details of which were kindly given me by Mr. T. Hay Wilson, I should estimate the thickness of the London Clay at High Beach at rather more than 400 ft.

Turning eastward from High Beach the party made their way to Loughton Camp. The other pre-historic camp of Epping Forest, known as Ambresbury Banks, has long been known to archaeologists, but Loughton—or, as it is sometimes called, after its discoverer, “Cowper’s”—Camp remained unknown till 1872, when it was accidentally discovered. It is about two miles south-west of Ambresbury Banks. Both camps have been carefully examined by the Essex Field Club, and an account of the exploration of the Loughton Camp may be seen in *Trans. Essex Field Club*, vol. iii, p. 214 (1884). Its position is one of much greater natural strength than that of Ambresbury Banks, and Mr. W. Cole, who had been a member of the exploration Committee, gave some account of it and of the interesting objects found. Many flint flakes, cores, and one implement were discovered, besides many fragments of rude, hand-made pottery, apparently of pre-Roman date. From the camp, looking southward, the party enjoyed a fine view over the woodland, and then made their way to Loughton Railway Station.

The Director has pleasure in acknowledging the services of Mr. W. Cole and of Mr. T. Hay Wilson in connection with this Excursion.

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EXCURSION TO CHIPPENHAM, CALNE, KELLAWAYS, AND CORSHAM.

WHITSUNTIDE, 1896.

Directors: REV. H. H. WINWOOD, M.A., F.G.S., and

H. B. WOODWARD, F.G.S.

Excursion Secretary: THOS. LEIGHTON, F.G.S.

(*Report by* THE DIRECTORS.)

I.—CHIPPENHAM AND KELLAWAYS.

By H. B. WOODWARD.

LEAVING London by a mid-day train on Saturday, May 23rd, the members of the Association arrived at about 2 o'clock at Chippenham Station, where they were met by the Director. Luggage having been sent on to the Angel Hotel, and lunch having been
 [JULY, 1896.]

obtained at the railway station, the members were conducted to a small pit in the Cornbrash near by. The rock presented its usual characters of rubbly limestone, with *Avicula echinata* and other fossils.

Proceeding along the lane north-eastwards to Cocklebury Farm, the party ascended the slope which here and elsewhere to the south of Chippenham forms the escarpment of the Kellaways Beds. In the adjoining cuttings of the Great Western Railway and its branch to Calne the presence of sandy strata might here and there be observed, but as in the case of the South Cerney cutting visited by the Association in 1888,* the Kellaways Beds are seldom, if ever, to be detected at the surface in any natural outcrop, though their presence is indicated by a gentle escarpment, that rises about 50 feet. Proceeding across the meadows south of Rawlings and Peckingell Farms the members arrived at a deep water-course about half a mile below Kellaways Bridge on the right bank of the river Avon. Here beneath a thin alluvial deposit there was to be seen a thick bed of calcareous sandstone full of fossils, and underneath it brown and blue sandy and ochreous clays, with *Gryphæa bilobata*, exposed to a depth of 5 feet. This section, as remarked by the Director, was probably as good an exposure of the Kellaways Rock of Kellaways as any that had been opened in the past. By kind permission of Mr. Caleb Webber, of Upper Peckingell Farm, the members were allowed to scramble about the banks and break up the blocks of rock that were exposed, Mr. Webber himself having removed some fencing that prevented free access to the sections.

The Director mentioned that the fossils of "Calloway Bridge" had attracted the attention of Lhwyd, in 1699, and they had subsequently been described and figured by William Smith in his *Strata Identified by Organized Fossils*, and by the Rev. Joseph Townsend, in his geological work entitled *The Character of Moses*. The fact is that in old days the rock was quarried for road-metal, and the organic remains naturally came under the notice of travellers. Mr. William Cunnington (formerly of Devizes) had informed the Director that there was an old quarry "close to the road, on the north side, not far from the bridge, and the sides of the quarry were about 4 feet high." Mr. John Rhodes, Fossil Collector to the Geological Survey, had in 1887 found an old man who had informed him that the Kellaways Rock was worked on the Langley Burrell side of the Avon, about two or three hundred yards south of Kellaways Bridge. The rock was said to be about 6 feet thick, but no stone had been quarried for about thirty years, and the ground had long been levelled.

The Director pointed out that above the Cornbrash there was usually some 12 to 20 feet of ochreous and sandy clay, on top of

* *Proc. Geol. Assoc.*, vol. x, p. 157.

which there were bands of calcareous sandstone, sometimes in the form of doggers, sometimes in more persistent bands of shelly stone, and these alternated with clays and sands, attaining a thickness of 20 or 30 feet or more. In mass the Kellaways Beds thus formed an irregular basement-bed to the Oxford Clay. The rock-beds were hardly recognisable in Dorset, but they had been detected here and there in Somerset. The characteristic zonal fossil was *Ammonites calloviensis*. Specimens of this fossil were obtained by the members, who lost no time in setting to work at the tempting beds of rock that were exposed. In the end the following species were obtained by them, and (as in other instances) they were named by the President (Mr. E. T. Newton, F.R.S.):

<i>Ammonites calloviensis</i> .	<i>Pecten fibrosus</i> .
" <i>Kœnigii</i> .	" <i>lens</i> .
<i>Belemnites Owenii</i> .	<i>Placunopsis semistriata</i> .
<i>Cerithium muricatum</i> .	<i>Rhynchoneilla varians</i> .
<i>Avicula inæquivalvis</i> .	<i>Waldheimia obovata</i> .
<i>Gryphæa bilobata</i> .	" " var. resembling
<i>Modiola</i> sp.	<i>maxillata</i> .
<i>Myacites recurva</i> .	<i>Waldheimia ornithocephala</i> .

The foot-bridge that here crosses (or should cross) the Avon was now found to be broken down, and marked: "Unsafe. By Order," one end of the wooden structure having fallen into the water, consequently the members had a rough scramble to get across. The passage was, however, successfully accomplished, and the party proceeded to Kellaways Bridge, and then visited a small gravel-pit on the western side. Here about 5 feet of gravel was exposed. It was formed chiefly of flat pebbles of local oolitic limestones, with a small percentage of flints. The Director remarked that remains of Mammoth had been recorded from the gravel at Christian Malford, while lower down the Avon valley other Pleistocene Mammalian remains had been found. Hence there was a chance of getting palæolithic implements, although none had as yet been discovered. Proceeding through Langley Burrell and down Pew Hill towards Chippenham, the party was conducted by Land's End and along the stony Gaston Lane over the Cornbrash to the Lowden Hill brickyard.

Here some of the species of fossils, previously obtained from the Kellaways Rock, such as *Myacites recurva*, were found in the sandy clays, and it was evident that the beds formed a portion of the Kellaways division, near the base of the Oxfordian formation. Some fine septaria were to be seen, but none of the hard beds of shelly stone that constitute the Kellaways Rock.

In the course of the evening the Director drew attention to some of the geologists associated with the district. He remarked that there were two reasons for their excursion: the district had

not before been visited by them, and it was a classical region for the geologist. One of the earliest Wiltshire writers who had given attention to geology was John Aubrey, F.R.S., who in his *Natural History of Wilts*, written between 1656 and 1691, observed, "I have often times wished for a mappe of England, coloured according to the colours of the earth; with markes of the fossiles and minerals." The same writer pointed out that the character of the "Indigenæ" varied according to the several sorts of earth in England, being respectively witty or dull, good or bad. North Wiltshire being "a dirty clayey country" the Indigenæ were said to be slow and dull, and heavy of spirit, melancholy, contemplative, and malicious; "by consequence whereof come more law suites out of North Wilts, at least double to the southern parts." Matters no doubt have changed since then! Coming to later times mention was made of Townsend and Wm. Smith, the latter of whom was consulted during the construction of the Wilts and Berks Canal. Sedgwick had in 1820 learnt some of his earlier field-lessons in a traverse from the Chalk hills near Marlborough and Devizes to the Oolitic valleys near Bath. Lonsdale had given us some of the first and best detailed sections of the Oolites. In those early days the Great Bath Road from London ran through Hungerford, Marlborough, Calne and Chippenham; and the coaches starting from the Angel Inn, St. Clement's, Strand, from Belle Sauvage, Ludgate Hill, from the Bolt-in-Tun, Fleet Street, or from the George and Blue Boar, Holborn, took some twelve hours in reaching Chippenham. The Great Western Railway had done much to add to the geological fame of Chippenham. Long trenches had been made alongside the railway near Christian Malford to obtain material for the embankments. These trenches, dug in the Oxford Clay, had yielded a remarkable series of fossils belonging to the zone of *Ammonites ornatus*. The Ammonites had been described by S. P. Pratt, who at one time resided at Bath. The species of *Belemnites* and *Belemnoteuthis* had been described and discussed by Owen and Mantell and Chaning Pearce; and the fishes had been described by Egerton. The Cephalopods in particular, were beautifully preserved, and in the case of the *Belemnoteuthis*, S. P. Woodward says, "In the fossil calamary of Chippenham, the shell is preserved along with the muscular mantle, fins, ink-bag, funnel, eyes and tentacles with their horny hooks; all the specimens were discovered, and developed with unexampled skill, by William Buy, of Sutton, near Chippenham."*

Buy, as the Director was informed by Mr. William Cunnington, was a carpenter and joiner at Sutton Benger. "When the Great Western Railway was cut through the district he was appointed as overlooker at the cuttings near Christian Malford. Here he was struck with the beauty and abundance of the splendid

* *Manual of the Mollusca*, 1851, p. 75.

Ammonites, etc. All were carefully dried, washed over with a solution to prevent their flaking off, and then cut accurately at the edges." The Director exhibited a specimen so shaped by Buy of *Ammonites Duncani* var. *spinusus*, also of the large *Belemnites Owenii*.

So arduously and so frequently did Buy labour among the clays of Christian Malford that when he had ceased his connection with the Great Western Railway, he continued to look upon the trenches as his own preserves. When, therefore, on one occasion he found a stranger digging at one of his favourite spots he at once ordered him off; but the stranger turned out to be Mr. Hugh Owen, chief cashier to the railway company!

Buy would never give an exact locality for his fossils, so many of them, whether from the Oxford Clay or Cornbrash, are labelled as from Chippenham, and that locality is therefore a noted one, as we may learn from the excellent Catalogue of British Fossils, by our old President, Prof. Morris.

II.—YATTON KEYNELL, CASTLE COMBE, AND MALMESBURY.

BY H. B. WOODWARD.

IN the afternoon of May 24th a number of the members started in a brake with four horses to Yatton Keynell. Here they alighted and were conducted by the Director to the picturesque old quarry described and figured by Prof. Hull in 1858.* The section showed the following strata:

			ft.	in.
	Forest Marble	5. Flaggy oolitic limestone		
	(Bradford Clay)	and clay	4	0
Great Oolite	Upper Division	4. Marly beds and shelly oolite . 6 ft. 0 in. to	7	0
	Lower Division	3. False-bedded oolite .	6	0
		2. Irregular rubbly and fer- ruginous bed with		
		Echini and Sponges .	1	6
		1. False-bedded oolite .	8	6

The beds had been examined in 1886 by the Rev. H. H. Winwood and the Director, and the latter had obtained a number of fossils, including *Terebratula coarctata*, although this species was not found *in situ*.†

Examples of this fossil were now discovered by Mr. Leighton and Mr. J. T. Day in bed No. 2, an horizon lower than that from which the fossil had been previously recorded, and with them were also found *Waldheimia cardium*. Mr. Wickes also identified the bed 2 as corresponding with the rich fossil-bed he has

* "Geol. parts of Wiltshire and Gloucestershire," *Mem. Geol. Survey*, 1858, p. 14.

† *Mem. Jurassic Rocks*, vol. iv. "Lower Oolitic Rocks of England," p. 268.

so successfully worked at Murhill and Ancliff.* A few Polyzoa were obtained, but the Coral-bed which elsewhere overlies the Polyzoa-bed was not detected.

Leaving the quarry the members walked down the pleasant combe to Long Dean, and then proceeded up the deep and charming valley leading to Castle Combe. Taking a peep at the comfortable-looking mansion long held by the Scrope family, and of special interest as the former home of G. Poulett Scrope, the eminent geologist, the members proceeded through the picturesque stone-built and stone-tiled village to the summit of the hill. Rejoining their conveyance they were driven by way of Grittleton and Hullavington to the King's Arms at Malmesbury. After paying a visit to the fine old Abbey the members took tea, and the Director distributed prints of a fossil obtained more than thirty years ago by Wm. Buy, from the Forest Marble of Malmesbury. This was the oldest known British Crab, *Palæinachus longipes*, described by Dr. Henry Woodward,† who had kindly sent the prints of the fossil.

The Crab was allied to the Spider Crabs (*Maia*), and to the Japanese Crab (*Inachus*), and Dr. Woodward had attributed the long duration of the form to its fecundity, for a modern female *Maia* would lay about 76,000 eggs.

III.—DERRY HILL, BOWOOD, AND CALNE.

BY H. B. WOODWARD.

ON Whit Monday the members started along Wood Lane and across the meadows to the Forest Brickyard by the Wilts and Berks Canal. On the way they ascended the slope which forms the escarpment of the Kellaways Beds, and the Director remarked that the Kellaways Rock had been found in the form of doggers in the Chippenham Cemetery. The view northwards from near the reservoir of the Chippenham water-works overlooked the dip-slope of the Forest Marble and its overlying Cornbrash, while southwards the Corallian escarpment of Derry Hill was a well-marked feature.

A richly fossiliferous bed of Kellaways Rock was exposed at the base of the brick-pit, and this was broken up with the help of Mr. Simeon Gregory, of Derry Hill, who, for a while acted as pioneer.

Only one Brachiopod was found in this pit (*Rhynchonella*), but in addition to most of the Mollusca found at Kellaways the following were also met with: *Actæon*, *Alaria trifida*, *Natica punctura*, *Turbo elaboratus*, *Arca*, *Astarte*, *Cardium cognatum*, *C. Crawfordi*, *Isocardia minima*, *I. tenera*, *Lucina despecta* (?), and *Nucula*.

* See "Report of Excursion to Bradford-on-Avon," etc., *Proc. Geol. Assoc.*, vol. xiii, p. 135.

† *Quart Journ. Geol. Soc.*, vol. xxii, p. 493.

After crossing the Canal at two points the members took the footpath to the foot of Derry Hill where, at Mr. Gregory's cottage, a number of fossils from the Lower Calcareous Grit were seen and transferred to the pockets and bags of the members. Among these were moulds of the middle part of a gigantic *Ammonites cordatus*, that presented a corkscrew-like aspect. Ascending Derry Hill, a locality mentioned by the Rev. Joseph Townsend as yielding good road-stone, the members inspected the quarry a little north of the high road on the way to Studley. Sands with hard bands of calcareous grit were here exposed, but the beds were singularly devoid of fossils. They represented the Lower Corallian or zone of *Ammonites perarmatus*.

Permission had been kindly granted by Mr. H. Herbert Smith, the agent to the Marquis of Lansdowne, for the party to pass through the park of Bowood by the Golden Gates. This, however, was not practicable, and the members entered by the humbler gateway near Christ Church.

After viewing the mansion the party proceeded by Buck Hill to the Black Dog siding, where the Rev. H. H. Winwood joined them. Thence crossing the River Marden and the Canal by New Mill, they ascended the hill by Conigre Farm to the quarries there opened in the Lower Calcareous Grit.

Here a fine example of *Ammonites perarmatus* at once attracted notice, and was secured for the Museum of Practical Geology. The Director said he had (perhaps injudiciously) remarked to the quarrymen that it was a very fine specimen, but so large that he could not run away with it. "We know'd that, sir," said one man, "or we should not have left it lying about." The fact is, fossils are a good deal sought after in the Calne district, and the quarrymen take good care of those they find. On the present occasion they produced from their shed a number of other specimens. Among these were the casts of *Am. perarmatus* to which the name of *A. catena* was originally given, because the internal casts of the chambers are often linked together like a chain; as well as several varieties of *Am. cordatus*, one an extremely inflated form, also *Belemnites abbreviatus*, *Natica*, *Gresslya peregrina*, *Gryphæa dilatata*, *Modiola*, *Ostrea flabelloides*, *O. gregaria*, and *Pecten vagans*.

Proceeding by Chilvester Hill and Curzon Street to the free-stone quarry east of the Workhouse at Calne, a fine section of white false-bedded oolite with marly partings was seen—the whole somewhat dazzling in the sunshine. These beds, as was pointed out by the Director, are known as the Coralline Oolite, and together with the Coral Rag which locally overlies it, they represent the Upper Corallian or zone of *Ammonites plicatilis*. The locality was a noted one for *Hemicidaris intermedia*, nests of which are from time to time found. Mr. John Rhodes, when collecting fossils for the Geological Survey, had seen the bed laid

bare in 1887, and obtained many specimens, while the Director who had been there before had not obtained one. Mr. Rhodes was then informed by the quarrymen that they had not found any of the fossils for seven years. The layer containing the *Hemicidaris* occurred, at that date, about 16 feet beneath the surface towards the western side of the quarry. On the present occasion traces of Echinoderm spines were found, but no specimen of *Hemicidaris* was obtained from the rock. One example was picked up by Mr. Herries, and *Echinobrissus scutatus* was also found. The fossil-bed was not favourably exposed, but representatives of the following fossils were obtained: *Cerithium*, *Chemnitzia*, *Littorina muricata*, *Nerinea*, *Pseudomelania* (?), *Gervillia acuta* (?), *Isocardia*, *Lima rigida* (?), *Modiola*, *Opis Phillipsi* (?), *Pecten fibrosus*, *Cidaris florigemma*, *Echinobrissus scutatus*, *Hemicidaris intermedia*, *Pygurus*, and *Serpula*.

After examining the dressed blocks of Calne freestone, which is locally employed for building-purposes, the members proceeded along the Strand of Calne to the Lansdowne Arms, where a short halt was made.

Leaving Calne and proceeding along the Marlborough Road towards Quemerford, a fine view was obtained near the cemetery of the Cherhill White Horse, which was cut in the Chalk escarpment about 200 years ago. After leaving Quemerford village the footpath was taken towards Blackland, across rich meadow-land with fine oaks and elms, situated on the "Oak Tree Clay" (Kimeridge Clay) of William Smith. In this pastoral region nothing was seen of that formation nor of the succeeding Lower Greensand and Gault, whose outcrops were crossed in the vale between Quemerford and Calstone Wellington. A deep road cutting near the Calstone School showed the pale-brown micaceous sandstones of the Upper Greensand. Here *Ammonites rostratus* and a form like *A. auritus*, as well as *Arca carinata* were found.

Mr. Jukes-Browne, who had kindly furnished the Director with some notes on the Cretaceous rocks, had observed that north of Devizes the Upper Greensand became thinner; it was reduced from 160 or 170 feet to about 60 feet in the area now visited. The upper green glauconitic sands were no longer to be found, and we had only the lower beds of malmstone and sandstone. Moreover, there was not so conspicuous an escarpment as near Devizes (see Fig.), and the beds of Upper Greensand in places form one continuous slope with the Chalk Marl.

The Members walked a short distance on to the outcrop of the lowest Chalk, and after taking a brief peep at the fine Chalk escarpment of the Marlborough Downs, they retraced their steps to Calne by way of Theobalds Green, and then took train to Chippenham.

An agreeable surprise awaited them after dinner. It appears

that Mr. J. T. Day, not feeling inclined for further walking, had remained in the Workhouse Quarry. He had interviewed an old quarryman, and with so much success that he had acquired about fifty examples of the *Hemicidaris*. These he generously presented to the Members, and considerable amusement was caused by the process of distributing them after drawing lots.

IV.—BOX AND CORSHAM.

BY THE REV. H. H. WINWOOD.

ON Tuesday, May 26th, the party travelled by train from Chippenham to Box, where they met Mr. Winwood, who acted as Director for the day, and were conducted by him to the "Clift," one of the entrances to the great underground quarries worked by the Bath Stone Firms, Limited. It is about a mile from Box Station, and on arrival, the party were received by Mr. George Hancock, the Managing Director of the Company. Pointing to a large-scale plan of the workings, he explained their extent. The following is the substance of his remarks:

The extreme points of the Bath freestone area now being quarried are—

- At Box and Corsham on the North,
- At Monks Park, Corsham, on the East,
- At Combe Down, Bath, on the West, and
- At Westwood, near Bradford-on-Avon, on the South.

Speaking generally, the dip of the workable strata is about 1 in 30, in a direction north-west to south-

east. Both gradient and direction are, however, subject to many local variations.

In most of the quarries the workable beds lie above the railway-levels. The quarries are connected with the railway by tramways, along the descending gradient of which the low stone-laden trolleys run by their own weight, the pace of each trolley being regulated by the brakesman who invariably rides upon it. Altogether there are between 30 and 40 miles of tram-line.

At a number of points the workable beds are reached by sinking inclined shafts from the surface, and the stone is drawn up the shafts by steam power. At other points, where the conformation of the surface admits of it, adits are driven into the workable beds from the sides of the hills.

The entrance to the Box Hill quarries, and through them one of the ways to the Corsham quarries, is through a doorway in the side of Box Hill. It is right in the workable beds of freestone, the quarry roof at that point being about 460 feet above Ordnance Datum.

The Box Ground beds are an earlier deposit than the Corsham beds ; but owing to the dip of the strata, and to the Box Ground lying east of the Corsham beds, the Box Ground beds lie at a higher actual level than the Corsham. There is no known area in which both series possess any commercial value. On the contrary there is, between the Box and Corsham district, a tract of ground some few hundred yards in width, in which both stones are found, the Corsham beds overlapping the Box Ground. But in this area each stone is found to be inferior in quality and texture, in soundness and thickness of bed, to the stone-beds of the same series in adjacent areas, and to be unfit for building-purposes, and therefore this "bastard" area is left unworked.

In the Box Ground district the aggregate thickness of the freestone which is being quarried varies from 10 to 22 feet. The depth of the working is entirely governed by the quality of the stone, those beds which are not of good quality being left unquarried, although they may be of the same character geologically as the best beds.

In the Corsham district the total thickness of the beds quarried varies from 6 feet to 24 feet. In the shallower workings the Corngrit and beds below are not quarried, while in most of the deeper workings the whole series is quarried ; that is, if each bed is of a good marketable quality.

Having entered the doorway in the side of the Box Hill and passed along a gallery about 8 feet high, the roof of which is mostly arched over, the ordinary roadways are soon reached. These are from 10 to 12 feet high, and 10 to 20 feet wide. The roof consists of the "rag" beds which overlie the freestone—coarse, shelly beds, which are of no value as building-materials. The floor is made up of the stone *débris* from the workings, a

tramway of 2 feet 6 inches gauge being laid along the centre. The sides are either the unquarried stone which is left as pillars, or walls or heaps of quarry *débris*.

Ventilation is secured by sinking shafts. If in any direction the air gets close and foul by reason of the workings being at a great distance from the main drift-ways, the matter is at once remedied by sinking an air-shaft from the surface. The stone is mostly from 60 to 120 feet below the surface, and the sinking of a shaft is not a very serious matter. Good air can always be depended upon, and there is plenty of headway and elbow-room.

Winter and summer the temperature is about the same, say, from 52 to 56 degrees.

Faults of any consequence are met with but seldom. In the Box and Corsham district only three deep faults, or "jumps," have had to be crossed. The practice is to cross these "jumps" at as few points as possible, and from each crossing to lay out the quarry workings right and left in lines parallel with the direction of the "jump." Roughly speaking, about three-fourths of the stone is quarried out, the remaining fourth part being left in as pillars to support the overhead strata.

Here and there the roof is propped with timber, whole larch being preferred for this purpose.

The ceiling bed in some parts of the Corsham district is so sound and strong that the galleries are excavated 40 feet or more in width.

Immense lengths of working-face are presented by the numerous galleries. From the western entrance to the Box Hill quarries to the eastern entrance to the Corsham quarries the distance is about two miles in a bee-line. Half a mile of this consists of a tunnel cut through the "bastard" stone for the purpose of connecting the Box Hill and Corsham quarry workings.

The party then followed Mr. Hancock into an underground gallery, and a neat little tin benzoline lamp, mounted on a wooden handle, was provided for each of the Members.

After traversing many complicated galleries and workings, the party arrived at a shaft which admitted daylight, and were informed that they were in the "Cathedral working." Mr. Hancock continued his explanation as follows :

A feature of interest in the Box Hill quarries is the "Cathedral" working. The name is not an inapt one, for the workings take somewhat the form of a lofty-arched nave and choir, transepts and chapels. Portions of the workings are lighted from two shafts, one of them of large dimensions, up which the stone was formerly drawn to the surface ; the other a smaller shaft, which afforded ingress and egress to the quarrymen. From the floor of the working a well is sunk down to the fuller's earth. Thus the entire section of the Oolite, from the surface of the ground to the

fuller's earth, is exposed at this one point. It is made up as under :

- (a) 38 feet in thickness of alluvial soil and thin shelly beds.
- (b) 24 feet of Box "Scallett" beds—a fine, close freestone. These beds were quarried over the whole area of the Cathedral working before it was found that it would not stand the weather, and then the
- (c) 10 feet of "rag" beds were sunk through to the
- (d) 17 feet of "Box Corngrit," which was also quarried over the whole area of the working, and until its non-weather properties were proved, when
- (e) 5 feet more of "rag" beds were sunk through, and immediately below these was found
- (f) 18 feet of the best Box Ground "weather-stone." Below the Box Ground stone is
- (g) 17 feet of "rag" beds, the lowest of which rests upon the fuller's earth, making a total depth of

129 feet.

It is in the (f) Box Ground stone-beds that all the Box Hill workings are carried on. Neither the Box Scallett nor the Box Corngrit is now quarried, both stones being inferior in quality, soundness and weather-properties to the Corsham stone.

The Corngrit which is known to architects and builders to-day is found in the Corsham series of beds, and is entirely different from the Box Corngrit. It makes its first appearance in the south-east part of the Corsham district, immediately below the Corsham beds. It is then from three to five feet thick. In some spots it is in one bed, but more often it "heaves" in two. As the workings proceed to the north and north-west, the Corngrit is found higher and higher up amongst the Corsham beds, until, at the northern limits of the workings, it is above them all, resting upon the topmost one. Where the Corsham beds are above the Corngrit, they are fairly level, subject only to the general dip. But where they lie underneath the Corngrit, they are subject to false-bedding, in most places very pronounced. The Corngrit differs from the Corsham stone chiefly by reason of possessing numerous small bodies of calcite, which take many forms. The quarrymen call these small bodies of calcite "oats," "reap-hooks," "pins," etc. The mass of the stone is generally firmer and closer in texture than the Corsham.

The bulk of the Bath stone which is sold during the winter has had a summer's seasoning in the open air, and the stone quarried in the winter is stacked away underground in the old workings until the spring. To this rule there is, however, one notable exception, and only one, viz., the Box Ground stone. This stone, owing to its exceptional weather-resisting qualities, is

sent to buildings in a perfectly green state throughout the winter season. One day it is a part of the bed-rock of the hill, the next day it is hewn out in blocks, and, with all its quarry sap in it, is brought out from the mine into the hardest frosts without injury.

METHOD OF QUARRYING.

The quarrymen work in gangs of from four to a dozen or so, each gang having allotted to it a width of about 80 ft. of rock. Nearly up to the face of the rock and about halfway across the width a tramway is laid, and at the end of the tramway a ten-ton crane is erected, the upper part of the crane pillar being fixed in the quarry roof, and the lower part in a large block of stone in the floor. In the way which will presently be described, a heading about 20 feet wide (called the "straight") is driven forward in about the centre of the 80 feet, and "side holes" are driven right and left to the limits of the 80 feet strip. Between the side-holes sufficient rock is left unquarried to serve as pillars to support the roof.

The initial operation consists in picking out, by means of a double-headed pick, a narrow horizontal gap in the freestone close up to the ceiling. This gap, which is called a "jad," is carried back into the rock at least 5 feet from the face. The pick-heads are fixed slightly obliquely on the handle, so that one point is at an acute and the other at an obtuse angle to the handle. By means of the obtuse angle point the picker can reach the far corners of the "jad," and make a clean, squared recess to receive the saws. The picking is done in the freestone rather than in the "rag," because it is much softer. A graduated series of picks are used, the "jad" being commenced with a heavy pick ($7\frac{1}{2}$ lbs. weight), and finished at the far end with a light one, about $4\frac{1}{2}$ lbs. weight, fixed on a 6 feet handle.

When the "jad" is finished, the next operation is to insert, about midway across the "jad," a one-handled saw into the space, and to cut down at right angles to the face about 3 feet 6 inches to 4 feet 6 inches, according to the thickness of the bed or beds, the aim being not to cut deeper than to give sufficient space for a man to enter when the beds are removed. A second saw-cut is next made some 3 or 4 feet to right or left, and at a slight angle to the first cut, so that the piece of stone which lies between the two cuts is narrower at the back-end than at the front, to facilitate its being drawn out of its position in the rock. This piece of stone is now joined to the rock at the back-end only. Wedges are then driven under the front of the piece until it is forced up from its bed and broken off at the back. This stone is called the "wrist" stone (? wrest). It is drawn forward with bars or chain, and its removal leaves a chamber five feet long, and between three and four feet wide, and four feet or so in height. Into this chamber the

quarryman gets, passing a long one-handed saw (6 or 7 feet long) over the top of the rock, and, sitting on a low stool at the far end of the chamber, proceeds to make a saw-cut along the back of the "jad," parallel to the face, and down to the floor of the small chamber. Having done this on one side, he turns himself round, and, facing sideways in the opposite direction, he repeats the operation on that side also. Other saw-cuts are made from front to back, and in this way the beds of rock are broken into and cut up into blocks of such sizes as it will yield. Water is conveyed into the saw-cuts from vessels placed on the rock, by which means the stone-dust becomes soft slush, and is drawn out from the cut as the saw is drawn backwards. When the blocks are cut off from the rock they are attached to the crane by a chain, and drawn from their position on to level ground, where they are carefully examined as to their soundness, and are trimmed and shaped fit for sale. This is done with axes (double-headed hatchets, about 14 lbs. each), and the operation is called scapling (? scalping, taking off the skin). When made ready for sale, the blocks are lifted with the crane and placed on low trolleys, which are conveyed to the railway loading-wharf or to the stacking ground, as the case may be. The beds below the picking standing are readily sawn up into blocks, and treated in the same way.

Blocks that are less than nine inches in thickness are too thin to be of value. One hundred cubic feet (more than six tons) is the limit of single blocks unless required for special purposes, when blocks up to nine or ten tons can readily be obtained.

Mr. Winwood observed that the word "Scallett" was of very doubtful origin: might it be connected in any way with the word "scalings"—those beds which were scaled off the top, and of less value? The "weather stone" spoke for itself as being that which, when exposed, stood the action of the weather better than any of the other beds. Mr. Hancock pointed out on the faces of the "ground stone" the marks (called "jaddings") of the picks by which the stone was originally worked, and the triangular impressions of the wedges used for detaching the blocks. The lofty pillars of "Freestone," left to support the floors and the cross workings, gave the not inappropriate name of Cathedral to this old working.

Previously to this, Mr. Hancock turned off the main road to the end of one of the sidings, where a gang of men were at work, and gave a most interesting and minute account of the way in which the large blocks of Freestone were sawn out. The whole process of picking, sawing, and wedging was gone through, and the members saw the crane detach a large block of more than five tons, torn from its base and dragged up the slope of *débris*.

Resuming the traverse to the Corsham end, the faults—one a throw of some 10 ft.—were pointed out, and attention was drawn

to the way in which the roof was supported by larch poles, periodically examined by competent men from time to time to secure the safety of the workmen. Numerous cracks and fissures overhead were sufficient evidence of the care required in this respect. A long flight of stone steps lead to the bright sunlight, somewhat trying to the eyes of those who had been two hours and a-half in the darkness underground.

Before mounting the conveyances the President, Mr. Newton, cordially thanked Mr. Hancock, in the name of the Association, for the treat he had given the members, and the kind and able way in which he had answered all their troublesome questions.

Mr. Hancock, in reply, said it had been a pleasure to him to conduct the party through a small portion of the workings in the Bath mines. He only regretted that there was not time to inspect many more of the workings. The district had been by no means exhausted, and he would be happy at any time to receive a visit from any member of the party or their friends, and to take them through the same, or any other portion, of the district, doing his best to make their visit both useful and interesting.

A short drive through Corsham Side and Worm Wood was then taken to Mr. Shepherd's quarry on the left of the Devizes road, about one mile from Atworth. After a few preliminary remarks from the Director, who stated that they were now on the roof, as it were, of the "cathedral," and were then looking at the beds which succeeded those they had seen at the mouth of the old shaft, the white oolitic beds at the base of the section representing probably the last bed of the great oolite, and the fissile beds above, without any intervening "Bradford Clay," representing the commencement of the Forest Marble series, hammers were busily plied, and many characteristic fossils obtained, of which the following were afterwards identified: *Saurian* teeth, *Hybodus grossiconus*, *Strophodus tenuis*, *Lepidotus*, *Mesodon*, *Cerithium muricatum*, var. *Astarte unguolata* (?), *Gervillia crassicosta*, *G. ovata*, *Lima cardiiformis*, *Lima* sp., *Modiola*, *Ostrea gregaria*, *O. subrugulosa*, *Pecten vagans*, *Plicatula fistulosa*, *Rhynchonella*, *Polyzoon*, Echinoderm plate and spine, Crinoid ossicle. Some fine ripple-marked slabs of Forest Marble were noticed. The thinner beds of this formation are still (as of old) shaped into stone tiles for roofing purposes.

Two other sections were then examined; one on the right exposed a thick bed of blue clay, streaked with yellow veins, and laminæ of fissile limestone resting on thicker beds of the series; that on the left, Mr. York's quarry, exhibiting the same series of the lower beds of the Forest Marble as the first. The quarrymen here seemed quite indifferent as to the existence or otherwise of fossils, stating that it spoiled good stone to knock them out, and, moreover, that it was not worth their while to preserve them; notwithstanding this discouraging statement, several members were

successful in finding both Saurian and Fish teeth. Remounting the brakes, and returning to Corsham, a meat tea at the "Methuen Arms" was partaken of, in time for the 5.3 p.m. train for London.

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