Edw. and H., but it presents some peculiarities which render its reference to *Alveolites* not altogether certain. It is distinguished by the remote fissure-like calices with nearly parallel walls, and

FIG. 3.—A fragment of the upper surface of *Alveolites Selwynii*, Nich., magnified.
From the Corniferous Limestone.

by the absence of any distinct concentric arrangement of the coral-lites. In the shape of the calices, it somewhat resembles *Cænites labrosus*, Edw. and H.; but it is in reality very different, both in its general form and its real structure.

I have only seen a single example of the species. It is dedicated to Alfred R. C. Selwyn, Esq., F.G.S., the Director of the Geological Survey of Canada.

Locality and Formation.—Corniferous Limestone, Port Colborne.

(To be continued in our next number.)

VI.—THE ISLE OF THANET. THE AMMONITE ZONE, THE DEPTH OF THE CHALK IN SECTION, AND THE CONTINUITY OF ITS FLINT FLOORINGS.

By F. A. BEDWELL, M.A., F.R.M.S.

IN the summer of this year I laid before the Geologists' Association some particulars of fourteen large Ammonites which I had found in the Chalk cliffs east and west of Margate. The following is the result of three weeks' further work on these cliffs.

There are 89 Ammonites or remains of Ammonites to be seen *in situ* between Cliff End, Birchington, and Kingsgate Bay. I have marked on the cliff itself the position of each of the 89, by placing on the Chalk a black cross thus + at a point on the eye level, which is as nearly as possible "three yards to the eastward of a perpendicular line passing through the Ammonite itself." When two or more lie near each other, I have indicated the fact by adding dots to the cross; and in one case where I have removed an Ammonite, I have placed a circle with a dot in the centre on the spot, and in another instance in a cave the cross is placed close to the specimen itself. I have measured the depth and height of each Ammonite, the first relatively to a "datum line" and the second relatively to the sand line. The "datum line" which I selected is the only one available; it is a line of nodular flints which is exhibited nearly continuously from Birchington to Kingsgate. It is in fact a line which actually guided me to the majority of the Ammonites; and although it is in some places difficult to decipher, yet it has very distinct characteristics of its own. It is nearly always double, and its indi-

vidual flints seldom run large, and are separated from each other, generally by a foot of chalk, frequently by much more, but seldom by less. The minimum distance below it at which I have found a specimen is 4ft. 6in. and the maximum 60ft. 3in. Referring to this band as a "datum line," and grouping in six different "averages" all the 89 various measurements so taken, the following particulars are obtained.

TABLE OF AVERAGE DEPTHS OF AMMONITES BELOW "DATUM LINE."

No. of Specimens.	Average depth below "datum line."		Greatest depth.		Least Depth.		Depth Unknown.
	ft.	in.	ft.	in.	ft.	in.	
8	6	8	8	0	4	6	
32	12	0	14	6	9	0	
6	16	8	17	9	15	6	
25	20	2	22	3	18	0	
11	25	2	27	5	23	5	
4	32	9	35	0	31	1	
1	46	9	...	...	...	...	
1	60	3	...	...	...	...	
1	...	...	...	...	...	...	
89							

It will be seen from these figures that the 12-foot line and the 20-foot line both represent periods of special maximum development. Indeed seven of the specimens on the 12-foot line lie in a space of 200 yards, and three of them almost touch each other, and look very much as if they had actually "died together."

The large majority of the specimens are referable to *Ammonites leptophyllus*. I identified thirty-five of this kind. I also identified four as *A. Levesiensis*, and one as *A. peramplus*.¹ The rest are indistinct.

In addition to these particulars, I am also able to give exact detailed

FIG. 1.—Outline of Isle of Thanet, showing the distribution of Ammonites along the coast.

¹ But query if these three forms are not identical. I have a flint cast in my possession which looks very much as if it united all three forms in its markings. See also Sharpe's *Mollusca*, Pal. Soc.

measurements of the whole of the Chalk seen in section along the cliffs of the Island, and these details will be found in the accompanying tabular statement. Altogether there is a depth of 180 feet of

FIG. 2.—Cliff-section from Birchington to Kingsgate.

FIG. 3.—Cliff-section from Kingsgate to Pegwell.

chalk in the section; the highest is seen at Foreness (point O in Sketch-map), and the lowest is seen at the bottom of the cliffs, just before the turn to Pegwell (point C).

Out of the whole 180 feet, the Ammonite zone, according to the position of the specimens found up to the present time, covers a depth of between 55 and 56 feet. I have searched for specimens in the chalk above and below these boundaries, but at present without success. Strange to say, the Ammonite zone, so far as I have now identified it, will be found to coincide with chalk, in which there are no lines of flint; individual flints occur rarely throughout the area of the zone, and bursts or spurts of flint show themselves here and there, and sometimes in connexion with the Ammonites themselves; but excepting just above the lower boundary of the zone, there are no lines of flints exhibited in it, and at present it looks as if the appearance and disappearance of the Ammonites was coincident with the disappearance and re-appearance of the flint lines.

The various undulations of the Chalk are shown in the accompanying sections, which, however, are necessarily much curtailed in point of detail.

The three uppermost bands of flint indicated in the accompanying table appear in various places between Birchington and Kingsgate; and wherever they are seen, they always preserve their relative distances and peculiar features. They are all more or less alike in appearance—the flints in the two upper lines being larger than those in the lowest line.

At Kingsgate and the North Foreland respectively, two bands are

to be seen rising out of the sand line, which require a very special notice. They are separated from each other by a depth of 31 feet. The upper of these forms an almost solid "floor" of flint of about 3 to 4 inches thick, which underlies the whole Isle of Thanet. Here and there it is pierced by small irregular rings or pockets of chalk, which appearing at uncertain intervals, check its absolute continuity; but its general aspect is that of a rigid, inflexible, almost rocky flooring. Three well-diggers independently informed me that they knew it all over the island, and they pronounced it as having always the one aspect above described; one of them had pierced it as far west as Westgate. It is seen rising up to the beach line in an altogether unexpected manner at the point P in the map and section, which is a spot at the back of Margate Harbour, close to where the carriage-road runs down under a bridge on to the sands. It does not appear again until we reach Kingsgate, and there it rises once more, and then runs along the face of the cliff by a series of faults to Pegwell, and there sinks again below the sand line. It must have a decided influence on the drainage of the island, and particularly on that of Margate, to the lower part of which I believe it forms a natural and nearly impermeable floor, and accounts for the condition in which I have sometimes seen portions of that town.

The line of flint mentioned as rising at the Foreland lies 31 feet below this "three-inch band," and it is equally remarkable. It is a foot and even more thick, but is wholly different in appearance from the other. It is like a large mass of irregular honeycomb, or ant's nest or wood which has been extensively bored by some huge xylophagous mollusc. But its chief peculiarity is this, that from it at irregular intervals spring perpendicularly columns of flint similar in constitution to itself, and extending to a height of a foot or a foot and a half, and sometimes even uniting it with the line of flint next above, and making one think for a moment of a honeycombed "potstone."

Mr. Whitaker has mentioned the "three-inch band" in his *Geology of the London Basin*, and he states there that it is to be seen at the top of the cliffs between Deal and Dover, surmounted by a portion of the Isle of Thanet Chalk. I am able to confirm this statement by a piece of evidence which puts it, I think, beyond all doubt. On recently visiting the cliffs at Old Stairs Bay, beyond Walmer, I found that they are very high and inaccessible, but that undoubtedly there is a line at the top of the cliff there which, in appearance, bears a most striking resemblance to the "three-inch band" of the Isle of Thanet; and, like that band too, it preserves its peculiar characteristics undeviatingly up to the moment when it leaves the cliff, at St. Margaret's Bay. Now on dropping the eye, in its progress along the cliffs beginning at Old Stairs Bay, to a depth of about 30 feet below the band in question, there will be seen a rich band of flint, with "columns" arising from it at irregular intervals, precisely in the same manner as may be seen at the North Foreland. And thus these two lines of flint serve to identify each other at the two localities in a very remarkable manner; and I think there can

be no doubt that they were respectively all at one time continuous and in the same horizontal plane.

The distance from Margate Harbour to St. Margaret's Bay is about nineteen miles, and from Kingsgate to Westgate is six miles; and here then we have evidence of lines of flint being formed over an area of at the least about 120 square miles—"by chemical processes identical and simultaneous in their modes of operation." But, at the same time, it would be no unfair deduction to take at least the square of 20 miles as the probable minimum extent of the field represented by the section thus exhibited to view; while I cannot help anticipating that these and other bands will hereafter be identified over a very much more extended area even than 400 square miles.

To return to the Ammonites, many of them are well worth a visit; one in particular is a magnificent basin, four feet at least in diameter if not more, and out of which the sea has worked the chalk, showing the contour of many of the chambers, and exposing to view a natural internal section of a portion of the shell. It lies between the points *i* and *s* on the map, and is on a low platform of rock just under the name of Mr. K. Loder, a gentleman who has added lustre to his name by unconsciously associating it, in letters of appropriate proportions, with this gigantic natural relic.

Should any geologist desire to visit the section, I shall be happy at any time to furnish him with exact details, which will enable him more easily to find all the Ammonites. A letter addressed to "Lincoln's Inn" will be sufficient.

On reference to the sections, it will be seen that I have figured the Ammonite-bed as appearing in three different places between Kingsgate and Pegwell; not that I have found any Ammonites *in situ* in those three places, though I found a fragment on the beach between the points *i* and *k*, but the chalk, at the three places which are indicated by the shading, brings, by its undulations, the Ammonite-bed on to the face of the cliff at these points. When we reach Pegwell itself, the Ammonite-bed is clearly represented for nearly half a mile; and four specimens have been found there *in situ*, by Mr. Leonard Wray, jun., of Ramsgate, who has, I believe, marked their position for me with the letter W. At Pegwell Bay 51 feet of the chalk, which is to be seen on the Margate cliffs, is wanting, and has been carried off the upper portion of the cliff.

The total depth of the chalk in section is obtained by the following addition: $Oo + Nn + Cc = 32 + 74 + 74 = 180$,—the heights *Oo*, *Nn*, and *Cc*, being the three lines thus figured in the accompanying sections, and which I measured with a plumb-line and measuring-rod.

The upper edge of the shaded band represents the "datum line," being the line of flints which guided me to the Ammonites; the lower edge of the shading gives a line of flints in which the lowest Ammonite appears.

I have added a table showing the distribution of the specimens, 93 in all, along the whole section.

TABULAR STATEMENT OF CHALK SEEN IN SECTION IN THE ISLE OF THANET.

Feet.	Details.	Exhibited at	Remarks.
0	Highest Chalk in section.	Foreness.	
12	Nodular line of Flints.		
22	Ditto.		
32 36.6	Ditto, guiding to Ammonites Upper limit of Ammonite Bed. Oct. 1873.	Near Marsh Bay.	No lines of Flint.
51	Highest Chalk in section at Pegwell.	Pegwell.	
85	Yellow Band of Chalk (Whitaker).	{ Kingsgate to Pegwell.	
92	Lower limit of Ammonite Bed. Oct. 1873.	{ Apple Bay, Kingsgate, and Pegwell.	
106	"Three-inch Band" of Flints.	{ Kingsgate to Pegwell.	
137	Columnar Band.	{ North Foreland.	Many lines of Flint.
180	Lowest chalk in section.	Near Pegwell.	

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EXPLANATION OF FIGURES ILLUSTRATING PAPER ON ISLE OF THANET CHALK.

Fig. 1.—Sketch-map of Isle of Thanet.

Fig. 2.—Cliff Section from Birchington to Kingsgate.

Fig. 3.—Cliff Section from Kingsgate to Pegwell.

The shaded part represents the Ammonite Bed, bounded on the upper edge by the guiding line of flints.

-----	The Three-inch band of flints.
+++++	The columnar band of flints.
a. Tertiary bed.	l. North Foreland.
b. Pegwell fault at which Tertiaries begin.	m. Joss Stairs.
c. A point a little east of Landing-stage, Pegwell. Lowest point of chalk.	n. White Ness.
d. West Cliff Terrace.	o. Fore Ness.
e. Ramsgate Harbour.	p. First Gangway, east of large Flag-staff.
f. Various faults.	q. Jetty-end of Cliff, Margate.
g. Dumpton Stairs.	r. Explained in text.
h. Dumpton Point.	s. Infirmary end of Cliff, Margate.
i. Broadstairs.	t. Marsh Bay.
k. Stone Stairs.	u. Apple Bay.
	v. Birchington.

TABLE SHOWING DISTRIBUTION OF AMMONITES IN THE SECTION.

Points marked in Sketch-map.	Distance. Miles.	Number of Specimens.
u to s	2¾	27
s to r	1¼	17
r to q	¾	No cliff.
q to p	1	24
p to l	2¼	21
l to e	4¾	None found.
e to b	½	4
	13	93

VII.—ON THE FORMATION OF MOUNTAINS. A REPLY TO THE REV. O. FISHER.

By Capt. F. W. HUTTON, F.G.S.

IT was with great interest that I read in the *GEOLOGICAL MAGAZINE*, Vol. X. for June, 1873, the Rev. O. Fisher's able paper on the Formation of Mountains; and although I cannot altogether agree to his reasoning, I have to thank him for re-calculating, more correctly no doubt than I have done, my table of the altitude of domes, and also for explaining several points which I had not clearly conceived before. Nevertheless, I think that I shall be able to show that his arguments against the theory that I have advocated¹ are not well founded.

For the sake of conciseness, I will, in what follows, call the theory that Mr. Fisher advocates the "Contraction theory," meaning thereby the theory of the formation of mountains by the secular cooling and contraction of the earth; while I will call the theory that I advocate

¹ On the Phenomena of Elevation and Subsidence, *Phil. Mag.*, Dec. 1872, and on the Formation of Mountains, *Geol. Mag.*, April, 1873, p. 166.