thickness of the basalt at only 3000 feet, the pressure on each square yard of underlying chalk would be about 2000 tons.¹

The analysis, which is extremely similar to one by Mr. Wonfor, of the Chalk of Cushendall, Co. Antrim,² shows that it is a limestone of very great purity, the per-centage of siliceous matter being so small as to be quite insignificant. It should therefore be of the highest value in many chemical manufactures, especially that of bleaching powder. But it is remarkable that although in the North of Ireland an immense quantity of this material is used up, it is not made there, but is mostly imported from Glasgow and Lancashire. So far as I know, there is not a single Chloride of Lime Works in Ulster.³

III.—A BRIEF MEMOIR OF THE GEOLOGY OF DORSET.

By J. C. MANSEL-PLEYDELL, F.G.S.

Part II.

(Continued from page 412.)

AS the sands and clays of the Hastings series lie conformably on the Purbeck Beds, it is probable that the same area which formed the embouchure of the Purbeck river performed still the same office during the Hastings Sand age; but the entirely different character of the deposit shows at least that the soil of the country drained by the latter was different from that which supplied the former; and it is evident also that, in the district under consideration, the motion of the water of the Hastings river was much more rapid, from the abundance of sand, coarse quartz, and gravel with pebbles.

This lower member of the Wealden consists of sand, sandstone, calcareous grit, and shale. At Swanage and Worbarrow the calcareous grit alternates with red and green sandy clay; it contains bones of the *Iguanodon* and portions of silicified coniferous trees, the stone into which they are converted being dark-brown in colour, and receiving a fine polish. It does not effervesce with acid. The Hastings Beds form the north side of Swanage and Worbarrow Valley, and pass through Godlingston, Corfe, Church Knoll, Steeple, and Tyneham; a small patch appears at Mewps Bay, Lulworth, and Man of War Cove. Their junction with the Purbeck Beds is favourably exposed at Worbarrow. In the little cove between the Tout and Gad Cliff, about fifty feet of clay alternates with beds of contorted limestone; at Swanage it is invisible, being masked by a fault. The only other appearance of this bed occurs between Chaldon and Holworth, flanked by the Greensand on the south, and the Ridgeway fault on its northern side. It is evident from our review of the Wealden and Upper Oolite Beds, as represented in this neighbourhood, that they are quite unconformable to the Cretaceous system, which not only overlaps them gradually, but covers them occa-

¹ The Chalk of Tyrone is in fact curiously shattered and split up into small irregular parallelopipeds, which appears to be due to more than ordinary jointing. The great pressure may have had something to do with it.

² Journ. Royal Dub. Soc., July, 1860.

³ A quantity of the Antrim Chalk is, however, exported to England for manufacture there.

sionally. At Osmington Mills, within less than a square mile, the Upper Greensand is in contact successively with the Hastings Sands, the Purbeck Beds, and the Kimmeridge Clay. Here the alternation of fine clays and sands peculiar to the Swanage Beds with the coarse drift of Worbarrow plainly reveals the swelling and subsiding of the ancient river which covered them eastward. From the presence of iron the Rev. O. Fisher considers the deposit to have been furnished from the New Red Sandstones of Devonshire.

Of the gigantic reptiles of the Wealden age the Dorsetshire beds produce two, *Iguanodon Mantelli* and *Megalosaurus Bucklandi*. Mr. S. H. Beckles, F.R.S., describes in the Geological Journal, vol. xviii. p. 446, casts of footprints in Swanage Bay occurring in two bands of sand-rock of the usual tripodal shape, about fifteen inches long, which may be the footprints of a Wealden Dinosaur, or perhaps of a Batrachian.

The Flora of the Wealden contains *Coniferae*, *Cycadeae*, and Ferns. In 1855 the *Gyrogonites* (so named by Parkinson in 1822), spore-vessels of the *Chara*, were found in the Hastings Beds of the Isle of Wight, a genus common in the Tertiary strata, but not found before this in the Secondary rocks.

The variegated Wealden Clays and Sands are about 1800 feet thick at Swanage, 725 at Worbarrow Bay, 660 at Mewps Bay, 462 on the east side of Lulworth Cove, and 172 at Man of War Cove, showing in a very remarkable manner the attenuation of the beds which takes place westward; this peculiarity is not restricted to the Wealden, but extends to the Lower Chalk as well.

The Purbeck Beds have been examined and mapped in great detail by Mr. Bristow, and published in the works of the Geological Survey of Great Britain. In Sheet 22 of the Vertical Sections every bed is shown on a scale of 10 feet to one inch, with full lithological and palæontological descriptions.

LOWER CRETACEOUS OR NEOCOMIAN.—Punfield beds.—A remarkable bed, partly marine and partly of estuarine origin, lies at the top of the Wealden Beds at Punfield, Worbarrow, and Mewps Bay. It has long been known to geologists as differing from the freshwater Wealden in mineral character, and in its animal remains, clearly indicating the gradual return of marine conditions which continued throughout the Cretaceous period.

A marine band, 21 inches thick, rests on the variegated beds of the Wealden, dipping due north at an angle of 65°; Mr. Judd, who has recently separated these beds from the Wealden Series, to which they were before attributed, divides this marine bed into three parts, the lower being a shelly Limestone, containing concretions of argillaceous Limestone, yielding Ammonites, *Vicarya*, and other marine shells; the middle portion is almost entirely made up of Oyster-shells with a few dwarfed specimens of *Corbula* and *Cardium*; the upper portion contains but few shells, and, like the middle, is mixed with much carbonaceous matter. The narrow band is succeeded (upwards) by a series of ferruginous sands, about 153 feet thick; its middle portion is composed of ferrugineo-calcareous rock, with Oysters and

other marine shells. The uppermost band, which is a dark-blue, finely-laminated shale, in part Cypridiferous, with thin bands of Limestone, made up of *Cyrena*, *Ostræa*, etc., is at present covered over by the *débris* from the beds above.

At Worbarrow the formation is about 68 feet thick, comprising a thin well-marked band of ironstone containing vegetable markings and casts of marine shells, with beds of grey and whitish laminated clay and bands of nodular ironstone. These ironstones contain casts of marine shells; also beds of light-coloured, sometimes pinkish, sand, with much carbonaceous matter.

The Punfield formation is exhibited at Brixton Bay, a little to the west of Atherfield Point, at Compton Bay, and Sandown Bay in the Isle of Wight.

GAULT, CHALK MARL, AND LOWER CHALK.—It is difficult distinctly to recognize the sub-division of the lowest beds of this series; only on the eastern side of the county is it of any importance; it accompanies the Chalk in its varied sinuations from Abbotsbury to Corscombe, and occupies the summits of the insulated hills above Lyme Regis, Lewesdon, and Pillesdon; it reposes successively on the Lias at Lyme, on the Inferior Oolite at Golden Cap and Shipton Gorge, on the Forest Marble at the Knoll of Puncknoll, on the Oxford Clay south of Abbotsbury, on the Kimmeridge Clay west of Osmington, and on the Purbeck Beds east of Abbotsbury. Its valleys of denudation are seen at Askerswell, Compton Valence, and Winterborne Steepleton. The Gault and Chloritic series has its greatest superficial development in the vicinity of Shaftesbury, and produces strata of chert, beneath which lies a band of sandstone, of great economic value, on account of its power to resist the decomposing action of the atmosphere; it is extensively used for building, the angles of the worked blocks retaining their original sharpness for centuries,—the marks of the chisel are as fresh now as when first cut. A narrow zone flanks the base of the Chalk range from Ballard Down to Worbarrow, a fault brings it to the surface at Mewps Bay, it forms the base of the eastern side of Lulworth Cove, and dips beneath the sea at Durdle Door. At Batts Corner it re-appears and forms the coast-line to Ringstead Bay, where a fault throws it northward above Holworth, and it follows the Kimmeridge Clay to Osmington, whence it turns eastward to Chaldon, skirting the north side of the Ridgeway fault from Poxwell to Bincombe. It occupies the heights above the village of Abbotsbury, and, after passing Gorwell and Little Bredy, it forms the base of the escarpment of the eastern side of the vale of Bredy.

It is not difficult to conjecture that these Lower Cretaceous Beds were continuous and extended over a large area westward, previous to the denudation which has so seriously affected this district. In the neighbourhood of Longbredy they are much disturbed: after encountering several lateral and vertical faults, it forms the base of Eggardon Hill; from Chilcombe it continues in a southerly direction through West Compton and Wynford Eagle. It fringes the base of two Chalk outliers, the major axis of the larger one taking a north-

asterly' direction from Frome Vauchurch through Toller to Chedington, that of the lesser from Wraxall to Melbury. The outliers Pillesdon, Lambert Castle, Stonebarrow Hill, Golden Cap, and type Down, form the most western representatives of the series. The great Oolitic vale of Blackmore from Melbury to Shaftesbury with only one interruption at Buckland Newton. At Wyke's Gate a spur of the series takes a southerly direction, and occupies a narrow valley to Cerne Abbas; small outliers occur at Blandford, Holcombe, and Hilton.

The Chloritic Marls at the base of the Chalk-range which bounds the southern and eastern sides of the Vale of Blackmore and the Dorset valley are very fossiliferous; the uppermost bed, consisting of an argillaceous limestone, is characterized by the *Cephalopoda* *aphites æqualis*; its principal development is at Chard, Monckton, Wimborne, and Chaldon, where it does not exceed eighteen inches thickness.

In the palæontological collection of the British Museum is the stem of a tree-fern, *Caulopteris punctatus*, from the neighbourhood of Shaftesbury; it is a cast in sandstone, and exhibits indications of alternation of climate, or seasonal interruptions to its growth.¹

UPPER WHITE CHALK WITH FLINTS.—A marine formation of great thickness, consisting of nearly pure carbonate of lime precipitated and deposited at the bottom of the sea, and in some cases consisting from ninety to ninety-five per cent. of Foraminifera. The difference between the Upper and Lower Chalk is the absence of flints in the latter; there are fossils special to each division, most of which indicate deep-sea conditions.

Denudation has been actively carried on wherever the Chalk formation exists in Dorsetshire, but owing to the absence of definite marks indicating any particular horizon, it is difficult to determine its relative position. The beds of flints which cover extensive tracts of the Chalk containing undisturbed layers of flint, afford evidence not only of the immense thickness of the original mass, but also of the enormous amount of material which has been removed. The whole group may be viewed as one continuous series, with a Fauna which varies no more than might be expected from the varied circumstances attending its deposition through a lapse of ages. The beds rise at Chilcombe with a bold escarpment characteristic of the formation; from Chilcombe Hill east of Bridport to Lulworth, whence it is contracted to a narrow elevated isthmus, to Ballard Down, which divides Swanage and Studland Bays. The most southern extension is on the west side of the county south of the village of Abbotsbury, its northern boundary flanks the vale of Melbury, and with various undulations towers over the Vale of Blackmore from Minterne to Shaftesbury, and continues conterminous with Wiltshire, from thence to Boveridge, where it takes a southerly direction to Wimborne, and westerly to Bere Regis, the Woolwich and Reading Beds reposing on it. From Corscombe to Shaftesbury it rests exclusively on the

¹ See paper by Mr. W. Carruthers in *GEOL. MAG.*, 1865, Vol. II. p. 484, Pl. XIII. g. A.

Upper Greensand, but here and there it is concealed by newer deposits; it has a dip varying from 10° to 90° . At Ballard Down the Chalk is vertical, the horizontal strata being suddenly turned upwards into a curve, which is easily traced by the layers of flints with which it is interspersed; this arises from a fault the evidence of which is seen in its greatest intensity and force at Cocknowle and again east of Corfe Castle. The Upper Chalk (whose characteristic fossils are *Rhynchonella octoplicata*, Sow., *Lima spinosa*, Sow., and *Marsupites Milleri*, Mant.) prevails on the northern side of the range meeting the Tertiaries at a very low angle, dipping gently to the north-east beneath overlying sands and clays. The Lower Chalk is well exposed at Houghton and Hilton, where the beds are much disturbed; they contain several species of *Inoceramus* and the Brachiopod *Rhynchonella Cuvieri*.

TERTIARY SERIES.—Lower Eocene.—The lowest of this series, the Thanet Sands, are absent in Dorsetshire, and they do not appear far to the west of London. The Woolwich and Reading Beds, the next in succession (with the exception of two isolated spots in the neighbourhood of Blackdown and Bincombe), do not appear west of Knighton. They are composed of sands, pebble-beds, and clays, accompanied in some places at the base with green-coated flints, which may be favourably seen at Studland Bay and in a pit near Pamphill, Wimborne; a small section of light-red mottled clays and pebble-beds over the Chalk occurs at Lulworth Park. At Crendle Common near Cranborne is a red-mottled plastic clay, extensively used for pottery of a coarse character. At Chalbury Hill near Horton are pale-grey mottled clays, with an overlying bed of flint pebbles; at East Bloxworth this series is represented by a pale-grey sandy pipe-clay, containing leaves of plants. From the neighbourhood of Cranborne to Wimborne and Bere Regis it overlies the Chalk with a discontinuous broken margin; at Tincleton a narrow isthmus of Chalk intervenes, and the Poole Tertiary basin is its utmost western boundary at Yellowham. The alluvial valley of the Frome divides it at Lewell, and, after making a curve through West Knighton, where the mottled clays almost disappear and are replaced by coarse sands, irregular pebble-beds, and whitish clays, it reaches the southern margin of the Poole basin near Broadmayne, and at Littlemayne the Chalk is overlaid by sands which in one place are concreted into large blocks of sandstone, the ordinary Druid Stone; it flanks the south side of the Poole basin from Warmwell, Winfrith, and Wool, where it takes a southerly direction to Lulworth, and joins the Purbeck range at Whiteway, which commences about a mile north of Durdle Door, extending to Studland; it follows without interruption the northern base of the Chalk range at West Lulworth; there are small outliers also at Milborne St. Andrew, Came, Bincombe, Bradford Peverell, and the lofty Blackdown. The Woolwich and Reading Beds form a salient feature in the landscape, owing to the prevalence of oak, which grows freer and better upon them than on the strata above or below; their line of demarcation may be at once recognized by this peculiarity.

The blocks of Grey Wethers, Sarsen Stones, or Druid Stones, which are scattered over the surface of the Chalk and older formations, such as the saccharoid sandstone of Portisham and Bridehead valleys, or the red sandstones at Winterborne Whitechurch, Milborne St. Andrew, etc., are thought by Mr. Prestwich to belong to the Woolwich and Reading Beds. Near the village of Broadmayne on the Wareham road are several blocks of indurated masses of sandstone (Druid Stones) *in situ*, left denuded by the force which scooped out the valley. The Portisham and Bredy breccias differ, inasmuch as they are conglomerates of flint, and transported from their original position by torrential action into these deep valleys.

LONDON CLAY.—Immediately resting on the Woolwich and Reading Beds is the basement-bed, as termed by Mr. Prestwich; it is usually composed of ferruginous brown clayey sands. At East Bloxworth it contains nodular concretions of clay-ironstone, peroxide of iron, and rounded flint-pebbles: it is a constant attendant of the Woolwich Series in the county from Chalbury to Knighton, but is absent on Piddletown Heath and the outliers westward to Blackdown.

MIDDLE EOCENE.—Lower Bagshot.—These beds consist of a thick deposit of sand and clays; they are extensively developed on the eastern side of the county, forming the main portion of the clay and heath district included within the Poole basin. They are remarkable in Dorsetshire for their important strata of pipe-clay, which is worked at Creech Grange, Nordon, and Rempstone. The export of this clay in 1870 from Poole was 60,210 tons. Mr. Prestwich considers the Lower Bagshot series, both in Hampshire and Dorsetshire, to be derived from the wear and denudation of land consisting of the older and crystalline rocks; the condition of the material being similar to rocks such as now form the strata of Cornwall and Brittany. Mr. Maw, however, thinks that these beds have been derived from the denudation of a Chalk-tract. The grains are larger and coarser at Poole and Studland than in the Isle of Wight, where they pass into grits. An old land seems to have existed, of which Cornwall and Brittany remain, the intermediate portion having been submerged and destroyed; the fossil remains point to the same conclusion, for the plants they contain are more numerous and better preserved as we proceed from east to west, and become more plentiful at Bournemouth, Studland, and Poole than at Alum Bay. In the compact clays of these localities there are not only Dicotyledonous leaves but numerous fronds of ferns allied to *Gleichenia*, which are well preserved, with their fruit, a genus which existed in the Cretaceous and Oolitic periods and now inhabits the Cape of Good Hope and New Holland. In the midst of these leaf-beds, in Studland Bay, freshwater shells of the genus *Unio* attest the freshwater origin of the white clay.¹ The fruit of a member of the *Arelia* family, now confined to North America, New Zealand, Japan, and the East, has been found at Bournemouth by Mr. Mitchell. Fine specimens of the leaves of a Palm (of the genus *Sabal*) have been found at Studland and Corfe. The river of that period may have

¹ Lyell, *Student's Elements of Geology*, 1871, p. 238.

passed through a district of granitic and syenitic rocks which brought down these pure kaolin clays. The coarser materials and quartzose grits were probably drifted from their original position either by periodical or intermittent floods.

The occurrence of isolated Tertiary patches resting here and there on the Chalk, of which the one at Tollard Royal is furthest from the central mass, leads to the supposition that denudation has removed the large masses which intervened, and, as has been already hinted, probably extended far over the Chalk below.

The heaths of Bere Regis, Affpuddle, and Piddletown, are here and there pitted with circular conical hollows, resembling the upper portion of an hour-glass; they vary from 60 to 80 yards in circumference; the largest is 280 yards round. They are supposed to be swallow-holes, the result of the dissolution of Chalk by means of the carbonic acid contained in the rain-water, and the subsidence of the superjacent sands into the resulting hollow causing a depression of the surface like that which takes place in the sands of an hour-glass soon after it has begun to run. The Rev. O. Fisher considers that the formation of these pits was subsequent to the outspread of the superficial gravel.

SUPERFICIAL GRAVELS, etc.—Gravels and Brick-earths cover the surface of the heath-lands, as well as large portions of the Chalk and the Oolites, on the border-lines of the Vale of Blackmore.

The High-level Gravels are all rounded by water-action, and originate from beds of which we have fragmentary traces in several parts of the county, but which do not now exist nearer than Cornwall, porphyry, granite, and quartz being their constituent parts; they cover the table-land between Bournemouth and Poole, which forms the eastern extremity of the extensive tract of land of which Picket Plain and Ochnell form the northern boundary, and were probably spread out previous to the wearing away of the surface of the present existing valleys. The lower gravel-beds are represented largely throughout the county, not only covering the deep combs which intersect the coast-line, but lie at the base and sides of many of the inland valleys. Those of the Stour and Piddle have yielded remains of *Elephas primigenius* and *Rhinoceros tichorhinus*; at Gains Cross near Durweston tusks of the former and teeth of the latter were met with in the railway-cutting in a bed of flint-gravel 60 feet above the river. Mr. Shipp (of Blandford) has a good collection of the remains of these pachyderms, from a pit in the nursery-gardens between the town of Blandford and the turnpike-gate on the Dorchester road; molar teeth of *Elephas primigenius* were found some years ago at Dewlish, in a tributary of the river Piddle. The Avon too has yielded 'elephants' teeth in gravels 40 feet above the river. Elephant, Bison, and Deer remains were exhumed from a bed of gravel at acombe at Encombe, the seat of the Earl of Eldon.

There are evidences of man's occupation in the cliffs near Bournemouth in the occurrence of flint implements among the gravels 120 feet above the sea-level. Owing to the absence of organic remains, it is impossible to decide as to the origin of these gravels, whether

they result from fluvial or marine agency. Mr. Codrington considers the gravels covering the table-lands at the highest levels are of far greater antiquity than the valley-gravels of the rivers, which were probably formed previous to the disruption of the Isle of Wight from the mainland; also that the rivers reaching the sea by Poole Harbour, Christchurch, and Southampton, were affluents to an estuary opening into the sea in the direction of Spithead.

The last movement appears to have been one of subsidence, and the occurrence of several submerged forests around our coasts gives good reason to lead to this supposition. Those of Bournemouth and on the north side of Poole Harbour, Sir Charles Lyell makes an exception to, and attributes their submergence in modern times to the washing out of the subjacent sandy strata on which they rested, and not to a general subsidence or change of level. In several parts of the county, especially on the chalk-uplands, drift-beds occur of local origin varying from flint-rubble and brick-earths to sandy clays. Sponges, Echinoderms, and Brachiopods (the usual Chalk fossils) are plentiful in these deposits, which represent the redistribution of the older gravels during the Pleistocene age.

SUB-AERIAL DEPOSITS.—Chesil Bank.¹—This remarkable beach runs from Portland to Burton Bradstock, a distance of 18 miles. Messrs. Bristow and Whitaker consider it to have been an ordinary beach subsequently separated from the mainland by denudation. It is connected with the mainland from Burton to Abbotsbury, where a narrow channel, the Fleet, which extends to Wyke Ferry, separates it. At Abbotsbury its base is about 170 yards in width, and its crest 22 feet above the level of the sea. At Portland its base is 200 yards wide, and its crest 42 feet in height. The separation of the land from the beach is, doubtless, owing to the configuration of the coast-line, which is without any high land or cliff from Burton to Abbotsbury; and the several streamlets which, through the imperviousness of the subsoil, and eastward trend of the coast, are diverted from their seaward course, succeed each other, and rill after rill by their united power attain sufficient force to excavate a channel, while the influx and reflux of the tide have contributed towards the formation of the Fleet, on whose bosom nearly 1000 swans roam,—the unique and enviable possession of the Earl of Ilchester. The Isle of Portland has acted as a base or breakwater in the formation of the Chesil Bank. Between Studland and South Haven there is a large accumulation of shingle, derived from the submerged beds as well as from the re-formation of older gravels.

The raised beach at Portland Bill consists of pebbles cemented together with comminuted shells; it is 30 or 40 feet above the sea-level, and about three feet thick. A projection southward shows another conglomerate with shells, chiefly *Littorina littorea*, *Littorina littoralis*, and *Patella vulgata*. This ancient beach terminates after a course of 250 yards. A bed of shingle caps the cliff at the Bill, and

¹ See a paper "On the Formation of the Chesil Bank," by H. W. Bristow, and W. Whitaker, *Geol. Mag.* Vol. VI. p. 433 (1869). Also J. Coode in *Proc. Inst. Civ. Eng.* vol. xii. p. 520 (1853).

extends some way inland.¹ Traces of an upheaval are absent on the mainland owing to the destructible character of the coast-line. There are some other instances of sub-aërial deposits in the county; the most remarkable of these is at Blashenwell, between Corfe Castle and Kingston, where a tufaceous deposit about 10 feet thick, containing land, fresh-water and marine shells, bones of animals, and wood, is spread over the clays of the Hastings Sands at their junction with the Purbeck Beds; it appears to have been the site of a small lake which became silted up by the deposition of lime held in solution in the water which passed through it. The source which supplied the water of the lake still exists, and flows into the Corfe river by the channel it has cut for itself through the tufa. The presence of marine shells may be accounted for by the agency of man, during the establishment of an ancient settlement on the banks of the lake; this supposition is strengthened by similar evidences in the neighbourhood, two of which are close at hand on the Kimmeridge Cliffs, showing a lengthened occupation by man, and where the remains of sea molluscs, bones of animals, and the accumulated fragments or refuse of human food, are present. It seems scarcely possible that any depression of the Corfe Valley on the north or south of the Chalk-range could have been the means of introducing marine organisms even with the aid of a tidal river.

Until recently the Coal-measures were supposed to offer the only proofs of an ancient Flora, but the presence of plants at every geological period is now incontestably established.² The Devonian epoch presents *Coniferae*, *Sigillariae*, *Calamites*, and Ferns, as well as fruits, such as *Cardiocarpon* and *Trigonocarpum*, which are also Carboniferous. The earliest known Insects are in the Devonian strata of St. John's, New Brunswick. The Permian Flora have a resemblance to that of the Coal-period; the Trias plants are chiefly analogous to those of the Secondary rocks. During the Oolitic period the abundance of the *Cycadeæ* compared with the diminishing ratio of *Equisetaceæ* and Ferns points to the existence of a clearer atmosphere and lower temperature, although a higher one than that which now prevails in Europe. Among the vegetable remains of the Lias, several species of *Zamia* have been found at Lyme Regis. At the base of the Upper and Lower Lias, respectively, Insect-beds occur; containing, besides Insects, small Fish and Crustacea, marine shells, as well as Ferns, Cycads, and leaves of Monocotyledonous plants, and apparently brackish and fresh-water shells. The Insects include wood-eating and herb-devouring beetles, and some grasshoppers. There are evidences of a terrestrial and marine vegetation from the lowest to the uppermost beds of the Oolites, and, though the sequence of the genera has not as yet been traced through each successive stage, they re-appear between intervals of several

¹ When visiting the Isle of Portland in August last in company with Mr. Prestwich, that gentleman pointed out to me undoubted proofs of Glacial action which had hitherto escaped notice.—J. C. M.-P.

² See paper by H. Woodward on the Carboniferous and other Old Land Surfaces, *Geol. Mag.*, 1871, Vol. VIII., p. 492.

periods. The Flora of the Wealden is characterized by a great abundance of *Coniferae*, *Cycadeæ*, and Ferns, and by the absence of leaves and fruits of Dicotyledonous Angiosperms. *Gyrogonites*, or spore-vessels of *Chara*, so plentiful in the Tertiary strata, were found in 1855 in the Hastings Beds of the Isle of Wight. The Miocene Beds of Europe, which have probably their only English equivalents at Bovey Tracey in Devonshire, present a vegetation differing little from that of the present day. The plants of the submerged forests of our coasts at Cromer, Torquay, and elsewhere, contain identical species with those now growing in England.

From what has been already brought before our notice it is clear that Araucarias, Pines, Cycads, Zamias, and other exogenous plants now growing, have their generic representatives as early as the Secondary epoch. The persistence of a species through more than one geological period can seldom be traced; gaps intervene, and it is only indirectly that the changes which have taken place on the earth's surface can be determined, the evidences being too frequently rendered obscure by the superincumbent beds, or placed altogether beyond our reach in the depths of the sea. The fact that the Cretaceous beds of Dorsetshire rest unconformably on the beds below shows that a great interval of time elapsed between the deposition of the two series, and accounts for the dissimilarity of their Faunas. There are instances, however, where the chain of life is unbroken, and uninterruptedly carried on, although accompanied by the continual appearance of new forms.

NOTE.—The Geology of the County of Dorset is illustrated by the following works published by the Geological Survey of England. Maps on a scale of one inch to a mile, Sheets, 15, 16, 17, 18, 21, 22. Horizontal Sections, Sheets 19, 20, 21, 22, and 56. Vertical Sections, Sheet 22.

ERRATUM.—In the first part of this paper, which appeared in our September Number, at p. 409.

Eleven lines from top of page, *for*, "are in the *British Museum*," *read*, "are in the *ELY Museum*."—EDIT. GEOL. MAG.

IV.—THE PALÆONTOLOGY OF THE POST-GLACIAL DRIFTS OF IRELAND.

By ALFRED BELL.

I HAD hoped that ere this some one better acquainted than myself with Irish post-Tertiary Geology would have collected into one memoir the details scattered throughout the various scientific journals, thus enabling English geologists to compare the later deposits of Britain with those of the sister-kingdom. Since no one has done so, I venture to put some notes of my own upon the subject before the readers of the GEOLOGICAL MAGAZINE, especially as, in some recent discussions upon the Irish drift, "Palæontological succession" has not received the consideration it may fairly claim.

Formations in different localities, producing groups of fossils which, if not exactly the same, taken species by species are so in their general aspect, may reasonably be considered to be of the same age, since it is rarely if ever the case that the same biological conditions return at different periods. It may also be assumed that where formations in two localities contain faunas widely divergent