl. I. fig. 1a-1d.

Young shells much resemble *Am. Calloviensis*, but in the adult the ornamented square back becomes rounded in this species.

5. AMMONITES REVERSUS, Leckenby (Simpson, MS.). Pl. I. fig. 2.

Discoid; of slight volutional increase, back rounded, ribs very sharply defined, bifurcating at the middle of the whorl, and then bending very decidedly from the aperture. Occasionally an entire rib is introduced. Aperture rounded. Scarcely indented by the succeeding whorl.

Locality. The Castle Rock, Scarborough.

6. AMMONITES VERTUMNUS, Leckenby (Bean, MS.). Pl. I. fig. 3a, 3b.

This Ammonite appears to approach most closely to *Am. Mariae*, D'Orb.; the ribs are strong and cord-like, forming coarse folds on the back.

Locality. Near Gristhorpe Bay.

7. AMMONITES POCULUM, Leckenby (Bean, MS.). Pl. I. fig. 4a, 4b, 4c.

Discoid; sides flattish, back rounded, ribs prominent near the inner margin, dying out before they reach the back, where their place is supplied by numerous slender ones, which pass uninterruptedly across it. In some specimens the ribs near the inner margin are so strong as to become tubercular. Aperture circular, slightly indented by the succeeding whorl.

Locality. Near Gristhorpe Bay.

8. AMMONITES CHAUVINIANUS, D'Orbigny.

I have referred this Ammonite to *Am. Chauvinianus* on the authority of Dr. Oppel, who identified it without hesitation.

Locality. The Castle Rock, Scarborough.

9. AMMONITES ALLIGATUS, Leckenby (Bean, MS.). Pl. II. fig. 2a, 2b.

Discoid; sides flattened, especially in the adult; back gently rounded; ribs numerous, entire on the sides of the whorl, bifurcating across the back; volutions deeply constricted at intervals, as in *A. rotula* and other species. Aperture subquadrate, scarcely indented by the succeeding whorl.

Localities. Near Gristhorpe Bay, and Scarborough Castle Rock.

10. AMMONITES ARDUENNENSIS (?), D'Orbigny.

Ammonites subtensis, Bean, MS.

The ribs are much more delicate and numerous than in D'Orbigny's figure, but there are no other distinctive features.

Locality. The Castle Rock, Scarborough.

11. AMMONITES BINATUS, Bean, MS.

This Ammonite approaches *Am. Bakeriæ*, but the foliations of the septa are much more simple, and in the adult the sides are flatter. In some examples, the opposing ribs do not meet in position on the back, but appear as if dislocated, and there is a flattish space intervening.

Locality. The Castle Rock, Scarborough.

12. AMMONITES KÖNIGI, Sowerby.

This is one of our most abundant Ammonites. Perfect specimens, 5 inches in diameter, are not uncommon, and I have seen fragments of individuals much larger.

Localities. Red Cliff, and Scarborough Castle Rock.

13. AMMONITES ATHLETA, Phillips.

The inner whorls of this species readily distinguish it from *A. perarmatus*.

Locality. Castle Rock, Scarborough.

14. AMMONITES GEMMATUS, Phillips.

This is an abundant, but most variable species. Specimens, 5 inches in diameter, are not uncommon. It passes into *Am. Duncani* by imperceptible gradations.

Localities. Near Gristhorpe Bay, and Scarborough Castle Rock.

15. AMMONITES GULIELMI, Sowerby.

Ammonites Rowlstonensis, Young and Bird.

This has also been an abundant and thriving Ammonite in the Callovian Sea. It is often marked in cabinets as *Am. Calloviensis*.

Localities. Near Gristhorpe Bay, and Scarborough Castle Rock.

16. AMMONITES MURRAYANUS, Simpson, MS.

Discoid; sides of the whorls flat; their inner margins squarish, of slow volitional increase, ribs slender, straight, with spines or tubercles on the outer margin. An inner row of tubercles on the outer whorl of aged examples. Aperture a parallelogram, more than twice as long as broad; not indented by the succeeding whorl. Diameter 12 inches; greatest thickness $\frac{3}{4}$ inch.

Locality. The Castle Rock, Scarborough.

17. AMMONITES PLACENTA, Leckenby (Simpson, MS.). Pl. II. fig. 1.

Slightly gibbous; inner volutions nearly concealed; principal ribs curving regularly and gracefully towards the aperture, occasionally bifurcating, but more frequently entire, with two or three shorter ones introduced between them, which all pass over and form a cre-

nulated back or keel. Aperture elliptical, two-thirds indented by the succeeding whorl.

Locality. The Castle Rock, Scarborough.

18. AMMONITES FLEXICOSTATUS, Phillips.

Localities. Throughout the entire range.

19. AMMONITES LAMBERTI, Sowerby.

Ammonites longævus, Bean, MS.

This Ammonite approaches *Am. flexicostatus*, but in *flexicostatus* there are two or three smaller ribs between each principal one; whereas, in *Am. Lamberti*, they simply bifurcate, and are much less incurved than in the former species.

Locality. The Castle Rock, Scarborough.

20. AMMONITES PUTEALIS, Leckenby (Bean, MS.). Pl. II. fig. 3a-3c.

Discoid; whorls rounded near the umbilical margin, flatter in the middle, and again rounded towards the keel; ribs prominent, obtuse, occasionally bifurcate, slightly undulating, and finally bending towards the aperture, where they become enlarged, but do not pass over the back; keel prominent. Aperture indented $\frac{1}{3}$ th by the succeeding whorl.

Locality. The Castle Rock, Scarborough.

21. AMMONITES TURGIDUS, Bean, MS.

This is not a satisfactory species; the outer whorl is entirely devoid of ornamentation, and may probably be the adult stage of the preceding, or some other species. Without an examination of the inner whorls the question cannot be decided.

Locality. The Castle Rock, Scarborough.

22. AMMONITES GREGARIUS (?), Bean, MS.

Except in its greater comparative thickness, which renders the umbilicus deeper, and the somewhat more robust character of the ribs, I cannot distinguish this from *Am. flexicostatus*.

Locality. South side of the Castle Rock, Scarborough.

23. AMMONITES LUNULA, Zieten.

This species, which is not uncommon, agrees so well with the description and figures of D'Orbigny, as to leave no doubt of its identity.

Locality. North side of Scarborough Castle Rock.

24. AMMONITES CHAMUSSETI, D'Orbigny.

Ammonites lenticularis, Phillips.

Locality. Red Cliff only.

25. AMMONITES FUNIFERUS, Phillips.

This is a much more depressed species than *Am. Chamusseti*, and the intricate character of the foliations of the septa also distinguish it.

Locality. Red Cliff only.

26. *AMMONITES HYPERBOLICUS*, Leckenby (Simpson, MS.).

Pl. II. fig. 4a, 4b.

This, on the contrary, is so much thicker than *Am. Chamusseti* as to be nearly globular. The outer whorl entirely envelopes the umbilicus; and the keel, which is not crenulated, is nearly obsolete.

27. *AMMONITES GLABELLUS*, Leckenby (Bean, MS.). Pl. II. fig. 5a-5c.

Discoïd; sides of the whorl smooth, or nearly so, having only faint distant undulations, which are most conspicuous towards the keel: back, a sharp keel becoming rapidly obtuse with age; aperture elliptical, deeply indented by the succeeding whorl.

Locality. Scarborough Castle Rock.

28. *AMMONITES CONTERMINUS*, Bean, MS.

Discoïd; whorls flattened, their inner margin perpendicular, their outer margins rounded towards the back: ribs sigmoidal, bifurcating in the middle of the whorl, and terminating near the outer margin; keel slightly elevated; aperture ovate, slightly indented by the succeeding whorl.

Localities. Scarborough Castle Rock, and near Gristhorpe Bay.

29. *AMMONITES BIPARTITUS*, Zieten.

Locality. Scarborough Castle Rock.

30. *AMMONITES BAUGIERI*, D'Orbigny.

Locality. Near Gristhorpe Bay only.

The last two species agree exactly with the descriptions and figures of D'Orbigny.

PLEUROTOMARIA ARENOSA, Leckenby (Bean, MS.). Pl. III. fig. 1a, 1b.

Trochus arenosus, Bean, MS.

Shell conical, imperforate?; whorls (6 or 7) flat, transversely and longitudinally ribbed, giving the shell a somewhat decussated appearance; at the lower portion of each whorl is a prominent band, formed of four strongly undulating nodular ridges, then two finer lines; these are succeeded by a smooth space, along the centre of which is the raised sutural band, somewhat crenulated; the remainder of the whorl occupied by eight or nine transverse wavy lines, crossed by oblique longitudinal finer ones, which are more prominent at distant intervals.

This species is closely allied to the *Pleurotomaria Galathea*, D'Orb. Pal. Frang. Terr. Jurassique, pl. 423. fig. 1-4.

Locality. Castle Rock, Scarborough.

PLEUROTOMARIA STRIATA, Leckenby (Bean, MS.). Pl. III. fig. 2a, 2b.

Cirrus striatus, Bean, MS.

Shell depressed, umbilicate?; whorls four, tabulated; keel slightly prominent, transversely ridged and crossed by numerous very fine oblique, irregularly undulating, raised lines, which pass uninterruptedly over the keel.

Locality. Castle Rock, Scarborough.

PATELLA? *GRAPHICA*, Leckenby (Bean, MS.). Pl. III. fig. 3a, 3b.

Shell oval, obliquely conical; apex very excentric, and marked by many radiating impressed lines, which become somewhat obsolete towards the margin.

Locality. Castle Rock, Scarborough.

CERITHIUM ABBREVIATUM, sp. nov. Pl. III. fig. 12.

Shell short, turreted, with about nine flattened volutions, and the suture distinct; height of the whorls only half their breadth, each with four rows of encircling costæ, and eight or nine elevated perpendicular spinose ribs; the ribs pass across the volutions obliquely from right to left; each rib has four large, prominent, obtuse, but rather irregular and unequal tubercles, which give to the shell a rugged aspect. Length about 7 lines, of which one-fourth is occupied by the aperture.

Locality. The Castle Rock, Scarborough.

CERITHIUM CULLENI, sp. nov. Pl. III. fig. 13.

Shell turreted, volutions eleven or twelve, compressed, somewhat angular at their junctions; their height is three-fourths the breadth, each having four rows of transverse costæ, undulated by the twelve or thirteen longitudinal ribs, and which run perpendicularly from the base to the apex.

It differs from *C. muricatum*, to which it bears some resemblance, in its less rapid volutional increase, and in the smaller number of its longitudinal costæ, which are also quite straight, and not bent in the middle of each volution, as in that species.

Named after Mr. Peter Cullen, the indefatigable collector of fossils at Scarborough.

Locality. The Castle Rock, Scarborough.

CHEMNITZIA LINEATA, sp. nov. Pl. III. fig. 14.

Shell turreted, smooth to the naked eye; whorls eight or nine, moderately convex, most delicately striated transversely, with an elevated line at the top of each whorl; the sutural line is well defined. Length $\frac{1}{2}$ in.

CUCULLÆA CLATHRATA, sp. nov. Pl. III. fig. 4.

Shell elongate, very inequilateral; beaks prominent, anteriorly rounded, posteriorly impressed, truncated, and obtusely carinated; surface ornamented with numerous close small ribs (larger on the posterior margin) crossed by the numerous concentric lines, giving the shell a very decussated appearance. The anterior margin is not marked with the more prominent ridge, usually occurring in this genus.

Locality. The Castle Rock, Scarborough. This species also occurs in the Cornbrash below.

CUCULLÆA MINIMA, sp. nov. Pl. III. fig. 5.

Shell small, somewhat quadrate, ventricose, nearly equilateral,

slightly carinated posteriorly, marked by numerous concentric ridges, finely decussated by many radiating impressed lines, giving the surface a punctated appearance.

Locality. The Castle Rock, Scarborough.

SOLEMYA WOODWARDIANA, sp. nov. Pl. III. fig. 7.

Shell transverse, elliptical, compressed posteriorly, short and rounded anteriorly; the ribs (eight or nine) on the posterior side prominent and granulated, those on the anterior side somewhat obsolete.

This interesting species, of a comparatively rare recent genus, is closely allied to the *Solemya Voltzii*, Rømer (Verst. Nord. Oolithen-Gebirges, pl. 19. f. 20).

Locality. North side of the Castle Rock, Scarborough.

UNICARDIUM SULCATUM, Leckenby (Bean, MS.). Pl. III. fig. 11.

Shell ovate, ventricose, inequilateral; anterior and posterior sides rounded, concentrically but irregularly sulcated; umbones prominent.

Locality. South side of the Castle Rock, Scarborough.

CARDIUM COGNATUM, Phillips. Pl. III. fig. 8a, 8b.

We have figured a more perfect example than the type-specimen of Professor Phillips, showing the ornamentation of the posterior area. It was only by comparison with the original specimen that the species could be identified.

CARDIUM CRAWFORDII, sp. nov. Pl. III. fig. 9a, 9b.

Shell subequilateral, ventricose, compressed towards the margins; umbones prominent; surface smooth, or with very faint concentric striæ; the posterior area ornamented with about fifteen longitudinal ribs; the middle ribs are the largest and more apart, and appear somewhat scabrous; they disappear or become quite faint before reaching the posterior edge; there is no definite ridge at the junction of the posterior area with the dorsal surface; the posterior margin is slightly angulated, and its junction with the ventral margin well defined; this, and the anterior margin, are gently rounded.

Named after Mr. W. B. Crawford, to whose exertions I am indebted for many fine specimens.

Locality. The north side of the Castle Rock, Scarborough.

ISOCARDIA (?) CLARISSIMA, Leckenby (Bean, MS.). Pl. III. fig. 10a, 10b.

Shell subtrigonal; umbones prominent and incurved; the surface smooth where the shell remains; posterior area flattened, its junction with the dorsal defined by a ridge; anterior margin slightly produced and gently rounded; posterior margin angulated.

Locality. The north side of the Castle Rock, Scarborough.

P.S. I am indebted to Professor Morris for much valuable assistance in the identification of species, and in preparing the descriptions of several of the new ones.—J. L.

DESCRIPTION OF PLATES I., II., III.

Illustrating some Fossils of the Kelloway Rock of Yorkshire.

PLATE I.

- Fig. 1a. *Ammonites Gowerianus*, Sow.; nat. size. (A portion entire.)
 1b. ———. At a more advanced period of growth; nat. size.
 1c. ———. Shape of the aperture.
 1d. ———. Suture.
 2. *Am. reversus*, Leckenby (Simpson, MS.); nat. size.
 3a. *Am. Vertumnus*, Leckenby (Bean, MS.); nat. size.
 3b. ———. Outline of front view.
 4a. *Am. poculum*, Leckenby (Bean, MS.); nat. size. (A portion entire.)
 4b. ———. Older and thicker form; nat. size.
 4c. ———. Suture.

PLATE II.

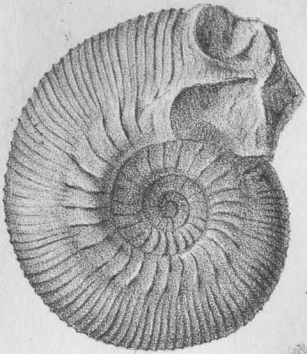
- Fig. 1. *Ammonites placenta*, Leckenby (Bean, MS.); nat. size.
 2a. *Am. alligatus*, Leckenby (Bean, MS.); nat. size.
 2b. ———.
 3a. *Am. putealis*, Leckenby (Bean, MS.); nat. size.
 3b. ———. Form of the aperture. In the specimen here figured, the siphuncle is not symmetrically placed, the dorsal lobe being on the left of the keel.
 3c. ———. Suture.
 4a. *Am. hyperbolicus*, Leckenby (Simpson, MS.), side view; half nat. size.
 4b. ———. Front view, showing aperture.
 5a. *Am. glabellus*, Leckenby (Bean, MS.).
 5b. ———. Shape of the aperture.
 5c. ———. Suture.

PLATE III.

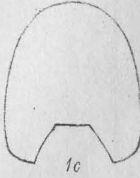
- Fig. 1a. *Pleurotomaria arenosa*, Leckenby (Bean, MS.); nat. size.
 1b. ———. Enlarged view of part of a suture and ornament.
 2a. *Pl. striata*, Leckenby (Bean, MS.). Upper view of spire.
 2b. ———. Side view.
 3a. *Patella? graphica*, Leckenby (Bean, MS.); nat. size. Upper view.
 3b. ———. Side view.
 4. *Cucullæa clathrata*, Leckenby; two thirds of nat. size.
 5. *Cucullæa minima*, Leckenby; nat. size.
 6. *Anatina versicostata*, Buvignier; nat. size.
 7. *Solemya Woodwardiana*, Leckenby; nat. size.
 8a. *Cardium cognatum*, Phillips; nat. size. View of left valve.
 8b. ———. View of the hinge-area.
 9a. *Cardium Crawfordii*, Leckenby; nat. size.
 9b. ———. View of the hinge-area.
 10a. *Isocardia? clarissima*, Leckenby (Bean, MS.); nat. size.
 10b. ———. View of the hinge-area.
 11. *Unicardium sulcatum*, Leckenby (Bean, MS.); nat. size.
 12. *Cerithium abbreviatum*, Leckenby; enlarged.
 13. *Cerithium Cullenii*, Leckenby; enlarged.
 14. *Chemnitzia lineata*, Leckenby; enlarged.

AMMONITES GOWERIANUS (p. 9). *Localities.* Red Cliff and the south side of Scarborough Castle Rock.

AMMONITES HYPERBOLICUS (p. 12). *Locality.* Red Cliff.



1a



1c



1b



1d



2



3b



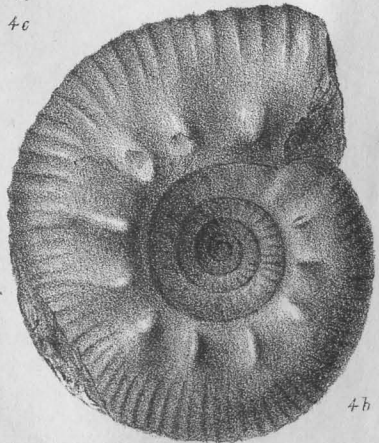
3a



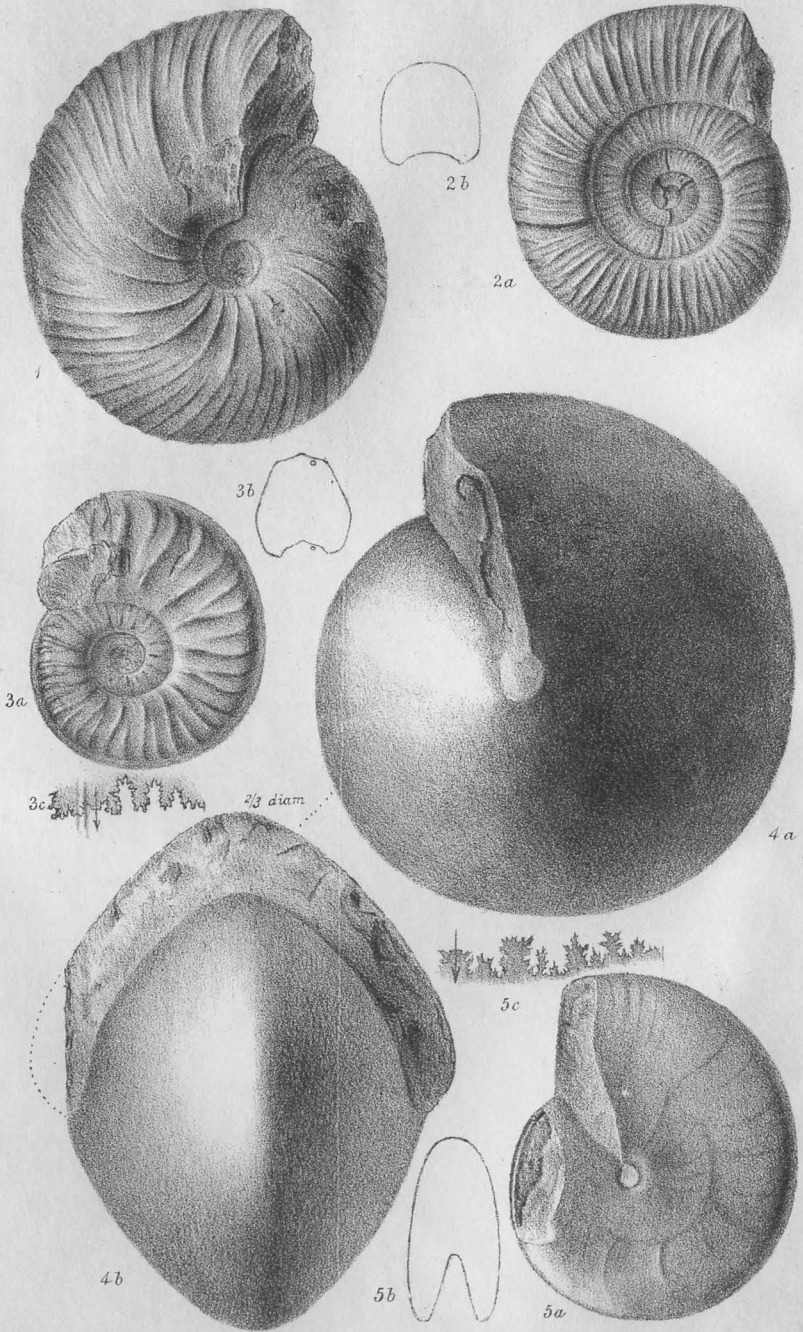
4c

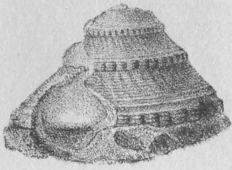


4a

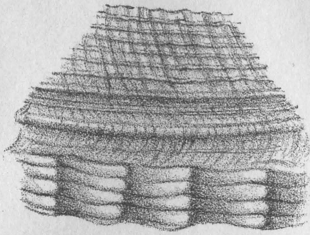


4b





1a



1b



2a



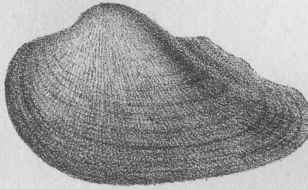
3a



2b



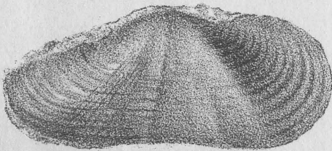
3b



4



5



6



7



12



8a



14



8b



13



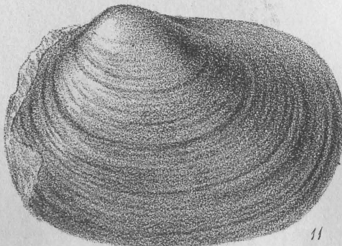
9a



10a



9b



11



10b